European Interregional Boundary-Spanning Institutions: The Case of European Aeronautics Industry

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ABSTRACT

For most SME in incumbent medium-technology sectors, international business is only possible, if additional support by specified institutions is provided. These additional services include information on foreign markets – regulation, market partners, sales potential – as well as coordination – for trade fairs, common international recruitment and qualification strategies – and capabilities like access to financial markets or international public funding for internationalisation or cutting-edge technological knowledge. For many of these services, private provision is possible, as exclusive use and rivalry in consumption are given. For other ser-vices, however, network characteristics restrict a completely private provision.

The proposed paper analyses institutional arrangements particularly designed on regional, national or European level to support linkages between organisations and networks in different European regions. The investigation is based on information collected within the framework of the "IKINET project – International Knowledge and Innovation Network" (EU FP6, N° CIT2-CT-2004-506242). The specific challenge of the institutions investigated within this paper refers to linkages between organisations and networks with different institutional designs, e.g. the role of public and/or private supply, the characteristics and subjects of services, organisational structures and modes of coordination. These institutions attempt to bridge the gap between SME and organisations in different regions, but also to ease the access to EU funding for transnational (transregional) cooperation between SME. The paper will analyse their products, organisational structure, funding and codes of interaction. This investigation will be used to identify general and regionally specific prerequisites for effective interregional boundary spanning institutions. Secondly, the connectivity between the institutions will be analysed to reveal necessary standards or institutional arrangements to secure interregional trust in cooperation. These standards can range from rather informal, for example on the basis of business norms in trade fairs, to completely formal arrangements, for example in the case of contractual agreements on intellectual property rights and licenses. The assessment of these institutional arrangements uses an integrative methodological framework based on institutional analysis to overcome information asymmetries in cooperative innovative processes, sociological and cognitive psychological models of organisational and cognitive proximity and management models for SME as learning organisations. As a result, insights are expected for the European Union, which institutional arrangements are necessary for technology plat-forms on a regional level to secure interregional knowledge interactions.

Keywords: international knowledge flows, interregional institutions, boundary spanning institutions, technology platforms

1 Introduction

Medium-technology industries comprise both, activities with high technological intensity and conventional services. Developments in the production cycle and changes in the economic environment concern both categories in different way. A great part of the sector output is performed by small and medium-sized enterprises (SME) with different knowledge capacities, which are dependent on different way by firm exogenous knowledge flows. The ongoing process of 'global shift' evokes worldwide organizational restructuring and conduct reconsiderations (DICKEN, 1992). Production concepts and procurement strategies endure re-definitions. Medium-technology SME are confronted with two major challenges. On the one hand, the diminishing role of geographic proximity in common business relations causes the need of new instruments to guarantee trust in cooperations and innovative organisational forms to secure viability and performance in the process of internationalization. On the other hand, the shift towards new technological paradigms requests the integration of technologically unprejudiced partners in the research process and the development of novel instruments for strengthening interaction and knowledge exchange between research and applications.

Due to various shortcomings in financial and human resources, SME are hindered to catch up with international knowledge flows (WICKRAMANSINGHE and SHARMA, 2005) and thus to adjust to global sourcing models and induce organizational learning in order to obtain competitive advantage (LAWSON and LORENZ, 1999). This paper discusses the support international boundary-spanning institutions provide in this concern to SME. Their services include information on foreign markets – regulation, market partners, sales potential – as well as coordination – for trade fairs, common international recruitment and qualification strategies – and capabilities like access to financial markets or international public funding for internationalization or cutting-edge technological knowledge. In general, the private provision of some of these services is possible because rivalry in the consumption and mechanisms to secure exclusiveness are existent. In particular cases however, private business is not reasonable, as the demand cannot reach the critical mass needed.

As institutions contain organizational, cognitive and social elements, they are powerful instruments to enhance interactive learning. Whether they enable or hinder learning depends on the predisposition of the various parts of the institutional system to establishing of local inertia (BOSCHMA, 2005). Here, we try to identify general and regionally specific prerequisites for effective interregional boundary-spanning institutions. Next, we analyse their predisposition to act as international trust brokers in interregional cooperations.

For illustration, we take the aeronautics industry, because first, it combines processes of high innovation potential like electronics with conventional manufacturing activities like forging. Second, industrial reorganization processes in aeronautics can be observed in recent years, which coerce SME to reconsider their procurement policies. Third, a number of institutional arrangements have been established to regulate the process on international level. And last but not least, because of the different technology bases, the increasing internationalization and the different observed approaches, aeronautics is marked out by very complex coordination structure. The investigation is based on information collected within the framework of the "IKINET project – International Knowledge and Innovation Network" (EU FP6, N°CIT2-CT-2004-506242). The paper is structured as follows: in the next two sections, the theoretical background to the empirical analysis is discussed. In section four, the organisational structure of the aeronautics industry is described and the main organisational and market-restructuring trends outlined. The whole section is designed to demonstrate the challenges that these developments imply for SME. The fifth section concentrates particularly on the situation of two segments of the aeronautics cluster in Northern Germany differing by their activities and proximity requirements. Section 6 describes two international boundary-spanning institutions, related to the investigated clusters and analyses their services, organisational structure and funding. The last part summarizes the basic results and identifies fields for future research.

2 Knowledge, Learning and Interactions

The theory underlying this paper is based on methodological framework integrating institutional economics, sociological and cognitive psychological models of organisational and cognitive proximity and knowledge management models for SME as learning organizations.

New knowledge is broadly accepted as a source of competitive advantage (NONAKA, 1991; NONAKA and TAKEUCHI, 1995; PORTER, 1990). Knowledge itself is intangible and inexhaustible. It cannot be carried away and it cannot vanish as in the case of other assets. For example, the knowledge how to solve the Rubic's cube once adopted, remains property of its owner, even after he has showed several friends how to do it. Following the work of POLANYI (1967), it is often argued in the literature, that knowledge consists from explicit and tacit components. Explicit knowledge can be easily expressed by using data (e.g. formulas, letters, and symbols) and stored in certain medium (e.g. book, compact disk, or film reel). On the contrary, tacit knowledge refers to the accumulated experience and skills, which are highly subjective, implicit and person-ingrained. They are difficult to formalize and cannot be aggregated at a certain place. The easier knowledge could be passed on, the harder its spreading could be controlled. While the distribution of codified knowledge is bound to the allocation of its material medium, the diffusion of tacit knowledge is more complex. It can be internalized through experience, practice, observation and self-immersion. Thus, implicitness is a natural access exclusiveness barrier to knowledge, whereas explicitness enhances the uncontrollable spreading of knowledge within certain area, independent of the willingness of its owner (FORAY and MAIRESSE, 2002). The lack of controllability on knowledge and its quality to be incompletely appropriable cause positive external effects for society (knowledge spillovers) and bear the risk of free-riders in research. This is the main reason why sometimes R&D-activities are not attractive for solely private provision. For the particular receiver knowledge spillovers are as far important as they induce learning and change his incumbent knowledge base.

Recent advances in cognitive science throw light on how human learning takes place (HOLLAND ET AL., 1986). It causes the formation of a structure by which to interpret external signals. This structure, initially specified by the gene, undergoes subsequent modifications caused by the individual experiences and socio-cultural environment. It consists of classifications, according to which people organize their perceptions and build cognitive patterns that help explaining and interpreting the environment. Both, the mental classifications and the cognitive patterns evolve reflecting the knowledge of new experiences – being continually tested and modified. Briefly, learning takes place. Learning processes make knowledge path-dependent and cumulative (MASKELL and MALMBERG, 1999). Incoming messages provoke reactions and changes in the mind along a strongly individual path so that the state of knowledge in every particular moment is dependent on previous events and experiences.

In order to induce learning, interaction with other people is needed. In the process of interaction several institutional problems appear. First, as interacting partners presumably keep different pieces of knowledge, based on different experiences, they are confronted with asymmetrical distribution of information. Whether the transmitted information is completely accurate, could be said only by the sender himself. If the received information will be useful for the receiver is most likely to be known by him after processing the transmission. This asymmetry increases the risk of opportunistic behaviour in the transfer of new knowledge. Second, in addition to the uncertainty on experiential knowledge of others, novel knowledge goes along with uncertainty, too (NELSON and WINTER, 1982). Nobody can guarantee the successful commercialization of knowledge just generated. Third, the process of communication is often hindered by misunderstandings and misperceptions, when common communication codes are lacking.

To summarize, following problems in the dissemination of knowledge can be identified:

- Implicitness – implicit components of knowledge are deeply ingrained in the person, who has experienced them. Due to the difficulty to be verbalized, their externalization means to extract them from the cognitive environment, where they have been initiated. This

bears a risk of loosing the linkage to the context. Their internalization mostly requires a long process of learning. High implicitness of knowledge generally hampers its transfer.

- Uncontrollability of knowledge flows – while too much implicitness hinders the flow, too little enables free fluxion, difficult to be controlled. The easier the knowledge can be shaped in words, the lower the additional investments that should be undertaken to understand and interpret the code, the more quickly and accurately the transfer can happen. Efforts of the firms have to be directed to reduce hazard of involuntary transfer to competitors.
- Requirements on knowledge diversity – as each individual has unique cognitive frame and different perception and interpretation of information, it could be assumed that a variety of cognitive bases is needed to bear the best knowledge exchange.
- Uncertainty about experiential knowledge of others – the receiving party should trust the communicated data; should have the opportunity to test the quality of the processed knowledge (WINK, 2007). In case of failure, 'sunk costs' in time, human and financial resources remain.
- Uncertainty about the credibility of the interacting partners – the party owing new knowledge should be given credible signs to rely on conjoint compliance for exchange. If not, transactions may fail to take place.
- Issues on cognitive level – lead to misunderstandings and false interpretations of the processed new knowledge, which can be costly and infuriating. The exchanging parties should share common knowledge bases, as to correctly understand, rightly interpret and successfully adopt the new knowledge (COHEN and LEVINTHAL, 1989).

All these features either are alone elements of market failure or enormously increase the costs of knowledge transactions. A sort of solution to these issues offers spatial proximity. Space generally determines the interaction patterns and allows frequent face-to-face communication, which is argued to be crucial for searching and validation of new ideas and concepts (SAPSED ET AL., 2005), and supports the development of social relations. These in turn act as natural factors in overcoming barriers to knowledge transfer, as they increase the capacity for immediate feedback and validations. In addition, operating within a small community, where people know and trust each other, nobody is fond of demonstrating hold-up behaviour. Under these social conditions, when information is spread very quickly, every case of misbehaviour risks public exposure and every violator – at least a public outcast (MASKELL, 2001). In this spirit, geographical proximity increases the social control and makes the 'signal' for sanction more credible. Furthermore, intensive interaction enhances the implementation of common cognitive frames and mitigates the differences in cognitive categories.

Looking more in detail, one can recognise that clusters combine the elements important for the exchange of knowledge and the activation of learning processes, namely the regional dimension, the interactions between the different actors and the coordinating mechanisms (STEINER, 2004). Clusters are defined as "regional specialisations on interlinked activities of complementary firms and their cooperation with public, semipublic and private research and development institutions" (p. 3), characterised by enhancing positive technological externalities and leading to economic advantages (STEINER, 1998).

For different types of clusters, the mode of learning diverges and the interaction takes place in different way (MASKELL, 2001). BOTTAZZI ET AL. (2001) introduce five types of agglomerations with fundamental differences in the knowledge flow and cooperation patterns:

- Horizontally diversified agglomerations – an example of the 'Marshallian' industrial districts emerged as an outcome from specialization. They comprise a great number of small firms engaged in fashion-driven, design-intensive sectors like footwear, clothing, tiles, etc. The knowledge associated with these products is accumulated within generations of experts and to enormous extent not formalized at all. Innovativeness and economic growth are favoured by competition atmosphere (PORTER, 1990). Exogenous in-

formation e.g., from international fashion fairs, is the main driver for innovation in the sector. Interaction happens mainly indirect in form of imitation and industrial spying.

- Agglomerations of vertically disintegrated activities – an example of the 'Smithian'-type clusters accruing through division of labour. Vertical input-output relations dominate this type of clusters. The disintegration has been partially forced by the possibility to formalize a great part of the knowledge exchanged. Innovations are mainly demand-driven. Both sides depend on the knowledge of the other side.
- Clusters with hierarchical relations – involve several well-positioned multinational oligopolists and auxiliary network of subcontractors, as in automobile or aeronautics. The orientation to the customer's needs dominates the interaction patterns and the new product development. The suppliers depend functionally and in their access to knowledge on the main contractor. The knowledge is primarily codified and exogenous with small share of implicitness. Intensified international research and global sourcing are characteristic. Strong vertical and weak horizontal linkages dominate.
- Science-based clusters – refer to high-technology industries (e.g. ICT, biotechnology). The high innovativeness is an outcome of high R&D-investments, intensive cooperation within the particular discipline and collaboration with researchers from other sciences (interface management) on both, local and international level.
- Agglomerations as outcome of path-dependency – result historically from geographical lock-in without any trace of agglomeration externalities. Knowledge is generally codified. International knowledge flows find only casually the way to the cluster.

Our main hypothesis is that different types of clusters strengthen different proximity dimensions and give rise to specific supporting institutions.

3 Institutions and Knowledge

A large body of literature outlines the importance of institutions in knowledge transfer and economic performance (NOOTEBOOM, 2003; COOKE 2004; KENNEY 2000). Silicon Valley for example, has a unique institutional endowment, which is doing much to encourage the formation of new firms – a crucial feature for the dynamism of the region (KENNEY and VON BURG, 2000).

There are different perceptions about what are actually institutions. COMMONS (1931) sees in institutions their general feature to create individual freedom's domains through restricting collective actions. Collective actions enable the transformation of social conflicts into cooperations and productive competition. NORTH (1994) stresses on the contribution, institutions achieve, to enable complex transactions and cooperations benefits through reducing uncertainties and opportunistic behaviour. Institutions are systems of rules and norms that make economic behaviour more predictable and afford economic actors to rely on the promises of others. Institutional arrangements serve for more durability of contracts and save this way transaction costs. A wide range of institutions is constituent for well-bred people, e.g., etiquette, good manners, customs, habits, reputation. These are all a kind of intrinsic socially sanctioned rules, we referred to as *informal institutions*. Although they give a certain order of social and economic activities, they would not be sufficient for relations that are more complex. *Formal institutional arrangements* not only strengthen them but also award the sanctions for non-compliance state recognition. Institutions facilitate learning processes and support economic actors to look out of the scope of their bounded rationality and improve their subjective cognition, inducing this way regional development and economic performance (NORTH, 1994).

All features like culture, religion, industrial standards, political traditions, rules, social capital, entrepreneurship, routines, values, and regional market settings for supply of capital, land and labour constitute the specific institutional endowment of a region, which emerges as a substantial part of the societal evolution. Procedures and routines, that had come out to be

useful and successful in the past, have been institutionalized and have become wide accepted in the society. Therefore, institutions reflect the knowledge of previous generations (KASPER and STREIT, 1999) and are an outcome of former economic activities in the region. The reciprocal interaction between institutions and economic actors shape the institutional evolution of the economy in the region. On the one hand, enhancing particular kinds of knowledge creation and impeding others, institutions map firms and entrepreneurs the way to certain businesses and industries (MASKELL and MALMBERG, 1999). Thus, the emerging and existing firms reflect the opportunities provided by the regional institutional environment (NORTON, 1992). On the other hand, changes and opportunities in the outside world (e.g., globalization, advances in technologies like internet, organizational restructuring, new technology paradigms etc.) bear challenges to the existing institutions. Developed to meet certain needs, they have to be flexible to acclimatize to the altering settings and to maintain the incentive structure of the region. For example, if the accumulation of knowledge enables divergent economic activities or innovations give rise to new product development, this process triggers also the institutions for assistance of the emerging new firms. Hence, institutions are alone object of evolution. Path-dependency and institutional 'lock-in' may hinder them to fit to changes and modifications of cluster requirements and bring this way clusters to decrease (MASKELL, 2001; BOSCHMA, 2005). In the words of NORTH (1994, p. 364): *"Societies that get 'stuck' embody belief systems and institutions that fail to confront and solve new problems of societal complexity."*

3.1 Institutions in the context of successful knowledge transfer

Let us here stress on the importance of institutional arrangements for generation and diffusion of knowledge and development of learning networks and summarize their inherent functions. Generally, institutions matter, when transaction costs are high (NORTH, 1994) and weak mechanisms for self-regulation exist. When knowledge exchange processes threat to fail because of high pre-investments, needed to search, explore and achieve a level of understanding with a transaction partner, institutions have to support the actors with reducing these transaction costs. Starting from the issues knowledge transfer gives rise to, identified in the previous section, and the displayed considerations about proximity, one can derive the general prerequisites for learning processes to take place. We argue that the basics for successful learning are determined through proximity, creativity, openness and diversity.

Geographical proximity of the interacting partners facilitates frequent face-to-face contacts and helps to strengthen the other dimensions of proximity, hence social, organizational and cognitive (BOSCHMA, 2005; TORRE and RALLET, 2005). Repeated interaction with the same actors accustoms to the way of thinking and to the used wording, and makes the exchanged data more understandable. It allows to follow the cognition of the communication partner and to bridge the gap between the own and the foreign experience. The more time one spends together with the opposite party, the clearer he sees the interdependencies and the more correct the interpretation of the received message can be done. The easier and the longer the communication to the business partner, the closer gets the relationship to him. The communication encompasses then both, business and private events. The social proximity itself facilitates the emergence of trust and increases the loss in case of rule violence.

This situation of convenience works against innovative behavior, when interaction happens selectively with partners one gets used to, instead of with those with the best work parameters or newest knowledge. Breaking incumbent technological paradigms to enter entirely new fields of inexperienced knowledge in order to search for new solutions requires a high degree of creativity and talent. For this kind of proceedings, the organizational environment is very important. Only if organizational routines are flexible and admit exceptions, new structures could receive a chance to be compared with old ones and to show superiority. Otherwise, organizations become 'stuck' in old solutions and concepts. Nevertheless, certain extent of similarity in the organizational structures facilitates learning processes and eases the interpretation and adoption of knowledge (see KOSTOVA, 1999).

In order to support innovative thinking and to intensify interdisciplinary work, knowledge networks should offer diversity. They have to be open for heterogeneous forms of knowledge, new members, innovative forms of coordination, etc. As opposite to closeness, openness is expressed in all dimensions of proximity. In geographical matter, it concerns the recent internationalization strategies. Firms enter new markets, search internationally for new procurement contractors; international knowledge networks try to overcome the limits to local knowledge generation. Further, the crossing of national boundaries causes confrontation with different cultures and value systems, which in turn influence the way of thinking and of decision-making. One has to be alert of social differences, when operating in the foreign market. Other dimension of openness is the cognitive. Crossing borders of new sciences and technologies means that the logic of thinking changes the rules. Cognitive openness is needed in cooperations, when adapting new knowledge to innovative products solutions or when operating on the frontier of different disciplines.

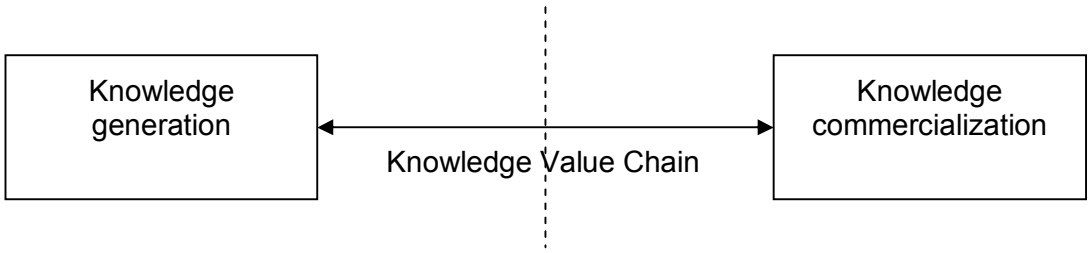
Considering these prerequisites, we obtain the functions institutions have to perform for successful knowledge transactions (see DRAGANINSKA and WINK, 2005). Institutions have to:

- prevent the knowledge shared within the network from not allowed external access in order to ensure controlled knowledge flows. Formal and informal institutions provide the opportunity to secure intellectual property;
- reduce the uncertainty about the experiential knowledge of others;
- develop mechanisms for enhancing commitment to exchange, e.g. strengthen social proximity (mutual trust or common interests), pursue long-term relationships or create other instruments to guarantee compliance to internal norms for end games;
- create basis for development of common communication standards in order to avoid misperceptions within the group of members. That disburdens the process of interaction and enables taintless communication, interpretation and adoption of new knowledge;
- ensure openness and diversity to avoid lock-in and improve the own absorptive capacity and knowledge base;
- increase the incentives for collective learning and creative working.

3.2 Boundary-spanning institutions in the context of successful knowledge transfer

'Boundary-spanning', 'boundary-crossing', 'bridging' institutions: Which boundary is exactly meant by these expressions? We can imagine three cases in which these terms could be used:

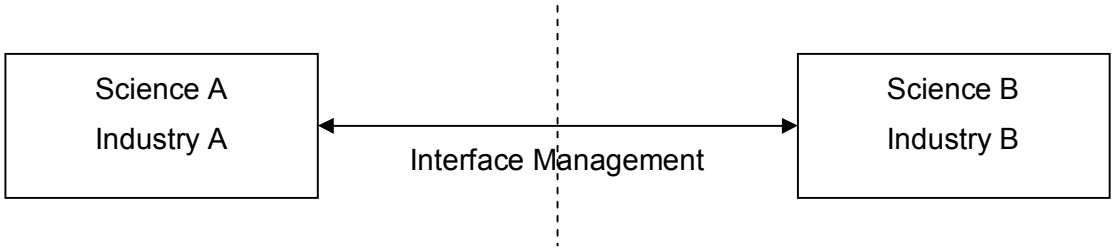
- When trying to encompass the fictive borders of the different stages of the knowledge value chain – knowledge creation and knowledge commercialization;



The searching for new knowledge often bears unexpected outcomes. Where the entrepreneurial spirit is well developed the institution of the market itself is enough to create motivation for exploitation of inexperienced knowledge (COOKE, 2004). Small highly flexible firms attracted from the expectations of good profit and the advantage of the 'first mover' accept the risk and uncertainty associated with this undertaking and act as a connecting link between generation and commercialization of knowledge. The knowl-

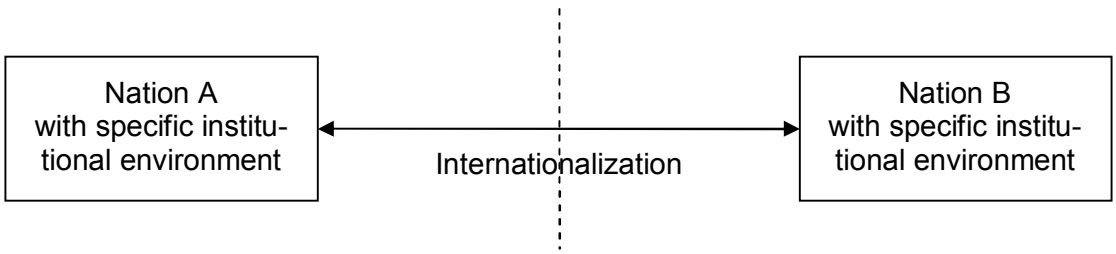
edge flow between researchers and practitioners is facilitated by cross-ownership relations. Organisational proximity and common interests are the driving forces of the process of adoption and adaptation of the new technology to innovative products and services. Where the market conditions for such architectures are underdeveloped, boundary-spanning institutional arrangements, established by ambitious authority or emerged bottom-up, achieve comparable effects. They should enable newcomers to enter the market and map the way to successful cooperations, address some entrepreneurial shortcomings like looking for funding or qualified labour, and not at last, strengthen certain kinds of proximity to facilitate the right allocation.

- When referring to the scientific (cognitive) differences between two disciplines and the specific institutions arranged to support them;



Knowledge transactions within different disciplines are mainly challenged by cognitive barriers and different professional basics. Either profound scientific background in both disciplines or very intensive interaction is needed to detect useful ideas from the first science and to implement them into the other. To process this kind of work, one should abandon accepted rules and norms even sometimes standards of doing things and follow completely new directions. Incumbent values have to be destroyed and newly build-up. Institutions enabling research beyond the borders of certain discipline have to ensure diversity of knowledge and open structures as to get access to various knowledge sources. Creativity has to be encouraged and the uncertainty, associated with it, reduced. Frequent interaction should be supported in order to develop joint communication codes. Institutions have to motivate the achievement of the right balance between proximity and distance in organisational aspect. For example, in the case of Silicon Valley, fluid employment relations and peculiar local industrial culture, supported by university tradition, in which innovative ideas are considered in general property of the scientific community, are few of the key contributors facilitating the growth and development of the high-technology agglomeration (ANGEL, 2000).

- When addressing the international dimension we face the geographical boundaries that often determine different national institutional endowments.



International transactions are accompanied by transaction costs different from the costs of transport and factor mobility, also called 'space-bridging costs' (KASPER and STREIT, 1999). The major difference between interregional and international exchange results from the fact that the contracting parties do not operate under the same institutional framework and jurisdiction ('international institution-bridging costs'). Peculiar customs, work practices or industry standards may cause that the partner's reliability and credibility differ from the standards with which one is familiar. If one party fails at the fulfilment

of contractual obligations, the means to coerce it to compliance are less straightforward than when both parties operate under the same jurisdiction. Consequentially, international transactions often face greater uncertainty and higher transaction costs as regional ones. Abandoning local production structures, tested and reliable in the past but not efficient enough to be internationally competitive in the present, sets new dimensions in collaboration. Boundary-spanning institutions in the context of the on-going internationalization should find a way to replace geographical proximity in its role of contributor to social relations and facilitate trust in business affairs otherwise.

Summarizing, institutions are needed to enforce knowledge flows between clusters in different regions and ensure better allocation and diffusion of innovations, where market systems are rather imperfect. Build artificially to meet the specific needs of the cluster, they get more and more an integral part of the cluster's landscape and embody additional political and intermediary functions. Institutions grow with the needs of the cluster, to which they are built to serve. In the century of short distances, advanced IT-communication and strong requirements to quality and productivity, institutional arrangements have to support firms to overcome barriers to internationalization, e.g. to enable them to find the proper business partner abroad or to enter a new market on lower costs. Furthermore, reasonably organized institutional arrangements get in touch with local institutions, help managers to cope with other cultures and legal systems and bridge the communication gap between the different organizational cultures in building-up a suitable platform for interaction and knowledge transfer, reducing this way market asymmetries and uncertainties.

In the next section, we take the aeronautics industry as an example and map at first the framing conditions, which confront the supplier industry with some challenges. We use them as a background for our further discussion about international institutional developments.

4 Civil Aeronautics in Europe – Changes and Challenges

4.1 Organizational and market restructuring processes

The history of the European aeronautics can be traced back to World War I, when the first pioneering attempts in this field have been done. During the World Wars, the advantages of the technology, challenging the law of gravitation, became quickly obvious for the participants. Tightly linked with military interests in this early stage, aeronautics grew to separate industry which experienced rapid development and was of strategic importance for the European governments. In the 70s, the Three Strongest in Europe – France, Germany and Great Britain – joined their endeavours – followed a little bit later by Spain and Holland – in order to meddle in the aircraft market and to challenge the U.S. leadership in civil aviation. Although interested in the market of civilian airplane, the birth of Airbus was rather political decision than market-driven project. The distribution of tasks in the cooperation was organized depending on the technological competences of the partners and efficiency seldom played in the front-row. Much more, the access to the technological pool, won by research and development, drew the attention of the partners (BERG and TIELKE-HOSEMANN, 1988).

This remoteness from the market and the increasing critic to national governments accusing their unjustifiable subvention policy regarding Airbus caused general reconsideration of the high production costs within the consortium. Processes of privatization and outsourcing of activities, which were not strategic for the company, started. Applications research, design, specification of the main characteristics, verification through prototyping, assembly and final product distribution were kept in-house. All the rest manufacturing has been externalized to sub-tier suppliers and collaborators under favourable conditions. A broad network of interconnected firms – spin-offs of former public firms or newly founded enterprises by former personnel of Airbus divisions – was able to optimize the production process and to produce at lower costs maintaining the same technological level. This tactic allowed Airbus to reduce the internal production costs and to internationalize the production process at the same time. Shifting from in-house to outsourcing led also to intensification of the international knowledge

exchange within the network. As the aeronautics sector is characterized by incremental innovation, able to arise in each stage of the value chain, the innovation level of the sector became a determinant of the technological standard of each one participating firm. With respect to the internationally dispersed parts of key knowledge, growing at the nodes of the entire network, new coordination forms had to be approached in order to obtain better accumulation. This resulted in immense increase of the transaction costs of the firm and challenged the new production concept.

The strong transatlantic competition in the 1980s led to some concentration processes in the United States and increased the pressure on the Airbus consortium, leaving on the world market for wide-body aircraft a duopoly – the European Airbus and the U.S. Boeing. At the same time, on-going globalization and advances in the communications technology turned the world to a 'global village'. Low-cost locations have been suddenly realized to lay behind the corner and put local producers in international competition. High transaction costs and bad position for knowledge control brought Airbus to undertake reorganizations of the production model, which concerned also the relationships with its subcontractors. In the late 1980s, Airbus introduced its novel conduct model – which is still valid today – and challenged all existing industrial partnerships at that time. According to it, the number of direct subcontractors of Airbus should be drastically reduced to few system suppliers and the whole network should become more hierarchically structured (ALFONSO-GIL and CHRONICAS, 2007). In addition, many countries have introduced local content requirements in the aircraft market. The local market demand could only be appropriated, if part of the production has been made in the particular country. Therefore, reallocations and global modular sourcing are seen not only as a nice possibility to reduce production costs but also as the firm's respond to trade policy instruments.

Table 1: Comparative overview on the organizational restructuring models

Manufacturing process	'In-house'	Outsourcing	Global modular sourcing
Concept of production	integrated	externalizing of particular activities	outsourcing of decomposed modules and assembly
Production costs	high	low	low
Knowledge flows	within the corporation	within the whole network	international, in horizontal and vertical dimension
Knowledge management	centralized by the prime	coordination with many decentralized units	better coordination with fewer system suppliers
Risk management	concentrated in the title firm	concentrated in the title firm	distributed along the network
Transaction costs	low	high	low
Property	state-owned	high public participation	public-private
Industrial relationships	strong restricted	linear (network)	hierarchy

This coordination model has influenced the organization of the manufacturing process, too. The shift from integrated concept to global modular sourcing has put some new requirements

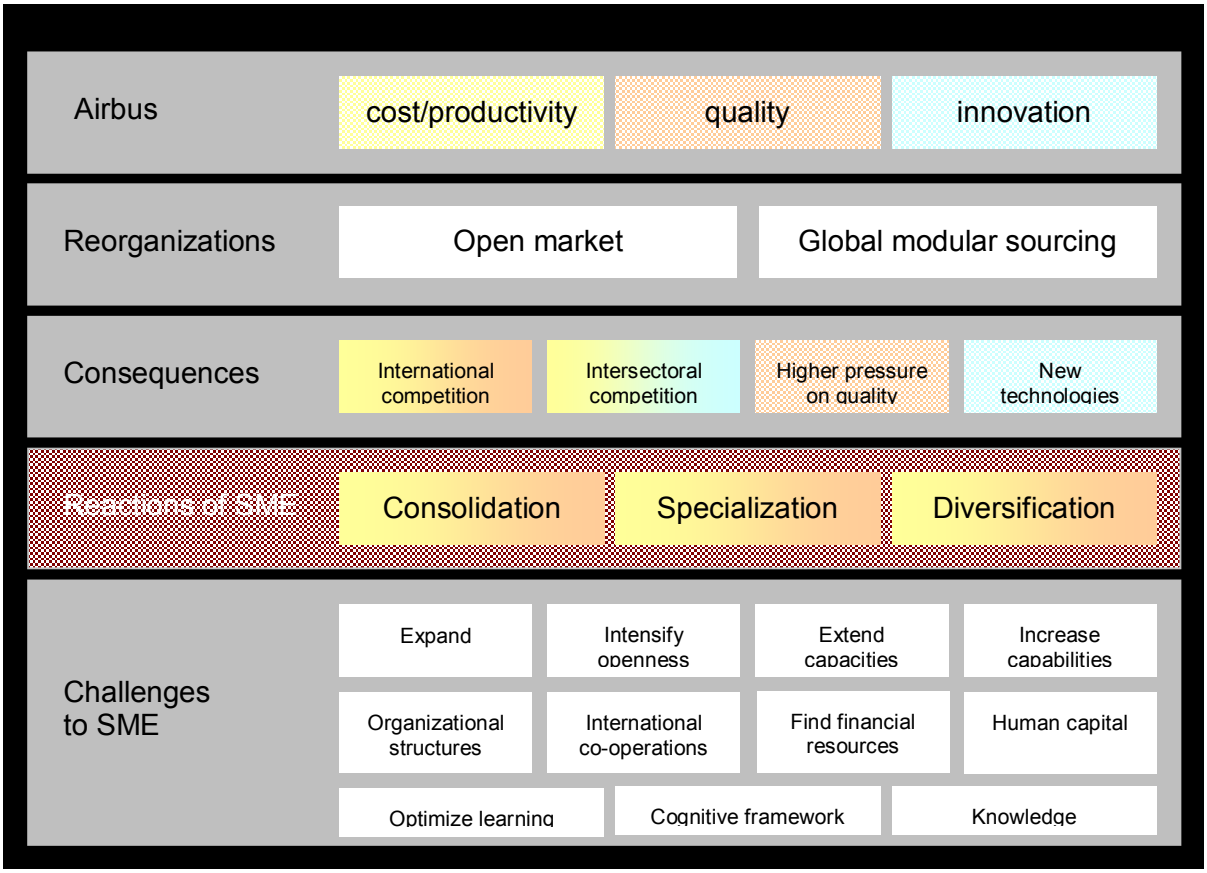
to the systemic conception of the production. It is held as following: Engineering groups from both, the prime contractor (Airbus) and the first tier suppliers (system integrators, called also *original equipment manufacturers*, OEM) work out a concept for decomposing of the final product in separate modules and a concept for their reassembly into complete airplane. The different modules or systems embody problems with different technical solutions. System integrators participate in the R&D as well as in the production costs of their client, sharing this way his financial risk. The decomposition is further processed in a tight collaboration with the own subcontractors, requirements always passing down the value chain and sub-systems, components and materials passing the other way up (BAIRD ET AL., 2000). The definition of the subsets and homogenous components is very labour-intensive and time-consuming, and thus strengthens the interactions between the engineers from both sides. Cooperation on this level is mainly based on long-term collaboration and good experience.

To the *equipment goods manufacturers* in turn, is given the realization of the defined modules. They are responsible to monitor the manufacturing process so that the provided parts satisfy the industry requirements with respect to quality, security standards and industrial specifications. These are also firms in the first tier, epitomizing high level of technological competence. Second tier subcontractors (also called *specialized*) are mechanical or service firms with tacit expertise in particular field of activity. While running down the hierarchy, the intensity of technological activities in the working packages decreases leaving for the last tier – *production subcontractors* – traditional manufacturing and standardized services. This last group comprises a great number of small and middle-sized enterprises (SME) with low level of specification, which makes them therefore extremely easy for substitution. Working tightly with all levels of the production pyramid with different competences along the whole value chain, they are adamantly searching for geographical proximity with the OEM or the primes alone. Attracted from higher-level subcontractors (see also 'anchor hypothesis' FELDMAN, 2003), they settle down close to each other, giving rise to aeronautics clusters.

4.2 Challenges to the industry

This latest reorganization of the business linkages is still an on-going process. It is considered as a clever step for the prime. Brought to the end, it will allow the company to reach two purposes: firstly, admitting better overview and maintenance of the contracts and consequentially, slimming transaction costs, and secondly, it lets them circumvent a great part of the R&D and production risk by spreading it along the value chain. The few system suppliers try to shift the disadvantage to their own suppliers as far as they can. Thus, passed down the pyramid, the restructuring impulse releases a lot of reactions (see an overview on Figure 1) and uproar among the firms operating at the bottom of the hierarchy – the real loser from the situation.

Figure 1: Reorganizations and challenges on the market for aeronautics



Traditional suppliers seem to believe that they have better opportunity for interaction when localized near to the customer. In this context, the literature acknowledges the dependency of SME on geographical and social proximity, because of the different financial and human resources shortcomings they have to develop international experiences and skills to cope with formal standards. SME are not enough flexible to face the challenges on the market. They have to contest their position with extending financial, organisational, cognitive and labour capacities, in order to deal with the increased risk situation and to be able to adjust to new modes of organizational learning. Their competitive advantages are highly dependent on extended openness, required to accumulate experience in international markets and get access to international knowledge flows counteracting their local inertia. Entering formal cooperations will help to improve tacit learning.

Put under pressure by these conditions, SME have two different strategies to go ahead. First, they could try to grow fast, get bigger and financially stable enough to be able to process the manufacturing of a complete integrated subset. Expanding this way will enable to find place among the suppliers of higher tier and bring more security in the business. This strategy of getting system-supplier is affecting the *organizational dimension of proximity*. The second alternative is to improve productivity. SME could try to deepen their knowledge in a particular field, find a promising niche in the market and work on specialization. This strategy gives nice prospects in getting extraordinary 'precious' for the contractors and not easy to substitute and challenges the *cognitive proximity*. Of course, tightly specialized firms have to be continually on lookout for new developments, innovative solutions and novel materials, which could revolutionise the incumbent understandings about aircraft manufacturing and in the worst case, make them residual. They have to consider in their services the quality requirements and the newest technology standards in the industry.

Both strategies tackle the problem of the own positioning among the fierce international competitors, but they still do not dissolve the risk, accruing from the fact that subcontractors in the aeronautics industry are – historically driven – enormously dependent on their clients.

Customization is also strengthened by the last trends in internationalization. The whole production system is predestined to serve to the production of an airplane. Every particular part – be it hydraulic system, electronic component or engine accessory – is designed according to the specifications of the final client, here Airbus. The enormous amount of time, human resources and financial capital that are needed to pre-invest in order to meet the security requirements, to handle the complexity of the problem and to bring up technological solutions before even knowing, if one is going to win the contest, makes it 'excusable' for firms to make attempts for diversification on other markets. The fierce competition accruing from low cost regions and premium-competitors makes it reasonable for firms to think about parallel sites. The pressure to internationalize is partially driven by the higher tier suppliers or the prime itself.

To sum up, it is not amazing, that increasing consolidation processes within the aerospace value chain, systemic specialization and diversification in other technologic fields become more and more evident on the market for aeronautics – they are just a logical outcome of this situation.

5 Aeronautics Clusters in Northern Germany and International Boundary-Spanning Institutions: Empirical findings

The following account is based on series of interviews and questionnaires undertaken in the aeronautics cluster in Northern Germany in 2005-2006. Representatives of fourteen SME and twenty service organisations from different sectors, all related to aeronautics, have taken part in the interviews. The firms comprised more specifically, manufacturing firms with intensified innovations activities and supporting firms from engineering and design, personnel and financial services as well as a couple of research and public-private services organisations.

The following issues within the empirical investigation have been identified as key:

- how do recent changes in the organisational and market structure of the aeronautics industry impact on the viability and performance of SME;
- what influence do knowledge exchange processes experience within the cluster;
- which challenges do SME face in open markets with respect to their own internationalization strategies;
- which role do international boundary-spanning institutions play in circumventing these shortcomings?

The aeronautics cluster in Northern Germany is spread on the territory of Lower Saxony, Mecklenburg-Pomerania, Schleswig-Holstein, Bremen and Hamburg. Its emergence has been considerably influenced by the near location of different Airbus production sites in the region and powered in recent years by the favourable conditions on the aeronautics market. The activities in the production centres of Airbus, located in Hamburg, Bremen, Nordenham, Stade and Varel, are according to the various competences of the plants, strongly diversified (see

Table 2). With respect of future expectations for growth, and notable contribution to innovations, special attention is given to the segment for cabin interior and management systems, settled mainly in Hamburg and its surroundings. Another big demanding customer with headquarter in Hamburg is Lufthansa Technik. Specialized on maintenance, repair and overhaul services as well as cabin customisation for VIP machines, Lufthansa Technik employs directly about 7,000 people and has several small to middle-sized subsidiaries in the region.

Table 2: Core competences of the Airbus production sites in Northern Germany

Production centres	Employees	Competences
Hamburg	10,000	Competence centre for cabin equipment and on-board systems; Maintenance and procurement of the whole A320 family; Centre of Excellence (CoE) for forward and aft fuselage
Bremen	3,000	Part of the CoE for forward and aft fuselage Wing high lift and equipment Manufacture for sheet metal plants Basic research in electronics and space technologies
Nordenham	2,100	Forward and aft fuselage Fuselage shells
Stade	1,500	Competence centre for carbon fibre composites Production of vertical tail planes, landing flaps, pressure bulkheads and spoilers
Varel	1,100	Manufacture of tools and precision components for all Airbus sites Specialization in wind tunnel models
Buxtehude	380	CoE in electronic communications and on-board management systems

According to their strategic positioning in the value chain and the level of own innovation the interviewed firms have shown substantial differences. Based on the share of academic employment, the investigated firms have been differentiated into three categories. The first group comprises *knowledge-intensive firms* with a share of more than 20% academic employees in total employment. They are characterized by advanced knowledge, to great extent formalized, good access to research units, a high share of own research and development projects and formal cooperations. Due to these characteristics, they are blessed with extremely low chance to be substituted in the value chain. Nevertheless, diversification attempts have been made to reduce the dependency on the main customers. The second class consists from *knowledge-intensified firms* with a share of academic employees in total employment of about 10-20%. These units have their expertise in highly specialized production processes – precious experience accumulated through learning-by-doing. Their opportunity to grow to system suppliers of higher tier is based on this very level of specialization and tacit knowledge. Research and development intensity is rather low and there are no international cooperations. Though recent changes in the market have made them increasingly aware of their high dependence on the demand-side, attempts to look for product applications in other sectors remained isolated. The last category – *conventional firms* – is the most dominating in the sector. With a share in total employment of less than 10% academic employees, they are rather imitators than leading-edge knowledge creators. They have no investments in R&D and no formal cooperations. Their competences refer to traditional activities, based on knowledge still not formalized. The importance of the single firm for the industry is restricted. Regarding their future viability, they count extremely on the social proximity to Airbus, exerting from existing long-term connections, facilitated through good experience in delivery and quality. Due to limited resources, they face challenges to adjust to global sourcing strategies and international competition and are therefore the group, at first preferred for substitution.

Further, according to the cluster classification identified by BOTTAZZI ET AL. (2001), two different cluster types have been recognized in Northern Germany:

- a hierarchical cluster with an 'oligopolistic core' characterised by customer-supplier-relationships

This constellation is the case for firms engaged in the competence centre for cabin interior and on-board systems. As previously mentioned, the 'core' of the cluster is built up by the two main demanders for these products – Airbus Deutschland and Lufthansa Technik. More than 300 SME with competences in mechanical engineering and cabin manufacturing attribute the 'periphery' of the cluster, the majority of them established 10-15 years ago. The most of the suppliers are *conventional firms* with share of academic employment of less than 10% of total employment, which presupposes rather common activities with low degree of specialization than expertise, based on outstanding knowledge bases. The firms do not participate in R&D activities and formal cooperations. The cognitive dimension is not strained for innovations but for adjustment of the production to new technological requirements and standards. These firms are predominantly focused on regional markets and show weak participation in interregional activities.

The rest of the suppliers fit into the group of *knowledge-intensified firms*. Here, slightly different situation prevails. Strong specialization and technological expertise in market niches form their competitive advantages. Several system suppliers in cabin equipment and on-board systems have been identified with one being a 100% subsidiary of Airbus. Positive impact on the innovation propensity of the firms, engaged in this specific aeronautics segment, has their access to knowledge flows from proximate scientific institutions and research organisations (BÖNTE, 2004). This may explain the regional cooperations, though only few, whereas it does not count for notes on internationalization activities. They seem mainly driven by the OEM and constrained by limits in financial and human resources.

As the typology name considers, vertical subcontracting relationships dominate the cluster. The strong technological and functional dependency of the firms from the single demanding client is evident for those firms, whose activities are still not diversified to other sectors. While all suppliers are linked to the 'oligopolistic core', horizontal linkages are weak or not available (PFÄHLER and LUBLINSKI, 2003; LUBLINSKI, 2003). Comparisons between firms located in the aeronautics cluster in Northern Germany and firms outside the cluster showed weak advantages of geographical proximity. Because of the knowledge spilling over from them, the influence of demanding customers is considered the most important agglomerative force for Hamburg's cluster in aeronautics; while effects based on labour market-pooling and trust are proximity-sensitive but not cluster-specific (LUBLINSKI, 2003). In particular, the accounts register the poor horizontal inter-firm linkages and acknowledge the difficulties of the firms to generate and exploit agglomeration advantages by the existing cooperation level.

SME, public authorities, key customers and other relevant groups react to the recent regional and industry developments. Their strategy is with joint forces to strengthen the identity of the region as an aeronautics location (DRAGANINSKA and WINK, 2006). Several qualification initiatives have been launched to facilitate linkages with other aeronautics regions and to improve the access to different knowledge bases. Increasing opportunities for participation on international fairs enable international knowledge flows to reach the region. Some attempts have been made for integration and development of stronger system capabilities in the cluster (Cabin Systems Holding, founded 2004 as a holding of SME, aiming to support the growth to system-supplier) as well as for more diversification of the cabin interior products within other industries[1] in order to overcome strategic weaknesses (WINK and DRAGANINSKA, 2006). Through the foundation of private associations for suppliers (Hanse Aerospace, founded in 1996) and engineering firms (HECAS, founded in 2001), SME aim to encourage and nurture

[1] Firm representatives consider a great potential for successful integration in other markets. The cabin and systems equipment of aircraft is applicable with a very few differences in manufacturing to ship's, bus's or train's cabin.

common interests and thus strengthen social proximity in the region. Informal events enable frequent face-to-face communication and invigorate the community feeling, working this way for better commitment within the network.

Modular sourcing strategies relativize these efforts to achieve close social relationships. Through task decomposition they make technically possible, what globalization makes necessary – the increasing need to embrace international competitors in the subcontracting process. That means that the cluster in Hamburg is only a local node of a global network with the acute need to find access to information about the rest of the nodes. Every particular firm have to get orientation in the 'global village' – find partners to cooperate with, find suppliers, that are able to work precisely and quickly at the lowest cost, find financial resources to mobilize high-skilled labour and to (with)stand the process of application. With diminishing social proximity to the business partner, other instruments to assure commitment and to prevent contracts from opportunistic behavior gain importance.

The multitude of firms in the global market is impossible to be investigated and assessed within the normal budget of a SME. The greater the area, where potential collaborators could be found, the more complex is the search. As to funding issues, on the one hand, to be engaged in the production process, engineering firms should pre-invest in the development of a competitive concept and apply with it to the OEM. The application is very time-consuming and labour-intensive. On the other hand, because of the ambiguity in the process and the lack of contract guarantee, the small firms face immense difficulties to find external capital to finance this pre-investment. Beside financial institutes, EU funding within the Framework Program for Research and Technological Development (FP) offers a considerable possibility to finance R&D.[2] The interviewed firms often do not consider EU funds because of lack of transparency in the promoted issues, long bureaucratic application-process and difficulty to find application partners.

Summing up, in the regional perspective trust is created through geographic propinquity and social contacts. As spatial proximity is the opposite of internationalization, the question arises, how the risks of international activities could be secured for the SME in Hamburg. The new situation confronts them with elements of market failure – imperfect information in the pre-contractual phase and increasing chance for opportunistic behaviour during the contract, – which give rise to collateral transaction costs, crucial for the activity/passivity of SME. Due to organizational weaknesses SME need support in order to internationalize at all - to find the adequate business partner abroad, where different social and cultural frames prevail and the behaviour of the contractual partner cannot be reliably anticipated on the base of the national jurisdiction. External help to overcome market entry barriers like contest requirements and political regulations in foreign markets is required. Instruments that strengthen organizational proximity and build up trust in the context of global shift processes are wanted.

- a science-based cluster characterized by knowledge complementarities

While in the hierarchical cluster the 'core' is built by the major demanders, central position in the science-based cluster adopts the technology. A typical example of leading-edge knowledge in the industry is the work with composite materials. Tests in the racing car industry, where carbon fibre reinforced plastics (CFRP) have been used at first, confirmed the favourable characteristics of the material. The possibility to reduce substantially the weight of the final product retaining a great mass of its flexibility at the same time makes the CFRP an interesting alternative to metal. Beside the advantages, many notes on vulnerability endorse the notion on the malicious character of new knowledge – technologies have to be adjusted to new applications according to their special characteristics.

In 2004, in awareness of the potential of CFRP for aeronautics and in order to maintain the creation of strategic knowledge within the region, Airbus Deutschland and several other well-

[2] Special features of the industry like long time horizons, external effects, financial and technological risk, regulatory standards, etc., often legitimate state subventions of aeronautics firms.

known enterprises have joined in a formal partnership and founded an innovations centre in Stade, Lower Saxony. In analogy to Silicon Valley, CFK-Valley Stade comprises a number of leading suppliers of different industries, innovative SME, engineering services firms, research organisations, public and private labs, spin-offs and other forms of cross-ownerships with various OEM, supported by services firms and institutions. The majority of the involved companies, according to our categorization, are *knowledge-intensive* with even more than a half of the employees consisting of academics. The basic prerequisite for membership is the excellence in the market or research (being one of the "market leaders") and non-rivalry to incumbent members (WINK and DRAGANINSKA, 2006). The whole structure, being enormous innovative capacity, concentrated on the research of new applications for weight-saving materials and the issues exerting on all levels of their production cycle process, has brought Stade the reputation of one of the world's leading centres for use of CFRP.

The research members – DLR, Technical University Hamburg-Harburg, Fraunhofer Institute for Applied Material Science in Bremen, etc. – guarantee access to international knowledge flows in Asia, North America and Western Europe. A number of regional and international formal cooperations enable broad exchange of ideas. High investments in applied R&D facilitate advanced achievements. Complementarities in the generated knowledge, frequent exchange of scientific results and quick adjustments maintain the dynamic of the prosperous cluster. Joint presentations on international fairs and recruitment initiatives, coordinated by the cluster management complement the interaction patterns, which allow the scientists to adjust their communication codes and to reach a conjoint level of absorptive capacity.

These relative high costs of the formal partnership are not so much the problem here. Much more, it is the need to deal more effectively with the technological and market uncertainty – thus, not the costs, but the effectiveness of the knowledge transfer is the issue. Firms with constant access to various engineering cultures and the search for solutions on the edge between different disciplines need mechanisms for enhancing organizational learning and improving the ability of the company in handling and evaluating new knowledge. A point of market inefficiency appears on European level, where the danger of suboptimal resource allocation and R&D duplication exists.

Summarising the specific requirements to the both cluster types, it is evident that the hierarchical cluster needs institutions, to not only enhance cognitive closeness, but also to nurture social proximity and trust and this way to build bridges to other cognitive coasts. The science-based cluster needs in comparison rather organizational proximity to strengthen the cognitive standards. Therefore, institutions have to produce additional benefits for internationalizing (for instance in form of EU funds, R&D-results or even higher likelihood for contracts by the client), exceeding the specific costs of the adaptation to the institution.

6 Interregional Boundary-Spanning Institutional Arrangements – Empirical findings

In recent years, almost all participants in the aeronautics industry have recognised the need of institutions, operating at international level, to secure their interests in international affairs. Several European and international associations as well as scientific networks have been founded to improve information about contingent cooperations abroad and to provide to their members reasonable arguments for selection of business partners and opportunities for future project funding (e.g. national aeronautics research programmes). They all represent the interests of various aeronautics groups in cross-border activities: the Association of European Research Establishment in Aeronautics (EREA) representing the research centres in Europe, the Association of European Aerospace Industries (AECMA) acting for the involved industries, the European Aeronautics Science Network (EASN) linking virtually the academic community in European universities engaged in aeronautics activities.

Both clusters, discussed in the previous section, have also given rise to specific institutions according to the specific activities they perform and the respective modes of learning.

6.1 ECARE – the international institutional reaction of the hierarchical cluster

In recognition of their weak position for entering on the international scene, European aeronautical SME – in this category the firms belonging to Hanse Aerospace in Hamburg – launched a joint support action called European Communities Aeronautics Research (ECARE).[3] It originated in a bottom-up initiative and received funding under the Aeronautics and Space Priority of FP6 of the European Union with intentions to be prolonged under FP7. ECARE have been organised as a dynamic network of aeronautics clusters[4] located all over the Europe and enclosing different industries related to aeronautics. The main purpose has been directed to increase the participation of R&D-intensive SME in research, funded by the European Commission and to achieve the full integration of European SME in the decision-making process affecting the industry. Attracting of more SME in European projects with aeronautical background is expected to secure their position within the aeronautics value chain.

The institution seeks to reduce market inefficiency through centralized coordination. It represents SME to outside institutions and organises them inside the network. On the one hand, the possibility of ECARE to aggregate the interests of its members improves the likelihood to obtain privileged access to policy makers and industrial partners. The establishment and maintenance of detailed database with company competence profiles aims to provide project coordinators with better overview of possible cooperation partners from the SME-milieu. A part of the offer is arranged to assess independently the technological capability of the SME and thus create transparency for industrial partners. The bottom-up foundation approach allows firms, affiliated to the initiators, to gain more control on the information supply of ECARE and thus save transaction costs for information procurement. On the other hand, ECARE can reduce the uncertainty associated with international transactions, especially in the case of knowledge-intensified firms. SME do not have the resources to pursue their strategies autonomously. Lack of managerial experience and difficulties in gathering of information associated with contracting international partnerships cause enormous transaction costs, which SME are not able to afford. Other important function is to create awareness for SME for the possibilities to obtain finance from official European institutions. The implementation of common practices and strategic lines to induce achievements generate *organisational proximity* among the members. Their affiliation to the same network and the availability of common interests strengthen the feeling of solidarity. Additionally, temporary geographical proximity within organized regional sessions and trainings reduces the *social gap* between the participants. The possibility to loose the good reputation in case of violation of the agreed conditions, not only in the international network but also in the regional cluster, to which the firm belongs, facilitates the trustworthiness within the network.

The initiative is open for all participants and industries related to aeronautics and the costs of participation in the network are restricted to the mere willingness to make formal application. The benefits on the contrary, are subject of network characteristics and depend on the accumulation of critical mass firms with good R&D propensity, which to attract the attention of project managers of multinational enterprises to the ECARE-database. The unwillingness of knowledge-intensive firms to participate in the initiative can be explained with the general difference of the issues they cope with – they have already their established contacts and channels for information. Knowledge-intensified and conventional firms should be far more interested in the services of ECARE, however, do not offer the requested characteristics for cooperation – financial stability and R&D-intensity. Particularly, knowledge-intensified firms, being oriented in financial matter, have good chance to profit from their participation in the initiative and find access to the production value chain.

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[3] The information about ECARE and ACARE (see next subsection) is gathered mainly from personal interviews with representatives of the consortium members and the official homepages of the initiatives: http://www.ecare-sme.org (ECARE) and http://www.acare4europe.org/ (ACARE).

[4] The expansion from 19 to 30 clusters is one of the main objectives of the network.

Although the system plays a significant role for overcoming internationalization barriers for SME (structures the technological expertise, reduces the transaction costs of searching firms as well as the uncertainty of contractors, etc.), transactions still depend on the benevolence of bigger industrial partners. Therefore, the availability of this boundary-spanning institutional offer, helps small firms to adapt into the new global environment, but does not guarantee success. Specific qualities are needed for the single SME to attract the attention of the upper stages of the production pyramid, where the real 'gatekeepers' of strategic knowledge are positioned.

6.2 ACARE – the technology-driven transnational institutional arrangement

In consensus with the 'Lisbon Strategy' of 2000 and after a profound assessment on competitiveness, environmental and safety issues in aeronautics, the 'Group of personalities in aeronautics' – a high-level group of industry and research leaders – advised to start an initiative in aeronautics, called 'Vision 2020'. Its ambition has been Europe to become the world uncontested leader in the field of aeronautics by 2020 (GROUP OF PERSONALITIES IN AERONAUTICS, 2001). The need of temporal harmonization of the long-term investment and commitment in aeronautics with the short-term view on technology innovation has been outlined as one of the critical points.

This has to be achieved by the industry through coordinated collaboration and targeted work on common identity of the industry firms. A conjoint framework for research and development had to be created as a guideline. Additionally, the Group recommended the foundation of the Advisory Council for Aeronautics Research in Europe (ACARE) that should develop a strategic approach to the research in aeronautics in Europe.

In consequence, in 2001, ACARE have been established by the major stakeholders in aeronautics embodying research, applications and regulators. About 35 to 40 persons in total represent the interests of EU Member States, European Commission, industry, research establishments, airports and airlines, academia and regulators. All in all, ACARE combines the names of the leaders in the industry – technology-intensive enterprises with status of OEM or even final client (e.g. Airbus, Alenia, THALES, SAFRAN) – with worldwide acknowledged research capacities – national giants on the field of fundamental research and innovative applications (e.g. DLR, ONERA). Apparently, ACARE bundles successfully public and private efforts for better cooperation and support on national and European investments.

As previously mentioned, its chief objective is to define and approve a long-term program on strategic technology development of the aeronautics industry in Europe – the Strategic Research Agenda (SRA). It should determine an appropriate set of technologies for the next 20 years and define the basic future research steps in the sector. ACARE is designed to act exclusively as a strategic body, oriented to issues in solely strategic matter. The team of ACARE makes strategic and operational recommendations as well as research studies for improving the SRA, but the implementation remains dependent on the stakeholders alone. The commercialization of an innovative product or method and its inclusion in the value chain expresses the expectations of the developer regarding the future and prospects of success of this product.

ACARE members meet once in month on the plenary, where they discuss incumbent issues and set further activities. The central topics outlined in the 'Vision 2020' are divided into five challenges, namely "Affordability", "Emissions", "Transport Systems", "Security" and "Safety". Within each topic, programs and further discussions are set and then held within special working groups. This temporary geographical proximity enhances the formation and maintenance of a *common cognitive framework* for knowledge exchange. The internal policy of ACARE does not regulate the attendance of the working groups. It is up to each stakeholder, if a representative in the certain working group will be send or not. The motivation of the participants accrues rather from the importance of the discussed issues than from a sort of enforcement. Their commitment to provide the best expertise according to the state of their knowledge is secured through the possibility of public monitoring, as the reports and position papers are available for the public upon request. Their implementation activities outside the

mission can also serve to signalize the quality of the given expertise and to confirm the utility of the made investment. Additionally, at the end of 2006, an independent group of experts will revise the achievements of the mission and try to identify possible weaknesses in order to launch the continuity of the process under the priority of FP7.

The affiliated firms are characterized by extraordinary high R&D-intensity, market power, strategic interests, and strong financial position. As ACARE is predominantly designed for voluntary contribution, each stakeholder has to bear the costs for the participation of its own representatives. Additional funds for reimbursement of projects of public interest and interface studies have been approved by the European Commission under the priority of FP6 as 'Specific Support Action'. Thus, the decision to take part in ACARE is more or less a weighed equitable decision between the costs and the benefits of this undertaking. The costs of participation are not only a matter of financial burden, but can also be expressed in time invested and human capacities usually bind in the inter-organisational production process, now devoted to the ACARE mission. This in general, impedes the participation of SME in ACARE and makes it completely unaffordable for conventional firms.

As supposed by GASSMANN and ZEDTWITZ (1999) in the case of R&D management in multinational enterprises,[5] the extra time and costs of coordination are compensated by the opportunity of the members to increase efficiency through specialization, focus and scale as well as to exploit more power. The constitution of ACARE as a strategic network, allows it to achieve efficiency through reduction of transactional inefficiencies in the open market. The structure allows better coordination and avoidance of redundant R&D as well as benefit from broader scope of activities with concurrent focus on the core competences of the firm (HAGEDOORN ET AL., 2000). The involvement in the ACARE-process allows the members to stay informed about the upcoming developments and early adopt beneficial practices. This implies that insider firms enjoy first-mover advantage in positioning on the international market and in gaining political influence. The affiliation secures access to the 'knowledge on the frontier' and thus enables advantage of information control. The *"ability to influence the decisions and actions of others"* (572) and the direct impact on the definition of the course of future technology is the best opportunity to launch the own interests.

6.3 Comparison

In the previous sections, we described two international institutional arrangements that have been established to meet the needs of different clusters and actors. Here, we will try to show what the basic differences are.

[5] *"The management of cross-border R&D activities is characterized by significantly higher degree of complexity then local R&D management. The extra costs of R&D coordination must be balanced by synergy effects such as decreased time to market, improved effectiveness, and enhanced learning capacities"* (GASSMANN and ZEDTWITZ, 1999: 233).

Table 3 displays several features that we would like to comment in this concern.

First, ECARE is an institution emerged on the initiative of SME-associations to handle the problems of SME in the context of internationalization and changing sourcing strategies of multinational enterprises. Its purpose is to support operatively SME in seeking industry partners and to increase their participation in EU funding programs. The arrangement is suited to serve the needs of conventional and knowledge-intensified industrial firms. On the contrary, ACARE is a result of policy considerations in aeronautics and concentrates on creating technology and market strategies. Established top-down it is oriented to the leading-edge performers in technology, represents the interests of all aeronautics stakeholders and offers a balanced mixture of basic and applied research, industry and regulative authorities.

Table 3: Comparison between ECARE and ACARE.

Category	ECARE	ACARE
Support	In operative issues	In technology and market strategy
Foundation approach	Bottom-up	Top-down
Members	SME-Associations	All aeronautics stakeholders
Members' knowledge intensity level	Conventional and knowledge-intensified firms	Leading-edge firms
Diversity	Application	Research-Applications-Regulators
Approach to overcome market failure	Centralized coordination to reduce transaction costs	Strategic network to increase efficiency of knowledge transfer
Openness	Open network	Club with restricted access
Entry prerequisites	Formal application	Suitable knowledge
Creativity	Engineering problem solution	Scientific development
Proximity	Social and organizational	Cognitive

Second, both institutions enable better resource allocation however perform different approaches to circumvent transactional inefficiencies in the market. ECARE concentrates on reducing the transaction costs of its members, resulting from the increasing spatial distance. It has chosen the way of centralizing cost-intensive activities like brokering of new cooperative arrangements, coordination, promoting transparency and assessment of the existing capabilities. The rationale in the case of ACARE is given by the improved efficiency of knowledge transactions. Strategic alliances offer aid in dealing with new knowledge and broaden the scope of the firm without the need to invest precious resources in other fields.

Third, both institutions claim to be open for new members. However, while the affiliation in ECARE is just a matter of willingness to apply formally, the membership in ACARE is implicitly restricted by the very object of partnership to high R&D-intensive firms, highlighted as superior in certain technological fields.

Fourth, the innovation of the engineering firms in ECARE is restrained by given designs, specifications and technological standards. In these limits, determined by the client, original problem solutions can be processed. Conversely, the members of ACARE are not restricted in their way to innovation. They make boundaries between different disciplines disappear and enter new scientific fields in order to perceive new knowledge able to be adapted for the solution of existing problems. These differences in the understanding for creativity determine also the proximity requirements of the two groups: the first – organisational and social closeness and the second – much more, cognitive proximity.

7 Conclusions

For the most SME in incumbent medium-technology sectors, international business is only possible, if additional support by specified institutions is provided. This paper addressed the institutional arrangements emerging on regional and European level to support linkages between organisations and networks in different European regions. Their specificity is deter-

mined by the different institutional designs, to which they have to serve, e.g., modes of interaction, coordination, organizational structures. We showed on the example of the aeronautics industry in Northern Germany, how different modes of interaction and learning as well as degree of knowledge formalization have lead to the appearance of two types of regional clusters. Pre-determined by these differences, SME are influenced in other way by restructuring and internationalization trends. We described the role of international boundary-spanning institutions in supporting these firms first, to overcome their problems in internationalization and second, to manage the challenges, set by new technological paradigms. In demand-driven hierarchical clusters local suppliers are confronted with incomplete information and uncertainties in the process of investigating the conditions in foreign markets and in reorganizing the own production. In science-based clusters, product modularization sets new standards related to the development of new technologies. While in the first situation, institutions concentrate on organisational proximity and serve as trust-brokers between firms in different regions, in the second case, they focus on bridging the cognitive gap between the actors and creating adequate platforms and conditions for stimulating organizational learning. For both institutional arrangements, different approaches for overcoming the elements of market failure have been observed: the first, saving transaction costs through aggregation of interests and thus reaching critical mass for the provision of cost-intensive services, and the second, improving efficiency in knowledge generation and dissemination through eliminating technological and market uncertainties.

These case studies have learnt us first, that bridging organisations have to be first, finely tuned to the specific requirements of the clusters, and second, particularly for hierarchically structured clusters middle-level institutions are needed, which to invigorate the cognitive translation and to enhance appropriate technological developments for SME.

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