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Dr. Nils Berkemeyer & Hanna Järvinen
Institute for Research on School Development, TU Dortmund

Knowledge Conversion in School Networks

Summary:

The paper refers to the framework model of Berkemeyer et al. (2008a) which was developed to explain and analyze functions of innovative networking processes. The present study deals with learning processes in school-to school networks. These processes were reconstructed by analyzing interview data in the project "Schulen im Team" on the basis of Nonakas spiral of knowledge creation using the method of content analysis. The study takes up the deficiency in examination of networks from a learning theory perspective and makes a contribution to a better understanding of innovation networks in an academic context. The findings indicate a spiral development of knowledge. At the same time they show different dynamics in the analyzed networks.

1. Introduction

Since the early 90s networks have become one of the central topics in the social scientific research. The network literature is growing radically in recent years (Bogatti & Foster, 2003; Bommes & Tacke 2006): For instance, important work has been published on governance and policy networks (e.g. Benz et al., 2007; Altrichter et al., 2007; Marin & Mayntz, 1991; Henning & Wald, 2000), regional networks (Tippelt et al., 2006; Schubert et al. 2001) on social network analysis (Burt 1992; Granovetter, 1973) as well as on management of networks between organizations (Sydow, 2006, Howaldt, 2002). Also in the discussion and

theory construction of educational sciences the subject is getting more and more attention (see overview Berkemeyer et al., forthcoming), even though the development is still way behind the current interdisciplinary discourse.

Besides the attention of the scientific community, the network phenomenon is also gaining importance in practice, e.g. in terms of intentional inter-organizational cooperation and co-ordination. The establishment of networks between organizations is oftentimes based on the presumption that collaborative structures promote learning and innovative knowledge creation processes across institutional boundaries. Hence, networks have become a significant platform for professional learning and organizational and systemic change in various fields (Kubiak, 2009; Howald, 2002). It almost seems to be considered as a factum that learning processes and innovation are triggered by networking (Berkemeyer et al. 2008b, Straßheim & Oppen 2006). In this respect it is not a big surprise that school-to-school networks are getting increasingly common as a school improvement and reform strategy as well.

Thus, with only little adequate empirical evidence school-to-school networks are regarded as support systems and as an appropriate framework for a sustainable development of school systems. The expected positive effects of the collaboration are essentially based on the efficient combination of existing potentials (Aderhold, 2004). Network-based projects and co-operations in the educational system are prevalently connected with aspects like teacher professionalization (Hargreaves & Goodson, 2006; Giles & Hargreaves, 2006), enhanced classroom instruction and school quality (e.g. Fußangel et al., 2008), and with reinforcement of school improvement processes (Dedering, 2007; Rolff, 2005).

Although there is a series of findings both on conditions of success and failure and on effects of networking between schools (e.g. Earl et al., 2006; Adler et al., 2005; Sammons et al., 2007), the basic domain of educational sciences - the actual learning and knowledge generation process - in networks has remained to a large extend unstudied. We assume that this desideratum is partly due to the still deficient theoretical and empirical foundation of network research in general (cf. Salancik, 1995) – particularly in educational sciences (Berkemeyer et al., 2008a). This is the impetus for this paper.

The paper refers to the *Framework Model for Analyzing Innovation Networks* (Berkemeyer et al., 2008a), which was developed to explain and analyze functions of innovative networking processes. The paper aims in particular, to answer the question, if learning processes in networks can be described on the basis of Nonakas (1994) theoretical concept of *Knowledge Conversion*, which is a fundamental part of the theoretical frame.

Starting by outlining the *Framework Model for Analyzing Innovation Networks* (Berkemeyer et al., 2008) and the operational model of *Knowledge Conversion* integrated in Nonakas *Dynamic Theory of Knowledge Organizational Creation* (Nonaka, 1994), we lay the theoretical foundations for the following empirical examination of teacher learning processes in school- to- school networks. These processes were reconstructed by analyzing longitudinal interview data with network coordinators (teachers) in the school improvement project "Schulen im Team" using the method of content analysis. Subsequently, first empirical results are summarized and discussed.

2. Theoretical Framing

2.1 Framework Model for Analyzing Innovation Networks

The Framework Model for Analyzing Innovation Networks with reference to various theories used in network analysis[1] should be deemed merely as a first attempt in educational sciences to conceptualize an operational model to describe the origin and development of innovations in networks between schools (see fig. 1). Innovation is here defined as processes, techniques or simply as forms of problem solving, which are unknown or unavailable for a particular school or a specific group of teachers (see Behrens, 2001).

The concept of *Knowledge Conversion* (outlined in chapter 2.2.) is a central element of the model. Our supposition is that by using the concept learning processes in networks can be divided into different phases that state the level of the knowledge generation process on the one hand and provide us information about the depth of the knowledge generated in the other hand.

[1] The model integrates numerous theoretical elements relevant to network analysis such as social exchange power and trust as well as components like coordination and cooperation. Due to space restrictions we forego the detailed description of these approaches, for further information see Berkemeyer et al. 2008a.

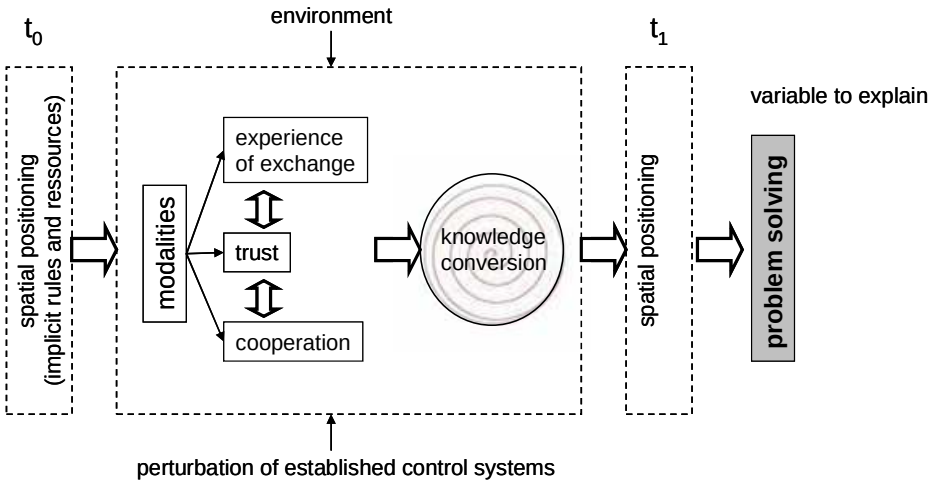

Figure 1: Framework Model for Analyzing Innovation Networks (Berkemeyer et al. 2008a).

The variable to explain in the *Framework Model for Analyzing Innovation Networks* consists of concrete solutions to a specific problem as well as knowledge about processes of problem solving constructed by professionals. These aspects are determined by the processes of knowledge conversion. They, in turn, are affected by three crucial factors: the network protagonists´ trust in each other, the experienced exchange and the forms and degree of cooperation that take place in the network. The network protagonists evaluate these categories with the *modalities of structuration*, which Anthony Giddens presented in his *Theory of Structuration* (1979, 1984). In this interpretative act individuals connect structural dimensions like interpretative schemes, norm and facilities to complementary dimensions of situated interaction. More specifically, social actors produce and reproduce structures that are decisively influenced by their spatial positioning (t_0). However, the networking processes irritate the spatial positioning t_0 and form a new spatial structure (t_1) that again can have different impacts on the former spatial positioning.

Finally, the framework takes network-specific environments into account, which can be experienced whether as a support or as a source of interference.

Because of the specific focus of the paper on learning processes in networks the following remarks concentrate on the model of *Knowledge Conversion* as a single aspect of the theoretical frame. Other elements of the framework remain at this point matter of further research.

2.2 Learning through Knowledge Conversion

In his article *Dynamic Theory of Organizational Knowledge Creation* (1994) Nonaka presented a learning model based on social interaction that emphasizes dynamic processes for

transforming prevailing knowledge and practices. Beyond characterizing learning as knowledge acquisition and as participation in a social community Nonaka perceives learning as a co-constructive process of innovative knowledge creation (ibid.; see also Paavola et al., 2004).

At the heart of his work is the premise that there are two types of knowledge: tacit and explicit (see Polanyi, 1985). Tacit knowledge is subjective and experience based knowledge that can not be expressed in words, sentences, numbers or formulas, often because it is context specific (ibid., Nonaka, 1994). This also includes cognitive skills such as beliefs, images, intuition and mental models as well as technical skills such as craft and knowhow. Explicit knowledge is objective and rational knowledge that can be expressed in words, sentences, numbers or formulas (context free) (Nonaka 1994, Nonaka & Takeuchi 1995). It includes theoretical approaches, problem solving, manuals and databases.

The knowledge creation process is a cyclic conversion of tacit knowledge and explicit knowledge. This spiral, highly dynamic and complex process is modeled in the figure below. It consists of four modes: socialization, externalization, combination, and internalization. These modes occur when tacit and explicit knowledge interacts with each other. In the following four sections, we examine each of these modes.

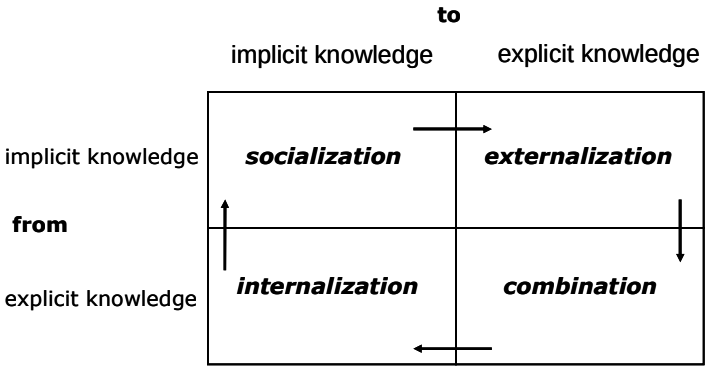

Figure 2: The Spiral of Knowledge Conversion (Nonaka, 1994)

Socialization is the first mode in the learning process and the primary source of learning that enables us to convert tacit knowledge through interaction between individuals (Nonaka, 1994). In this mode, learning occurs implicitly, within a social context through observation, imitation, participation, interaction and practice, rather than through written or verbal communication (e.g. on the job training). The process of acquiring taci5t knowledge can be supported by joint activities, personal connections and social networking.

Through *externalization,* tacit knowledge is made explicit, i.e., expressed in language or symbols, in a form which can be accessed, understood, shared, adapted, and reused. The

conversion of tacit into explicit knowledge involves techniques that help to express one's ideas or images as words, concepts, figurative language (such as metaphors, analogies or narratives) and visuals (Nonaka, 1994; Nonaka & Konno, 1998). Externalization is a complex process of "constructive collaboration" (Nonaka 1994, p. 24), which involves repeated "rounds of meaningful dialogue"(Nonaka, 1994, p. 20).

Combination as the third mode of *Knowledge Conversion* is according to Nonaka the social process of reconfiguring existing explicit knowledge "through sorting, adding, recategorizing, and recontextualizing" (Nonaka & Takeuchi, 1995, p. 67).

Internalization is the process of understanding and absorbing explicit knowledge in to tacit knowledge held by the individual. Knowledge in the tacit form is actionable by the owner. Internalization is largely experiential, in order to actualize concepts and methods, either through the actual doing or through simulations. The internalization process transfers organization and group explicit knowledge to the individual.

The four modes of knowledge conversion represent distinct levels of a learning process (cf. Nonaka, 1994). The process of socialization forms the basis for cooperation, mutual understanding and trust (Nonaka, 1994; Nonaka & Takeuchi, 1995). The subsequent phase of externalization initiates reflective processes that can lead to a sustainable change of attitudes and routines as well as to an adjusted repertoire of acting (cf. Argyris & Schön, 1978) in the following processes of combination and internalization.

As to organizational learning processes networks play a special role. In network-specific conversion cycles combined organizational knowledge assets can be processed. The "co-evolution" (see Nishiguchi, 2001) between networks and its member organizations is ensured by the coupling of the inter-organizational to the organizational processes of knowledge creation. These potentials of organizational opening are also used in the project design "Schulen in Team" presented in the next chapter.

3. Examining Knowledge Conversion in Networks using the Example "Schulen im Team"

3.1. The project "Schulen im Team"

The school improvement project "Schulen im Team" (see Berkemeyer et al., 2008b), launched in February 2007, is a cooperation project of the Mercator Foundation and Institute for Research on School Development at the TU Dortmund, Germany. Additional support is

provided by the Ministry of School and Further Education of the State of North Rhine-Westphalia and the local authorities of the municipalities Essen and Duisburg.

The main goal of the project is to test local school-to-school networks as a support system to enhance subject-related classroom instruction and curriculum development. In particular, the project places emphasis on the cooperative development of shared goals, intervention strategies and transfer concepts.

The 40 participating schools (38 secondary and 2 primary schools) in Essen and Duisburg are organized in 10 networks a´ 3-5 schools. Every school has two selected network coordinators, who are responsible for the actual networking processes.

The networks are conceptualized as platforms for learning, in which interactive knowledge creation processes are triggered. We suggest that new knowledge will emerge in a co-construction of professionals as it has been characterized in theoretical models like Nonakas or in concepts of "community of practice" (Wenger 1998) or "network based learning community" (Jackson, 2006; Chapman, 2003) as well.

The whole project research design draws upon *The Framework Model for Analyzing Innovation Networks.* The focus of this sub-study, on the one hand, is to explore, if the model of *Knowledge Conversion* can be applied to learning processes in school-to-school networks. A further central research question is, if the model helps to detect and describe divergent dynamics and developments in the networks examined.

3.2 Methodological Approach

The empirical study presented is based on a qualitative design and is inspired by both the theory of Nonaka (1994) and the reported experiences of teachers, who work in networks. The approach uses the theoretical framing as an orientation to capture learning processes in networks without restricting the object of the research too much in advance.

The analyzed material is in all 116 semi-structured interviews with the network coordinators from all 10 networks in the project "Schulen im Team"concerning aspects of networking such as cooperation, benefits and transfer (see interview guide Berkemeyer et al. 2008c). Due to the longitudinal design of the project research the interview material origins from three different waves of data collection (September 2007, February 2008, June/ July 2008). This makes it possible to describe dynamics and development over time.

To analyze the data we used the method of content analysis (Bos & Tarnai 1989, Mayring, 2000). Its major benefit comes from the fact that it is a systematic, replicable technique for

compressing many words of text into fewer content categories based on explicit rules of coding. Furthermore, the pace structure of Nonakas learning model suggests the selection of a method that bases upon classification in different categories.

We designed a set of coding categories, which connects the theory with the data in a reasonable way. First, deductive main categories were formulated with respect to Nonakas modes of knowledge conversion: *socialization, externalization, combination and internalization.* Subsequently, in dependence on both the material and the theory additional deductive and inductive sub-categories were phrased (see Bos & Tarnai, 1989).

The objectivity of the classification system was achieved by having defined and documented the categories of analysis precisely in a manual so that different persons can apply them to the same content and get the same results. Due to space restrictions, only the main categories are described in the following section.

The category *Socialization* was conducted with reference to the definitions inferred from Nonakas theory. The category covers statements, in which the network coordinators describe "the process of sharing experiences and thereby creating tacit knowledge such as shared mental models and technical skills" (Nonaka & Takeuchi, 1995, 63-64). "Physical, face-to-face experiences are the key to conversion and transfer of tacit knowledge" (Nonaka & Konno, 1998, 46).

The category *Externalization* aims to capture narrations about "a process of articulating tacit knowledge into explicit concepts. It is a quintessential knowledge-creation process in that tacit knowledge becomes explicit" (Nonaka & Takeuchi, 1995, p. 64). Dialogue, in which individuals articulate their own perspectives and experiences is the key for such conversions (Nonaka, 1994; Nonaka & Konno, 1998).

Statements about processes of "systemizing concepts into a knowledge system" (Nonaka & Takeuchi, 1995, p. 67) are covered by the category *Combination*. This deductive category involves combining different bodies of explicit knowledge […] through sorting, adding, combining, and categorizing of explicit knowledge" (ibid.).

The coding category *Internalization* is targeted on passages in the text, in which the network coordinators describe "a process of embodying explicit knowledge into tacit knowledge. This process is closely related to processes of learning by doing" (Nonaka & Takeuchi, 1995, p. 69).

The inter-coder reliability was tested by two independent coders with a sample of 20 interviews. The calculated coefficient developed by Holsti (1969; see also Merten, 1983) was 0.76, which is considered to be a satisfying reliability score ((Bos & Tarnai, 1989).

The classification system was discussed and designed within the research team to ensure its validity. Further validity measurements could not be taken.

3.3 Findings

As described above, 116 interviews with the network coordinators in the project "Schulen im Team" were analyzed pertaining to the different phases of knowledge conversion (socialization, externalization, combination, internalization) in order to reconstruct learning processes in networks of schools. The study involved a total of 1,595 coding decisions. The calculated mean for each interview is 13.8.

On the basis of the results a positive development of knowledge creation can be drawn over time. Particularly, according to the increase of coding decisions the processes of combination and internalization gain considerably in importance. The figure below shows in percent the distribution of the coding decisions in all three waves of data collection.

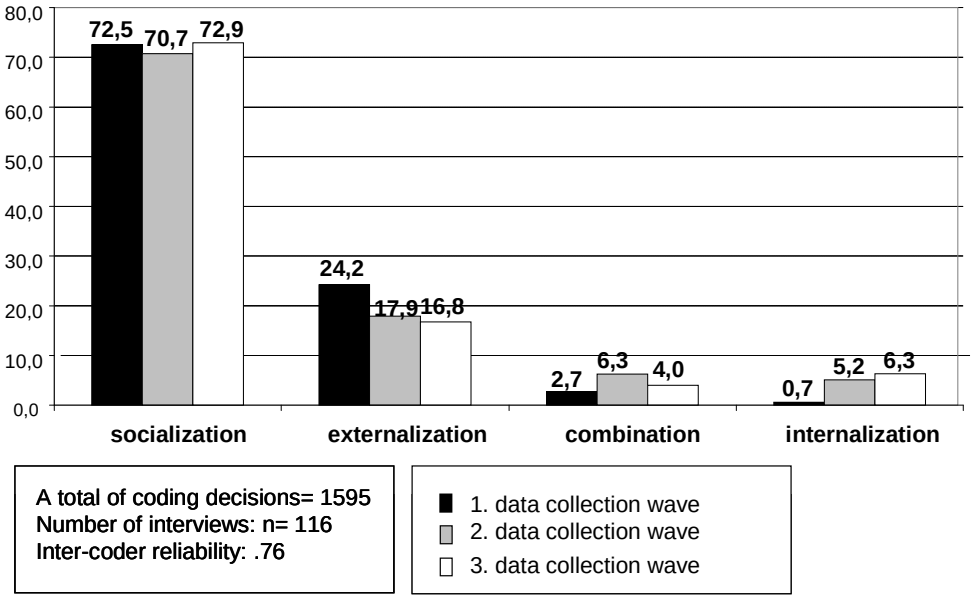

Figure 3: Coding decisions in the Main Categories (in %)

The frequencies of the incidents coded indicate a central importance of the processes of socialization at this early stage of networking (see fig. 3). Therefore, the results are in accord with Nonakas theory that suggests the learning process starts with getting to know each other and forming a team in the mode of socialization (cf. Nonaka, 1994). Shared norms, values and

face-to-face experiences support this conversion mode. The following statement of a network coordinator underlines this development:

"Mathematik und Sprache, da sind die Fortbildungen gelaufen, was natürlich die Interaktion sehr gefördert hat […] man hat sich einfach sehr viel gesehen. Dadurch war natürlich die Zusammenarbeit und, dass man sich auch kennenlernt sehr gut gegeben."

The coding judgements referring to *externalization* denote an existing conversion process from tacit to explicit knowledge in the examined networks. The stated processes of reflection focussed on the definition of problems, future visions and strategies of problem solving. The network coordinators also articulate practical experiences, collectively reflect these and form concrete concepts in the network interactions. A network coordinator reports on this process:

"[Wir haben uns ja wirklich mehrmals getroffen], haben angefangen mit unseren Erwartungen, Wünschen und den genauen Zielen und haben ziemlich viel diskutiert halt wie der Jetzt-Zustand ist. Auch viel haben wir uns über unseren Unterricht ausgetauscht."

The coded references to the categories *combination* and *internalization* attest a further development in the spiral of knowledge creation. The network coordinators describe, for instance, collecting and combining tuition material and constructing lecture series. The following phase of experimentation in practice marks the beginning of the *internalization* process.

All in all, the findings indicate a spiral development of knowledge creation, even though the different modes of knowledge conversion are partly in parallel in progress. There are tendencies that suggest that only the existence of the prior modes of knowledge conversion allow the evolvement of the following. Socialization as a network´s internal exchange and foundation of the collaboration keeps it central relevance over time in all networks.

Moreover, the analysis reveals different dynamics or rather learning rates in the examined networks. In figure 4 the processes are exemplified by comparing two networks in detail. To make the distinction particularly notable, the results are presented without the coding decisions according to *socialization*. Whereas the development of network A (n=13) is rather slow and show only few aspects of combining and internalizing concepts developed in the network, the findings from network B (n=12) describe a fast spiral dynamic of knowledge creation. Already in the early stage of networking experiences and contents of different practices are reflected and combined with each other. Beyond this, the findings show a clear trend to internalization in the interviews of second and third data collection phase.

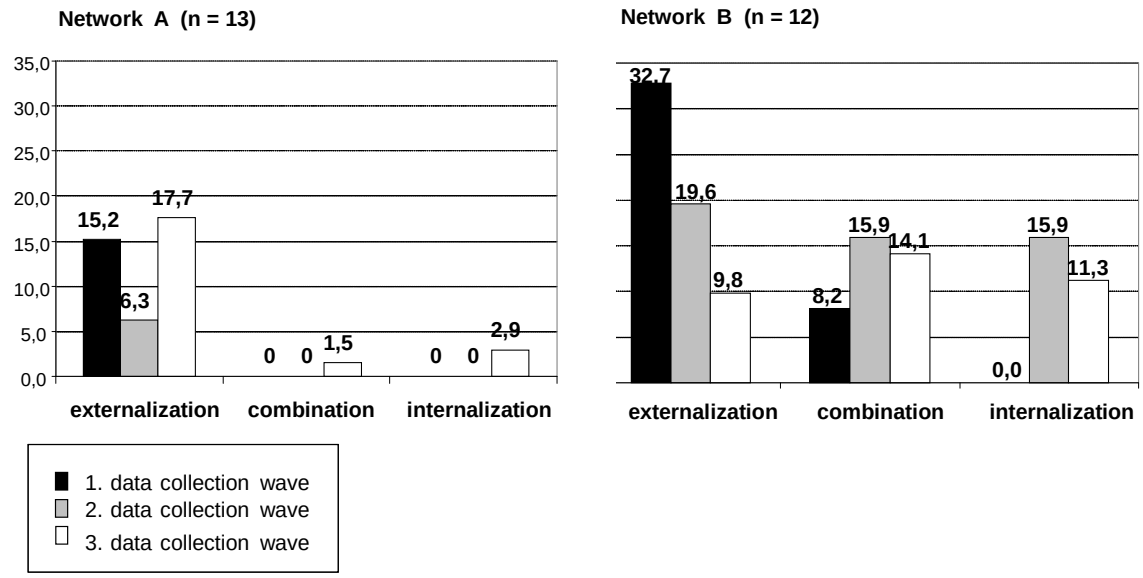

Figure 4: Dynamics in network A and B concerning Knowledge Conversion: Coding decisions in the Main Categories without Socialization (in %)

Although the findings provide information about the learning rate in the different networks, they do not allow satisfying disclosure of the quality and depth of the knowledge generated. At this point of research, it remains vague, if fast development in the spiral of knowledge is at all an indicator for an intensive learning process.

4. Conclusion

Given that network-based forms of cooperation predicated on the aspiration for organizational and systemic change in the educational system resulting from professional learning of teachers are becoming increasingly prevalent, the paper takes up the deficiency in examination of (school-to school) networks from a learning theory perspective, and makes a contribution to a better understanding of innovative networking processes. The most interesting outcomes of the analysis are summarized below.

Firstly, the study within the project “Schulen im Team” suggests that Nonakas (1994) model of *Knowledge Conversion* which also is a fundamental element in the *the Framework Model for Analyzing Innovation Networks (Berkemeyer et al. 2008a)* provides at least one possible theoretical orientation for empirical research on learning processes in (school) networks. The findings of the content analysis point out all the central learning categories conceptualized in Nonakas theory, and indicate a spiral development of knowledge. Furthermore, the study uncovers divergent dynamics in the analyzed networks which primarily state the varying learning rates. However, to define the depth of knowledge generated further research is

required by means of an adjusted and specified model integrating an element to determine qualitative differences. This element is also to be amended to the *Framework Model for Analyzing Innovation Networks*. To examine and specify other elements of the framework remains a matter of further research.

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