



**THE TRANSFER OF KNOWLEDGE IN TECHNOLOGICAL  
CROSS-BORDER INDUSTRY CLUSTER – CASE STUDY**

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**Abstract:**

The paper discusses the problem of creation and development of business, technology clusters, aimed at developing knowledge base for cross-border environment. The discussed example concerns Polish-Slovak cluster, focused on research of innovative methods for monitoring the safety of structure using fiber Bragg grating sensors.

*Key words:* cluster, knowledge processes, cross-border cooperation

**INTRODUCTION**

Knowledge processes make development of modern enterprises more dynamic and drive their innovation. Knowledge as a resource is appreciated especially by those companies that see opportunities to strengthen competitiveness through innovative products, services, organizational or marketing solutions. Although the dominant form of market behaviour is still competition, more and more companies seek to integrate with their market partners, business environment, and even competitors [11]. In developing such cooperation borders are exceeded, in the first step of neighbouring countries. Popularity of clusters and networks is growing, facilitated by, among others, availability of EU funds to allow the financing of their activities on an international scale. Participation in clusters is a mobilization for companies: to determine their own development strategy, involvement in pro-innovative initiatives on a scale beyond the interests of a single entity, closing to the scientific community, as well as to acquire new knowledge.

The paper discusses the example of setting up a Polish-Slovak cross-border industrial and technology cluster, aimed at developing knowledge base of its participants, in terms of application use of innovative methods for monitoring the security of large-scale structures using fiber Bragg grating sensors. The aim of this paper is to assess the knowledge processes in the cluster, on the background of specific characteristics of cross-border aspects of benefits for its participants: universities, companies and NGOs [16]. The paper is closed with recommendations for the further development of the cluster. This paper is part of the project: "Industrial technology cluster – a pro-economic development of the Polish-Slovak border innovation and new technologies network", conducted in 2011-2013, thanks to the funding of the CBC Programme Poland-Slovak Republic 2007-2013.

**KNOWLEDGE PROCESSES IN INNOVATIVE ORGANIZATIONS**

Knowledge is an intangible asset, forming as a result of the systematic development of skills, experience and the identification and exploitation of opportunities, as well as avoiding the risks [22]. Knowledge is gathered in the minds of men, documents, databases, etc. It includes the organization and competence of its staff, its generating and imitative capacity, as well as skills used in business processes, including innovation processes in both organizations, as well as at the inter-organizational level [4].

The processes of knowledge are intangible, and concern development of own and external knowledge within the organization structures, codification instruments, transfer of knowledge and its use in an organization, product, etc. [8]. The organization obtains knowledge basically in its outside environment [9], among others through active participation in the market, thanks to the cooperation with universities or clusters. Development of knowledge in the organization concerns earlier gathered knowledge (e.g. knowledge of workers) which can be identifiable, possible to develop and use [19]. Codification of knowledge relies on selection, storage, updating and sharing of this knowledge in an accessible and understandable form, so that it can be later used in practice. Transfer of knowledge allows it to reach out to anyone who can use this resource effectively. Transmission and absorption may involve both explicit knowledge, as well as hidden, and the transfer process can take place in a formal way (through the primary means of communication in an organization) and in an informal manner, mainly through personal contacts. The use of knowledge in a practical way is a confirmation of purposefulness of the realized knowledge process, and the ability to capitalize knowledge should be reflected in, among others, implemented innovations. The effect of knowledge processes include increase of knowledge, resulting from the feedback process by which the effects of

completed knowledge process are at the same time an input data to a subsequent process [9].

Creating an added value is an important attribute of a knowledge-based organization, which is characterized by, among others, manufacturing products rich in knowledge, employing knowledge workers, having a high potential of intellectual capital and a good relationship with the environment, from which it also acquires knowledge [6]. Relations with the environment are a platform that allows organizations to transfer valuable knowledge from outside and confront it with their existing knowledge, resulting in the conversion of knowledge and forming its new resources [15]. Knowledge-based organizations are looking for attractive opportunities for its acquisition, display activity wherever chances of access to valuable knowledge are drawn, as well as try to create conditions favourable to the transfer of knowledge from the outside.

### KNOWLEDGE CLUSTERS

Cooperation with competitors can be a valuable source of knowledge acquired from the environment [12]. Joint acquisition of knowledge is one of the most important aspects of joining the cluster by businesses competing on a day to day basis. A cluster is a geographic concentration of interconnected companies, specialized suppliers, service providers, companies operating in related industries and associated institutions (e.g. universities, professional associations, etc.). Cluster participants (mostly companies) fall in mutual interactions, competing with each other, but also co-operating [18]. Clusters can be defined as binding structures, mutually integrating and driving the flow of knowledge [2, 3]. Cluster environment is conducive to innovative behaviour of all entities: enterprises are mobilized to achieve their goals through innovation in market, and business environment institutions and research centres actively join innovation processes at every stage to receive in return, not only a contact with business practice but financial income as well [1]. Key features of clusters are [20]:

- spatial and sectorial concentration of companies in one or a couple of industries,
- formal and informal nature of cooperation of cluster network participants: businesses, business environment institutions, governments, universities, etc. [7]
- specialization of entities in the cluster,
- flow of knowledge, technology and innovation among clusters participants.

In some clusters, more intensely than in others, there is a process of diffusion of knowledge, held by its transfer between enterprises, scientific institutions, consulting companies and research institutions, business environment, etc. The carriers of knowledge in clusters include: entrepreneurs, local governments, consultants, researchers, and others [21]. Among the many types of clusters, emphasis on joint development of knowledge is observed in so-called "Knowledge clusters". They integrate companies for which priority is knowledge, information, patents and inventions, obtained through access to research, research institutions and universities [14]. This type of clustering are distinguished by [13]:

- faster commercialization of knowledge,
- dynamic development of intellectual capital,
- increase in trust between the partners,

- reducing operating costs through the use of infrastructure, among others, back laboratory research, business services and training,
- increased ability to obtain external funding,
- greater complementarity of knowledge,
- improved innovativeness and competitiveness through the creation and implementation of new innovative solutions, new technologies.

The strength of knowledge-based clusters is the ability to enhance the competitiveness of their participants by expanding a strong network of relationships with universities, businesses, public authorities and engaging in a continuous process of innovation, increasing synergy effect [13]. Despite many barriers to business cooperation with universities [12], science-business relations are developing dynamically, also through clusters. Participation in clusters allows scientists to get closer to the issues of economic practice, as well as facilitates the commercialization of knowledge, if it is perceived as an attractive and useful in terms of application. The effectiveness of commercialization is conditioned by the efficiency of knowledge processes occurring in clusters. Knowledge transfer involves the transmission of structured and interpreted bundles of information relating to various areas of knowledge such as economic, technological, etc. Depending on the nature of the transferred knowledge, it contributes to creation of different types of innovation in clusters and participating companies [22]. The following channels of knowledge transfer can be identified within a cluster:

- benchmarking groups,
- development centres, institutes of technology and universities, concerned with education and training of employees,
- mutual cooperation programs,
- joint projects and research and development,
- joint initiatives in the field of manufacturing and product development,
- activities of clusters integrators such as industrial associations [17].

Companies participating in clusters obtain knowledge and share it on the basis of direct (formal and informal) links with other cluster participants, as well as in external relations of the cluster with its environment. The dynamics of the transfer of knowledge and the transfer of knowledge between the companies forming a cluster depends on, among others, the frequency of interaction between cluster participants and the density of network links between them [5].

### TECHNOLOGICAL INDUSTRIAL CLUSTER ON THE POLISH-SLOVAK BORDER – CASE STUDY

One of the key objectives of the EU's cohesion policy is to strengthen the peripheral marginalized areas, with less potential for development, which include, among others, border areas. On the Polish-Slovak border, an instrument of support for socio-economic development is Cross Border Cooperation Programme Poland-Slovak Republic 2007-2013 ([www.plsk.eu](http://www.plsk.eu)), which through the European Regional Development Fund, funded include network of projects, implemented jointly by at least three partners.

The project "Industrial technology cluster – a pro-economic development of the Polish-Slovak border innovation and new technologies network", was implemented in 2011-2013, as a network project of: University of Bielsko-

Biala, University of Zilina and the NGO CEIT in Zilina. The idea behind the project was to transform the established network of partners into a cross-border cluster. The activity of this cluster would focus on the research of application methods for monitoring security threats of large objects using optical fibre Bragg grating sensors. As part of the activities dissemination of the results of the cluster Polish - Slovak research was planned. The rationale for the selection of the described research topic is the significance of public safety issues in the Polish-Slovak border, in terms of socio-economic development of the area. Specific climatic conditions (high snowfall), and degradation of technical infrastructure has similar security threats around the border. Bridges, industrial buildings, such as warehouses are exposed to vibration and overload, resulting in, among others, a danger of collapsing (e.g., under the pressure of the snow).

So far, the threats for large-scale structures were not monitored in a 24 hours system in the borderlands. Popularization of innovative methods of research on these issues can significantly improve the level of public safety of bridge as well as industrial and large public buildings users. A comprehensive solution to the common problem of improving the security of the borderlands is, in a special way, interesting for parties responsible for creation and operation of such infrastructure, including: construction engineers, construction companies as well as the users and managers of these objects (e.g., local governments and businesses). Indirectly involvement in the cluster can also contribute to improving the economic competitiveness of entities involved in design, manufacture and exploitation of large-scale structures. The creation of cluster had been preceded by the implementation of two research components:

1. the research of safety level of two selected objects in the borderlands; development of methodology for such measurements, using optical interrogator with fibre Bragg grating sensors, for other common objects in the borderland.

2. the research of demand for knowledge and innovation in industrial companies in the borderland.

Conducted research helped to define the following specific objectives of the cross-border cluster for the first five years of its existence:

- a) the intensification of cooperation in the field of opportunities to improve public safety and the dissemination of results of scientific research among entities responsible for creation and exploitation of technical infrastructure, among others, designers of these types of constructions, construction companies, users and managers of these objects (e.g., local governments and businesses);

- b) the desire to improve public safety in the field of exploitation of large-scale structures and the transfer of knowledge on innovative methods of research in the field of construction safety to businesses, governments and other institutions and bodies outside the cluster on the Polish-Slovak border, interested in these issues;

- c) the exchange of knowledge and good practices, among others, in the application of innovative methods for the diagnosis of large-scale structures using optical fibre Bragg grating sensors;

- d) common education in methods of care for the safety of large-size structures;

- e) animation of further development of scientific research and the resulting Polish-Slovak innovation networks

and modern technology in a direction aligned with the needs of the Polish-Slovak borderland.

The cluster was created in December 2013. At the moment two universities (University of Bielsko-Biala, and University of Zilina) and two non-governmental organizations (CEIT of Zilina and Bielsko Foundation for the Support of Entrepreneurship and Culture in Bielsko-Biala) are participating in the cluster, as well as seven companies from Poland and Slovakia. Given the nature of the cluster and its goals, it can be assumed that it should develop in the coming years, taking the form of both the technological and industrial cluster, as well as a research cluster, based on knowledge. In first case, this cluster will stand out in the field of cooperation between a group of companies and non-governmental organizations, strongly oriented on innovative technologies and closely associated with scientific units, which in this case were the initiators of the creation of this cluster. In terms of the research cluster, based on knowledge - one can identify the regional concentration of entities engaged in research and entities benefiting from their results [14]. It is particularly important for participants in this type of cluster to have access to research, research institutions and universities [14]. Transfer of knowledge in the cluster will be a two-way one: the participating companies will implement the results of research conducted by universities operating in the cluster, and scientists perfecting the methodology of monitoring of large structures using optical fibre Bragg grating sensors will benefit from the opportunity to observe these structures in real conditions of their operation, which will significantly improve the conditions for the implementation of research and strengthen their application functions.

In a situation where the cluster is operating at the junction of at least two countries, external factors affecting its operation are rather complex. The environment in which the cluster operates shapes both behaviour and attitudes of its members (companies, universities, non-governmental organizations), as well as the market in which participants of the cluster operate. The implementation of goals of the cross-border cluster presented above, should also take into account specific conditions of its specific environment. Among factors conducive to development of cross-border clusters, one can point:

- an incentive for companies from EU, national and regional authorities for strengthening innovation, making cross-border cooperation and joint implementation of research and development projects,
- additional financial support from the EU, aiming at development of borderlands, including the establishment and development cross-border networks of clusters,
- dissemination of good practices resulting from the cooperation within the cluster, reinforcing a sense of confidence, awareness and benefits of cooperation,
- similar conditions of doing business on both sides of the border, as well as market situation of the companies participating in the cluster, identical needs and expectations, especially in terms of technological development and growth of innovation and competitiveness,
- construction of support structures for cross-border partnerships between businesses, NGOs, governments, universities, the development of information exchange platforms.

Disincentive factors for functioning of cross-border clusters include, among others:

- a complex system of gaining EU support for the development of cross-border clusters,
- shortage of funds to sustain the activity of clusters at the end of their funding by the European Union,
- lack of an integrated cluster policy on both sides of the border (e.g. at the level of districts, provinces, etc. ), lack of coordination in this respect,
- lack of real incentives to develop cross-border cooperation (beyond common use of the European Union funds),
- shortage of experts and managers specialized in cluster management, in particular cross-border ones,
- language barrier, cultural worldview, etc.

Short lifetime of the cluster does not allow for an assessment of its effectiveness in terms of knowledge transfer and implementation of other objectives. A difficult moment the cluster financed from EU funds is a completion of the project and transition to self-financing settlement, resulting in a need to raise funds to its continue operations. One of the critical factors, deciding on the stability of the cluster can be the efficiency of knowledge transfer processes between its participants, as was the purpose of its creation. The transfer of knowledge from academia to other participants of the cluster is, in terms of the sustainability of this project, mandatory for a period of the next five years of cluster activity. Cluster animators, however, should put a special emphasis on the parallel transfer of knowledge between companies in the cluster, and the integration of Polish and Slovak members of the cluster. This will require overcoming the language barrier, developing a communications platform for cluster participants through the portal [www.ptklaster.eu](http://www.ptklaster.eu), but also will provide the participants with the possibility of personal meetings and establishing bilateral relations, in order to build mutual trust and foster cooperation.

In the border regions of Poland and Slovakia more and more clusters and networks are working, but few of them go beyond the area of one of these countries. However, many things indicate that in the coming years, cross-border clusters may become an important area of integration on the Polish-Slovak borderland, mainly economic and academic environment. Facilitated by the availability of EU funds support for cross-border cooperation, but at the same time by picking a requirement of at least 5-year-old sustainability of tied partnership.

Creating cross-border clusters requires, on the part of their animators, to take action that goes beyond standard procedures associated with such initiatives. The point is to overcome the following barriers: language, spatial, administrative, organizational and communication, allowing the creation of cross-border cooperation platform in the cluster, not discriminatory for either party. Rarely do we deal with the implementation of such initiatives without external support, mainly the EU one. In the years 2007-2013 and 2014-2020 a significant pool of European Community funds will be allocated to the development of innovation and the construction of knowledge-based economy, among others, through the development of clusters and networks.

The activities of the described cluster focuses on researching industrial applications of innovative methods for monitoring the security of large-size structures using optical fibre Bragg grating sensors. The subject of cooperation positions the cluster as almost a niche one, addressed to

companies, institutions and organizations interested in tracking the development of the application of this method, for example, due to the exploitation of this type of constructions: bridges, viaducts, halls, etc. It is essential to conduct among these entities, a recognition of their problems associated with current monitoring of the safety of these structures, themes of interest in the use of innovative technology, developed by the cluster and realistic expectations in terms of the collaboration. This cluster should thus constitute a reservoir of high-quality knowledge concerning the use of the above mentioned methods, in terms of cooperation in order to improve the level of public safety of industrial users of bridges and large public buildings. Relevant actions to be taken for the further development of the cluster are [10]:

- acquiring new cluster members on both sides of the border,
- developing research topics in the cluster according to the interests and needs of its participants, going beyond currently defined research issues,
- promoting, so-called good practices, resulting from the effects of research, primarily disseminating information about performance benefits that can be obtained through the use of innovative security monitoring design technology,
- financial security of the cluster,
- professionalization of cluster management, including elimination of barriers in cross-border contacts and barriers in science-business cooperation.

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