

Non-hierarchical Regional Networks - Theories, Models, Methods and Instruments – a Research Agenda

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1 The Collaborative Research centre “Non-hierarchical Regional Production Networks“

1.1 Introduction to collaborative research centre

In January 2000 the Deutsche Forschungsgemeinschaft (DFG), the central public funding organisation for academic research in Germany, established the collaborative research centre (Sonderforschungsbereich) “Non-hierarchical Regional Production Networks“ at the Chemnitz University of Technology. Collaborative research centres are programmes of long-term co-operative research in universities and neighbouring academic research institutions.

1.2 Practical field of research

The empirical field of the collaborative research centre, “Non-hierarchical Regional Production Networks“ is in south-west Saxony, a region formerly part of the German Democratic Republic, where since reunification only a small number of large scale enterprises exists and most enterprises are SMEs and micro-enterprises .

A significant number of them co-operate in regional networks. Many of these SMEs have highly specialised competencies. Due to their limited resources they are only able to realise partial sequences of complete process chains. Therefore co-operating in networks is a strategic option for these companies.

Many of the current networks in south-west Saxony are strategic networks, based on hierarchical structures which are dominated by a hub-firm, usually a powerful large-scale enterprise. Examples are, for instance, the networks of the automobile manufacturing industry. The hub firms, in Saxony for instance Volkswagen, are the centre of such networks and dominate the economical, organisational and technological structures of the network and hence the structures of the SMEs.

On the other side, SMEs are attempting to develop poly-centric networks to bundle their competencies and compensate disadvantages of size mostly with the target of independence of large scale enterprises.

1.3 Concept of the collaborative research centre

A lot of research work has been done on the co-operation of companies in such networks. But studies have shown that on one side hierarchical structures of centrally dominated networks are a restraint on SME's development. On the other side internal

hierarchical structures inside the companies in both kinds of networks have to be considered an obstacle for the development of the inter-organisational structures in the network.

This drives us to think about options of non-hierarchical networks. In opposition to traditional network research which concentrates on the networking of companies, the approach of this project is process-oriented, where only those elementary productive units which are necessary for the process are directly networked together.

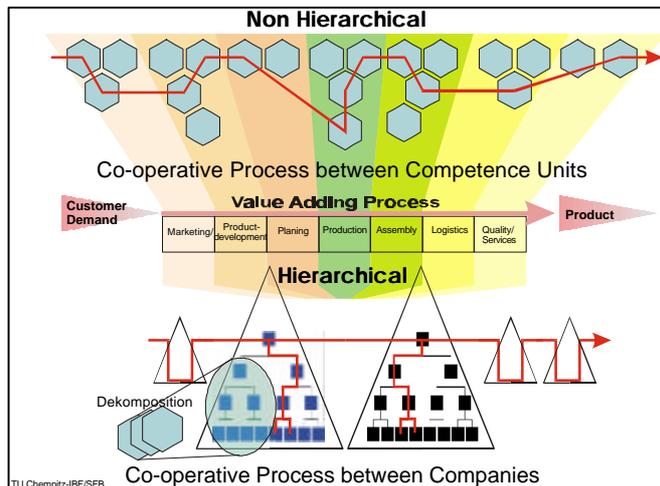


Figure 1
Hierarchical vs. non-hierarchical networks
/Baum, Dammann & Enderlein 2000/

1.4 The Competence Cell

Therefore the model of the competence cell has been developed. The competence cell is a model used to describe the elementary productive units which can cooperate in a non-hierarchical production network. It is the smallest, non-divisible production unit, consisting of the personnel (one worker or a small group) with its individual competencies and its resources (e.g. technological equipment). The competence cells are autonomous in their decisions, adaptive and able to cooperate in networks.

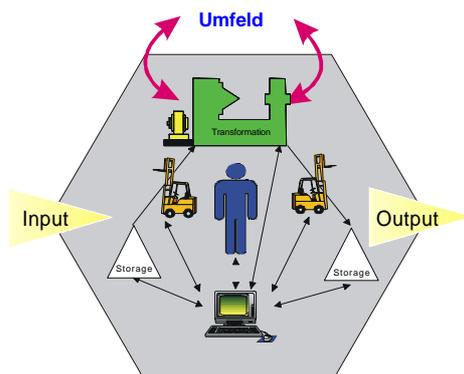


Figure 2
Non-hierarchical Network of Competence cells
/Wirth 1999/

The model of a non-hierarchical production network supposes that in a given region a vast number of different as well as similar competence cells exists and are competing to participate in a production process.

Non-hierarchical networks mean direct co-operation of competence cells with equal rights in self-organisational developed networks for the customer-oriented fabrication of products.

Constantly changing customer demands and products leads towards temporary dynamic networks with alterably production processes structures.

The competence cells participating in such networks, develop their specific competencies. On the other hand they gain experience in the co-operative processes and develop their ability to co-operate e.g. by developing trust with their partners. Their improved competencies are used in forthcoming projects.

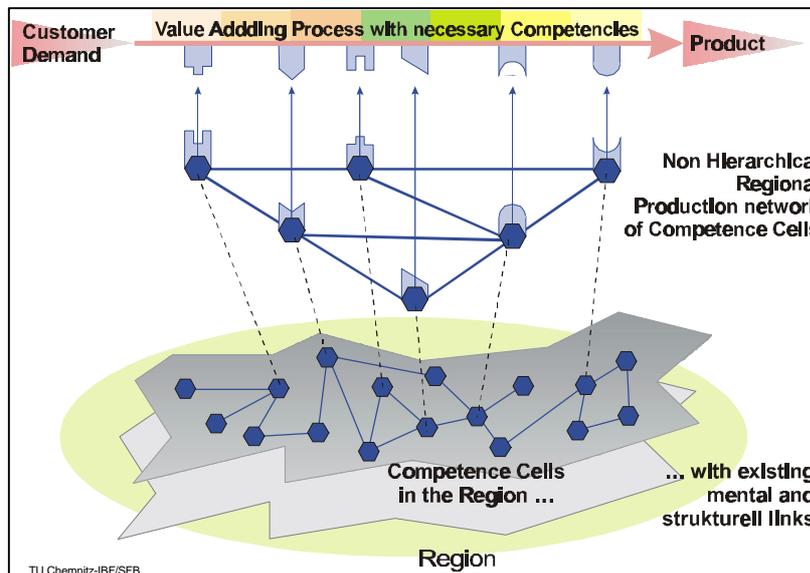


Figure 3
Network of competence cells
/Wirth 1999/

1.5 Objectives of the collaborative research centre

The main objective of the collaborative research centre is to develop the model of competence cells and mechanisms of their networking by:

1. Developing the competence cell model in respect to its structure, size, interfaces, etc. and describing prototypical competence cells for certain elements of the value adding process such as marketing, product development, production planning, production, assembly, quality assurance, distribution, services.
2. Researching mechanisms of network development consisting of competence cells
3. Researching the learning processes and development of the competence cells as a feedback of the networking process
4. Developing methods and instruments to support the development (e.g. multi-agent system to support the decomposition of the process-chain and suggestions for the composition of the network) and the operation (e.g. controlling of the network operations) of the competence cell networks.

1.6 Participants in the collaborative research centre

The collaborative research centre “Non-hierarchical Regional Production Networks“ in Chemnitz is an inter-disciplinary institution with participation of 13 departments of the Chemnitz University of Technology, e.g. mechanical engineering, computer science, business administration, social sciences and additional partners from the industry.

2 "Work-structures and Personnel Development" in the Collaborative research centre

In the following I would like to discuss the basic idea of the collaborative research centre, the idea of non-hierarchical networks, from an human engineer's point of view

which considers the structures of networks as inter-organisational socio-technical systems.

The co-operative realisation of processes requires the design of efficient inter-organisational structures.

In addition to economical and legal matters (for instance financial, logistical or contractual conditions), the network structures are also based on socio-technical relationships which are much less in the focus of network research. The elements of the socio-technical system of networks are:

- personnel and social conditions and relationships (such as ability to co-operate and communicate, qualifications, trust, power);
- technical and technological conditions (marked by the requirements of the process chains to be realised and by the technical equipment which supports the process realisation; and
- and thirdly, organisational relationships which describe the procedure and the structures of the process realisation.

These characteristics, interacting in the socio-technical system, decisively influence the performance of co-operative structures.

Knowledge of the socio-technical system of co-operative work is essential for the design of the structures of the network. Furthermore, it is necessary to understand the development process of network structures by means of self-organisational forces. These forces arise with the use of the structures by the protagonists.

2.1 Levels of the analysis, evaluation and design of inter-organisational work structures

With the co-operative realisation of process chains and the following development of network structures, changes are emerging in inter-organisational and inter-personnel relationships.

For the evaluation of such changes, the following organisational levels are to be considered in the analysis.

1. the assignments and structures of the organisation or relevant organisational units
2. the tasks of the teams, their consistency, and their co-operation
3. the tasks and the organisational working conditions of the individuals

The higher levels contain the subordinate ones and influence them. The subordinate react to these influences, stand in interaction with each other, but can also show relatively independent features.

Out of each of these three levels, specific knowledge and evaluations can be gained about the status of the development of the network.

2.1.1 Changes of structures on the organisational level

The realisation of co-operative tasks requires an intense, close co-operation from all partners. This co-operation causes the development of inter-organisational structures which can be developed in various ways.

This ranges from relatively loosely tied connections, which could be characterised as inter-organisational interfaces, to relatively close relationships, where the inter-organisational interconnections can predominate the internal bindings. In extreme

cases it is imaginable that this can lead to the development of inter-organisational groups or networks of individuals which only maintain quasi-external relations to their original organisations.

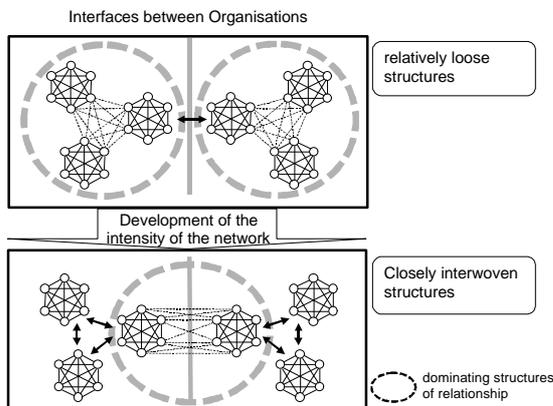


Figure 4:
Changes of structures on organisational levels

2.1.2 Structures of co-operation on group level

The co-operation between groups can be handled by communication on different hierarchical levels.

The question is which of the following hierarchical levels realises the inter-organisational processes

- top management
- middle management (e.g. foremen)
- operative level

The intensity and effectiveness of the co-operation and the closeness to the process are decisively influenced by the communicating persons.

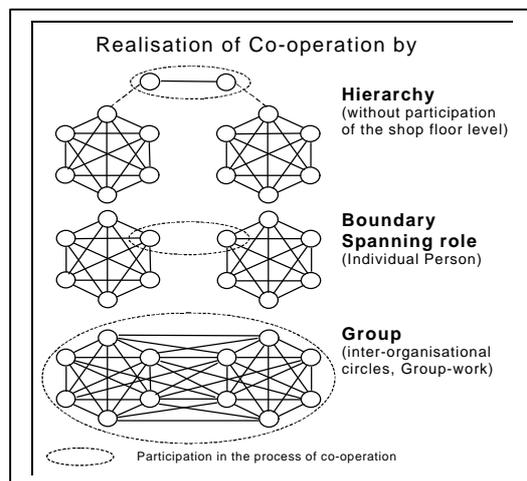


Figure 5:
Structures of co-operation on group level

2.1.3 Structures of the co-operation on an individual level

Different co-operative tasks require various closely interwoven co-actions of the co-operating persons and thus a various close interconnection of operations and communication.

Different co-operative processes demand various interconnections between operations and communication. This could lead to:

- relatively independent realisation (e.g., collective use of resources);

- sequential realisation (e.g. communication about timing and causal or functional sequences);
- reciprocal realisation (exchange of information is necessary for the realisation of the individual operations); and
- joint realisation (communication is an integral element of the jointly executed operation) /Sandholzer, 1990/

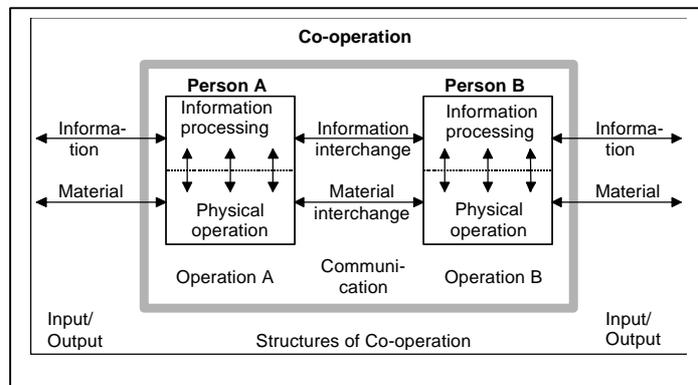


Figure 4:
Structures of interpersonal co-operation

2.2 Non-hierarchical networking

The current mode of co-operation is mostly hierarchical. In most cases, the two components of co-operation, operation and communication, are delegated to different hierarchical levels: operation to the shop floor level and the inter-organisational communication to the management level. The "redirection" of communication regarding the co-operative production process, produces process losses and prevents direct feedback from shop floor to shop floor.

However the design of inter-organisational structures depends on the proportion of communication that is needed to fulfil the operation. Certain processes of co-operation may demand very close and interwoven interactions between communication and operation. In these cases the design of non-hierarchical structures should be the solution.

The question is now, how inter-organisational structures could look like?

In the internal design of work and organisational structures, traditional hierarchical boundaries in the organisations are softened by the hierarchical shifting of tasks and competencies. This is realised by designing group work systems or by the shop floor workers' participation in the process of designing working conditions. In this way, the knowledge, abilities, and skills of the workers can be used to create working conditions which actively motivate and promote the individual workers personal development. This supports an increase of flexibility and quality in the processes to be realised.

These abilities, knowledge and skills utilised by the shop floor workers, are specific, detailed and above all, they are extracted from the process and thus are a powerful potential for technical, technological, and organisational improvement.

In organisations co-operating in networks, we can frequently observe that the internal processes are perfectly designed with the participation of the shop floor workers. But the participation of the shop floor stops at the boundaries of the factory. The knowledge of the co-operative process of the workers is rarely used externally and the shop floor level hardly participates in the design of the co-operative process. This causes inefficiencies and disturbances in the process. Designing boundary-spanning participatory structures may be a solution for this problem.

Currently several methods of designing boundary-spanning functions are discussed such as inter-organisational circles (see Endres and Wehner, 1996). However they are not integrated into the process of co-operative work.

An integrated solution could be realised by unifying operation and communication at one organisational level. An approach to realise this objective could be the design of boundary-spanning groups.

	Organisational structures	inter-organisational structures
disintegrated approaches	e.g. Quality Circles	e.g. Inter-organisational circles
integrated approaches	e.g. autonomous workgroups	Boundary-spanning Groups = Networks of competence cells

To realise this it is necessary to enable the people forming these “quasi” groups to behave as groups. That is why it is necessary to

- transfer the **competencies** for the co-operative process to the people who are acting in the process. This includes co-ordination and decision-making competencies for their actual field of work; and
- enable the people who are to solve co-operative tasks to recognise a group **responsibility** for the co-operative process by enlightening the importance of their own action in context with the whole process chain

The basic hypothesis of this approach is, that the unification of operation and communication, as a kind of inter-organisational job-enrichment, will lead to better participation of the acting people in the processes of co-operation by means of more direct communication, better understanding of the processes of their partner, and better feedback from the processes and self-organisational development of the co-operative structures. It will improve motivation and job-satisfaction of the people and thus efficiency and quality of the process.

These "boundary spanning" groups which avoid hierarchical obstacles in the design of the network structures could be an approach to design such networks of co-operating competence cells which I introduced at the beginning.

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