CLUSTERS AS THE ELEMENT OF ECO-INNOVATIONS PROMOTING IN THE EUROPEAN CONSTRUCTION ON THE POLISH EXAMPLE

Renata STASIAK-BETLEJEWSKA

Institute of Production Engineering, Faculty of Management,
Czestochowa University of Technology

Abstract

Sustainable development as a key strategy of the European Union is a determinant for the creation of regional policies aimed at supporting innovation process. Eco-innovations in the field of construction are a part of the sustainable development strategy of European countries. There are different kinds of institutions and its initiatives that are part of a part of innovation transfer playing extremely valuable role for promoting eco-innovation in the European Union. Clusters are both a part of supporting innovation strategy and a tool of tool of the individual industries achievements promoting in the context of competitive economies. Clusters create a friendly environment for the innovative initiatives creation and contribute to the enterprise competitiveness development in the international arena. The article presents an analysis of selected cases of Polish clusters as part of the eco-innovation supporting system in the energy saving construction industry. There are presented examples of Polish cluster initiatives with particular emphasis on the analysis of projects in the field of the energy-efficient construction, as an element of Polish policy of innovation promoting.

Key words: *sustainable development, eco-innovation, construction, eco-building, cluster*

Introduction

The results achieved by the company, despite the noticeable effects of the recent crisis, show that the period of transformation has helped to shape an economy based on solid foundations and rules of operation. Poland's economy is heavily dependent on the Euro zone countries, where the economic situation is still unstable. Furthermore, the increasing degree of internationalization of the economy, manifested in, among others, increased dynamics of networks of cooperation and trade relations, as well as the challenges of the sustainable development, increasingly pose a threat to the economy in the future. Maintaining a relatively high growth rate will therefore require accurate identification of market opportunities and threats, as well as anticipation, enabling economic potential, mainly through increased innovation and adaptability of enterprises.

Data related to Polish accession to the European Union in 2004 show, that the indicator of expenditures on the innovation activities in relation to GDP has increased more than 4 times. The share of public funding to support innovation

in Poland increased from less than 0.10% of GDP in 2004 to 0.45% of GDP in 2010, mainly due to rapid growth in spending of EU funds. At present, Polish entrepreneurs have the opportunity to benefit from extensive portfolio of support instruments in the R&D&I (Research, Development and Innovation) area. Analysis of the available programs supporting the innovativeness 2007-2013 show functioning of 60 supporting instruments directly or indirectly aimed at the innovation development in Poland. These instruments are very diverse and its characteristics are following: coverage (regional/nationwide), source of funding (state budget/structural funds/other international programs), target group (entrepreneurs/others), the form, the implementing institution (e.g. PARP – State Agency for Entrepreneurship Development, NCBiR - National Centre of Research and Development, Marshal Offices, Regional Offices, regional authorities set up to implement support programs). There are about 25 supporting instruments, that are implemented in the framework of regional operational programs financed by the Structural Funds in period 2007-2013. Other 30 instruments are implemented under the national operational programs. Operating programs include actions that promote both R&D and human capital, as well as specialized services to enterprises (technology parks and incubators, counselling). The system itself providing financial support is dominated by subsidies granted regardless of the degree of risk associated with the project.

The main pillar of the current system for financing R&D and innovation is the Operational Programme for Innovative Economy 2007-2013 directed mostly to entrepreneurs. The programme supports projects of supra-regional importance within technological innovation in products and processes and innovation in the field of the product and service sectors design, which directly or indirectly contribute to the formation and development of innovative enterprises. The supportive and promoting programmes concerns innovative activities with the nature and extent that generate the highest added value for the economy and enterprises by strengthening the competitive ability of the Polish economy in the international dimension. The other important factor is also existence of the Special Economic Zones, which are administratively separated areas in Poland, where investors can pursue economic activity on preferential terms. The purpose of this supporting instrument is to accelerate regional development by attracting new investment and promoting job creation. There is also a programme of the investments supporting for Polish economy for 2011 – 2020 that was elaborated by the Ministry of Economy and implemented in 2011. Its objective is the innovativeness and competitiveness development through contributing to new investments conducted by Polish and foreign companies. There is also a high importance of National Fund for Environmental Protection and Water Management role in supporting of eco-innovations. Moreover, there is a series of support programs within national budgetary resources aimed at entrepreneurs (e.g. Voucher for innovation).

Innovation should contribute to improve the competitive position of enterprises by allowing for its rapid development and more efficient meeting customer needs and responding effectively to the global challenges (MURA, LÖSTER, 2012). Purchase of the machinery and equipment significantly helped to improve the productivity of domestic economy. At the current stage of Polish economy development, there is emphasis on the greater support for R&D&I actions.

Innovations are defined most frequently in accordance with the Manual of Oslo in 2005, elaborated by the OECD and Eurostat, concerning the rules for the collection and interpretation of data on innovation. According to the above manual, innovations include: implementation of a new or significantly improved product

(good or service) or process, a new marketing method or a new organizational method in a business practice, workplace organization or external relations (OECD, EUROSTAT, 2008).

The service sector is a dynamically growing sector responsible for a significant GDP share. It is indicated as the main driver of the innovation in the service sector with its multidimensional nature in the form of increasing cooperation and bonds between the industrial sector and the services. Innovation in the services consist of implementation of various types of technological, organizational, managerial, or in the field of human capital. An example may be a new method of reaching customers and the use of the latest technological solutions in their use. Innovation in the services sector does not require very intense, a separate state support, because horizontal innovation policy also works on the service innovation. Innovation in the services consist of implementation of various changes' types related to technological, organizational, managerial, or human capital changes.

Innovations in the service sector are related to the sustainable development idea promoted by European Union countries in the last decades. Contemporary construction is focused on the implementation of the sustainable development idea in the production and service field since the awareness of the energy consumption changes became stronger. A number of innovative solutions, that appeared in the construction, are related to ecological and energy saving products.

Eco-innovation is an innovation that improves the efficiency of the natural resources use in the economy, reduce the negative impact of human activities on the environment or enhancing the economy's resilience to environmental pressures. Eco-innovation (OECD, Eurostat 2008) is the implementation in the business practice a new or significantly improved product, service or process, including the implementation of a new marketing method or the work organization method (Oslo Manual, 2008).

Ecological construction is associated with assumption that organization of the buildings and its surroundings should be managed with the way that interferes less with the natural environment, and most importantly, enhancing the conditions of human live. Selected elements of the sustainable construction: a) the avoidance of materials harmful to the environment; b) the right location; c) the house design should focused on reduction of the energy consumption and pollution production. Eco-building is based on the selection of healthy and energy-saving building materials. It uses clean renewable energies and it involves the rational exploitation of buildings and durability of materials. A similar concept, usually on a smaller scale, is a "*natural structure*", which focuses on the use of natural materials available on the spot. It is associated with it also called green architecture. Although most of the programs "*green house*" is not directed at existing buildings, their principles can be used to upgrade existing buildings. Ecological building practices are aimed to reduce the negative impact of the buildings on the environment. The second principle concerns assumption that each building should be as small as possible - reducing the total surface area, better utilization, changing and finishing equipment. Third principle is related to avoiding of the excessive buildings spread (the tendency of cities to growth in a piecemeal manner).

One of the determinant of the ecological level of the construction is the energy efficiency of the building determined by several factors: architectural, technology, thermal insulation and workmanship quality. The energy efficiency is an effect of the collaboration of many elements of the building: architectural, construction and installation. Passive buildings are the latest generation of the energy-efficient buildings. It is with the highest thermal comfort and extremely low demand for thermal energy ratio of maximum 15 kWh/m2/year. Passive construction technology,

as one of the most advanced forms of the energy-efficient construction, has become increasingly popular in Europe and around the world. In Poland it also shows a growing interest in the technology.

Ecological and energy saving construction is identified as the eco-innovation associated with solutions for sustainable development, that are implemented in order to change patterns of the consumption and production by developing technologies, products and services to reduce negative impact on the environment. Eco-innovations has particular importance in the construction market, where the concept of sustainable development is gaining more and more popularity and the number of low-energy passive buildings is steadily growing. The construction is currently going in this direction that the building itself produce energy for its own needs.

In order to reduce negative effects of the construction industry on the environment, the sustainable construction concept based on eco-innovation was created. The assumption of this concept includes design and construction of buildings in accordance to the care about environment and economical use of natural resources throughout the all construction cycle: design, construction work, operation of the building (proper use, renovations, maintenance and modernization) and its demolition. In practice, it includes the use of materials as the most environmentally friendly, reduction of the energy consumption and pollution production, greening of the building and surrounding. The European Commission assumes, that the construction industry is associated with profitable opportunities within significant reduction in the energy consumption and the carbon emission and increasing renewable energy sources share, which can contribute to the achievement of the objective *"3 x 20%"* by 2020. This intention is identified as the goal in the following fields: reduction of the carbon dioxide emission by 2020 by 20% compared to 1990 emission, energy efficiency improvement in the same period by 20% and increase the renewable energy sources share in total energy production to 20%. It is estimated that failure to achieve the mentioned targets would have negative financial consequences in the range of 5 to 20% of the gross domestic product of the European Union. In 2010, the amendment of the Energy Performance of Buildings Directive (2002/91/EC) (EPBD directive) concerning the energy performance assessment for buildings was adopted. The amended directive requires member states to draw up a list of current national instruments and measures in this regard and, if necessary, propose further to 30 June 2011. The provisions of the Directive shall enter into force in Member States not later than 9 January 2013, subject to certain exceptions, related to buildings other than those occupied by public authorities, which will take effect on 9 July 2013. The biggest practical importance of this directive is the building energy ratings system, resulting in energy quality certificates. Energy testimony will have to identify almost every building and dwelling, building collective residential or public, both new and renovated. The extension of the EPBD directive is the EU's Lead Market Initiative (LMI), that identifies six markets with the biggest growth potential, including the construction industry, as responsible for a significant part of the energy consumption and greenhouse gas emission affecting indoor air quality and being a subject to a large part of public procurement. LMI focuses on the following tasks in the field of sustainable construction: the introduction of environmental statements of products, conducting comparison requirements for buildings that meet the criteria of the sustainable development, the introduction of the sustainable development aspects to design through the use of innovative technologies and products, and implementation of procedures related to the calculation of life-cycle cost (LCC - Life Cycle Cost) in public procurement, as well as increasing supply chain efficiency and increase the qualifications of contractors. The policy of the Polish government on the energy

consumption reduction in the construction is determined by the New National Environmental Policy under which assumes modernization of heating systems, reduction of losses in water distribution networks, water conservation, insulation of buildings, segregation of garbage and materials recovery, waste heat recovery and the use a number of other high-tech solutions in the technical infrastructure of towns and settlements. The second document is the Polish Energy Policy by 2020, where the introduction of selected eco-innovative products to market and support selected research in order to achieve energy security, the competitiveness of domestic economic operators improvement and the environment protection have been planned.

An important initiative within was the publication of the EU Commission's Communication on the sustainable consumption and production, and the action plan on sustainable industrial policy, that includes information about Eco-design Directive of 2005 (2005/32/EC) on the general principles for the setting of eco-design in relation to energy-using products (Energy-using Products - EuP). The Directive aims to implement the assessment of environmental aspects into product design, taking into account the phases of its life cycle. Broadening the scope of coverage it will mean a number of construction products affecting energy consumption. The European Union committed itself to promoting green initiatives also through the implementation of the Action Plan for Environmental Technologies (ETAP) under the Framework Program for Competitiveness and Innovation for 2007-2013. European Union has allocated almost € 195 million to fund projects that promote eco-innovation. The aim is to support first applications and market uptake of innovative technologies and practices, bridging the gap between research and development and the business world and overcome the market barriers that currently hamper the development of innovative and environmentally friendly products and services, especially those encountered by European small and medium-sized enterprises.

Legislative changes have increased the demand for tools to support the implementation of the principles of sustainable development of the construction industry. This has resulted in new research directions. These are: conditions of material and utility building materials (their usefulness, modified and new solutions); energetic conditions, the impact of buildings on the environment (including environmental aspects, waste management and recycling used construction materials for construction and reuse of products), the impact of buildings on the indoor environment. Research results have set major trends, which goes towards building combining environmental, social and economical aspects in the form of the low-energy or passive building. The first initiative in the terms of passive houses appeared in the mid-nineties of the twentieth century. In 1998, this type of construction has gained funding by the European Union under the THERMIE program, one of whose objectives was the rational energy use in buildings as well as integration of renewable energies.

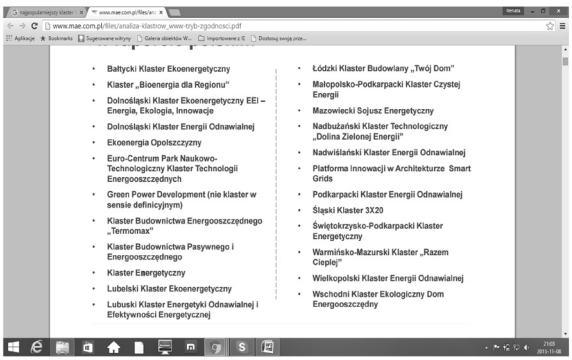
One of the most important goals of the contemporary eco-innovations in the construction is to minimize operational energy intensity of buildings. It is necessary to pay attention to the location of the building, its shape, and location of spaces depending on their functions, so the structure of using solar energy can be planned. In the contemporary eco-houses there is also possible to produce the heat energy generated by residents and its equipment. The appropriate setting of the building in relation to the world and the best possible use of natural light can significantly reduce energy consumption. The use of natural weathering and geographical conditions also allows for natural ventilation of the building. In addition, the use of solar panels and wind turbines and the use of modern insulating materials allow to reduce the energy consumption.

All eco-innovations applied by the construction industry requires following technological advance within construction materials and solutions on the energy consumption reduction. Tracking the changes within the construction solutions on the eco-innovations is possible mainly owing to constant research cooperation between industry and research institutions that provide information about the newest technologies and applications and gain financial support for the innovative projects. Clusters are identified as drivers of innovation and economic growth because the clusters' structure creates favorable conditions for open innovation, promoting cooperation between different market actors in the process of innovation creating, combining complementary skills and competences and involving users in the development of innovative solutions (user-driven innovation). Clusters play a role of a catalysts for lasting changes that will allow more efficient use existing resources and improve productivity and competitiveness of the construction enterprises. The existence of clusters involves the integration of the public support available around selected clusters of key importance and potential competitive economy (by central support services) and individual regions (through regional support), enrolling in an intelligent national and regional specializations. This allows the co-financing development projects within the framework of the promotion of eco-innovation.

Material and methods

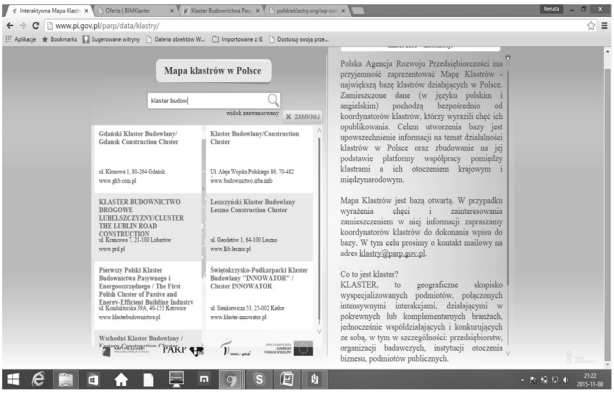
The object of the research analysis in the paper is a group of chosen clusters in Poland, that have been found on the basis of innovative initiatives within the construction eco-innovations. Analysis of the clusters takes into consideration of their efficiency identified by the following data: fields of activity, a number of cluster's members and kind of entities involved in the cluster's activities, a number of the realized projects on the eco-innovations, a quantity and a quality of information on the eco-innovations available on the clusters' websites. Clusters have been chosen with the applying research results of the Report Desk Research on the eco-energy clusters (Fig. 1) and interactive map of clusters in Poland in basis of the searching construction clusters (Fig. 2).

Figure 1. List of the eco-energy clusters operating in Poland.



Source: Market analysis of the eco-energy clusters and others operating in Polish, German and French conditions. Report Desk Research. Pełka 3600.

Figure 2. List of the construction clusters operating in Poland.



Source: based on http://www.pi.gov.pl/parp/data/klastry/ download 30.09.2015.

The research procedure included following stages of the research analysis:

1. A preliminary review of the clusters and available of the information on the clusters activity.
2. Preparation of the clusters' list and list of the key information sources.
3. Review of the chosen clusters' websites with regard to its content on the chosen information criteria: fields of activity, a number of cluster's members and kind of entities involved in the cluster's activities, the offer scope, a number of the realized projects on the eco-innovations, a quantity and a quality of information on the eco-innovations available on the clusters' websites.
4. Selection of the most significant clusters' initiatives (for the eco-innovation trend) and its characteristics elaboration.

Research analysis concerns also the information from the following sources: PARP (State Agency of The Entrepreneurship Development), Polish Ministry of Economy, Ministry of the Regional Development. Choice of the clusters for elaboration is related to its defining.

A cluster is a geographic concentration of interconnected companies, specialized suppliers, service providers, businesses operating in related industries and associated institutions in particular fields while interacting and competing with each other (PORTER, 1990).

Relations between companies and institutions should be understood as a specialization in the economic or business profile associated with a specific product or service - and therefore author uses interchangeably: cluster, cluster and economic specialization. A cluster can include companies from various sectors operating within a value chain. It can also be defined functionally. Companies operating in the cluster are independent - competing with each other, while in some areas they cooperate. In the cluster, there is also important collaboration between companies with related institutions belonging to the R&D sector (universities, research institutes, educational institutions), business support infrastructure (science and technology parks, certification institutions, advisory firms) and public administration. It is assumed that the cluster is a

concentration of companies and institutions, which are characterized by a high level of various kinds of interaction, functional relations and cooperation (in the competition). These characteristics and the collection of various types of specialized actors and resources (agglomeration effects) are the key to high innovation and competitiveness of a given cluster. Clusters are developing so on the basis of the knowledge transfer, innovation and the best use of the resources available in the cluster location. It is due to intense interaction and cooperation, dialogue and coordination that occur with the natural competition between actors in the cluster. Competition optimizes the use of resources inside enterprises (and other entities) and stimulates innovation. Cooperation can while optimizing the use of internal and external resources and allows innovation through a new combination of different resources, knowledge and couplings return (Polish Ministry of the Economy, 2013).

Cluster development constitutes primarily the development of businesses that create a large cluster, including the creation of new companies and their inflow from the outside (for example in the form of foreign investments). A manifestation of cluster development is also inflow of capital and human resources. New clusters can also arise on different sectors and already existing clusters (e.g. energetic, material engineering). The development of the cluster is determined not only by the potential of individual companies operating within clusters, but also the quality of the environment and the use of specialized external resources. In particular, educational institutions educate staff who have expected qualifications and competences and research units generate the knowledge and pursue research that can be used by companies of the cluster and prepared to work with these companies. The development of the cluster is also determine by the quantity and quality of relationships - internal and external environment - created by entities operating in a given cluster.

In a cluster, there are implemented joint ventures, business (including joint research and development), which on one hand are a derivative of the market needs and impulses, on the other hand - an adequate flow of information and the readiness and preparation of entities operating in the cluster for joint action. In particular, the cluster may include several cooperative relations. The adoption of formulated above understanding of the cluster concept implies that cluster policy may cover a number of activities and instruments aimed at supporting the development of specific clusters of companies and institutions. The purpose of this policy is a cluster development in normative terms that facilitates a high level of interaction and cooperation leading to the strengthening of existing competitive advantages and create new ones.

The above concept of clusters and development policies based on clusters is combined with the concept of smart specialization (smart specialization), promoted by the European Commission as a way to organize development policy, improving the efficiency of spending structural funds and increase synergies between different EU policies, national and regional (FORAY et al., 2009).

Intensification of clustering processes in the Polish economy in the perspective of 2020 resulted in a significant increase of the competitiveness and innovativeness. Increased level of interaction, collaboration and the knowledge flow resulted in new and innovative projects and better use of available resources, both private and public. Intensified cooperation with the R&D sector led to a more rapid transfer of the knowledge and technology, as well as increasing the intensity of private investment in R&D. As a result of inter-sectoral collaboration there was developed a new, intelligent specialization and modernization of the economic structure and development of sectors that generate high added value. Development of international cooperation of clusters had the effect of greater openness of the Polish economy and Polish businesses

and the inclusion of clusters in international value chains (cooperation links), which involved, among others, the inflow of foreign investment into the country.

Functioning in the Polish economy clusters are characterized by different economic potential - from local clusters, affecting the local economy ecosystem, through key regional clusters which are engines of economies of individual regions, the national clusters key, recognizable and able to compete in international markets from other significant economic centres that define international competitiveness of the Polish economy. The vast majority of clusters is, however, local or regional importance. A characteristic feature of the key clusters in Poland (national and regional) are: increased intensity of the research and development (realized to a large extent by the operating their businesses) and the use of the knowledge and strong interaction between companies, universities and research institutes (flow of workers and knowledge, shared R&D projects, cooperation and communication, etc). The development of these interactions stimulates innovativeness of the companies in clusters and enables technology transfer and commercialization of the knowledge. These interactions contributed to better align education and ongoing research into the needs of businesses, leading to the creation of new resources and competitive advantages of the companies. Cluster development is also marked by development of cooperating universities and R&D entities (DZIERŻANOWSKI, 2012).

The national key clusters compete on a global scale and have an international dimension - which means that the companies operating within the cluster are intensively involved in a trade exchange (a large share of export) and international value chains. Other entities operating in these clusters, such as universities and research institutes, participate in international networks of relationship. These clusters are strong links in the collaborative networks of European clusters and build their global competitive position.

Results and debate

1. The First Polish Cluster of the Passive and Energy-Efficient Construction

The first construction cluster was founded in 2008 as the First Polish Cluster of the Passive and Energy-Efficient Construction located in Silesian region in Poland. In the case of the analyzed cluster the intention of cooperation became development of the common activities in the field of designing, building and managing buildings energy efficient. This is achieved by combining the resources of individual members of the Cluster and the common pursuit of learning, mainly empirical, in the field of energy-efficient construction and its dissemination and offering on the market in the form of comprehensive services. The members' group of the cluster includes: Silesian technical universities, Polish Institute of the Passive Construction, the Chamber of the Construction Engineers, designers, companies providing energy-efficient buildings for the energy-efficient and passive houses.

The Upper Silesian Industrial Park plays a role of coordinator of the cluster's project. One of the project is "*Construction of energy-efficient office administration building for the needs of the Upper Silesian Industrial Park in Katowice*". The project program is implemented within Regional Operational Program of Silesia in 2007-2013 in the frame of action No 1.3 Technology transfer and Innovation. The amount of the fund within the project is 4.931.116,91 PLN.

Cluster was established to (The Agreement on Cooperation in the framework of a project called: *"The first Polish Cluster of Passive and Energy Efficient Construction"*, 2008):

1. initiate projects using modern, energy-efficient and green technologies in construction,
2. develop a program of research - Development Cluster,
3. take action to raise funds for implemented by Cluster research and development and its functioning, in particular from the European Union budget and from the State budget and from local government units,
4. publish and promote the results of research work in order to be as the widest possible use by entrepreneurs,
5. promote, support and integrate the activities carried out by cluster partners arrangements for dissemination of modern, energy-efficient and environmental technologies used in construction,
6. participate in projects, both domestic and foreign, prepared with the aim of clusters,
7. the establishment and development of information technology and information related to cluster promotion, the creation of an online database about products, applied technologies, training, trade shows, conferences, and services provided by the parties,
8. organize training conferences and workshops on the construction industry and related industries, which will be promoted modern, energy-efficient and green technologies,
9. efforts to organize and ensure the participation of Parties in the exhibition concerning the industry construction,
10. promote a cluster in the domestic market and abroad,
11. encourage other entities to join, action and cooperation within the cluster,
12. attracting investors for investment activities within the cluster,
13. take action to create a field of study in the field of modern construction technologies.

Clusters' members initiatives were financed from own resources of the Cluster coordinator. In 2010, the Cluster gained the support of the Polish Agency for Entrepreneurship Development, under Measure No 5.1 for realization of the project concerning development of the cluster. The aim of the project is to support the development of cooperative entities within the cluster, in particular between enterprises and business environment institutions and scientific. It allows for easier transfer of the knowledge within R&D and its practical usage in enterprises, and to achieve synergy effect through the joint promotion of new technologies and the associated new services, joint training and cooperation in the provision of market services, as well as common use expensive, specialized equipment. Key to the development of cooperative relations and thus the project is:

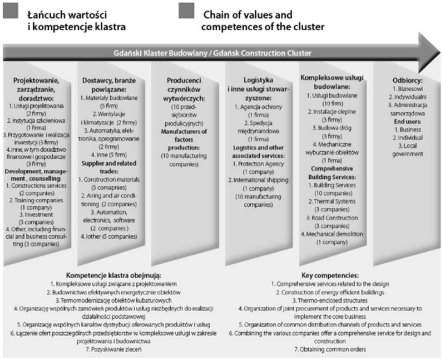
- creation of laboratory facilities and hardware,
- intensify the exchange of knowledge between members of the Cluster,
- gaining knowledge of the results of R&D research from the outside connections,
- obtaining reliable test results of the energy consumption and the energy-efficient and passive houses.
- Cluster has own laboratory in the form of energy-efficient house project that assumes:

- the use on eight floors 5 different HVAC systems,
- the use of diverse energy sources,
- monitoring technology used to formulate practical conclusions,
- installation and testing tri-generation system enabling the production of electricity, heat and cooling gas,
- the heat recovery from ventilation.

2. Achievements of the Gdansk Construction Cluster

One of the most successful construction cluster in Poland is the Gdańsk Construction Cluster that was established in 2007 by 18 founding members in the Pomeranian region in Poland. It consists of companies that have technological potential and, most importantly, rich experience in the application of the modern eco-innovative construction technologies. Apart from standard industrial and infrastructure construction, one of the major tasks executed by GKB is cubature construction effective in terms of energy, in particular low-energy and passive housing. The goal of cooperation is to create mechanisms ensuring or facilitating access to knowledge, transfer and implementation of the most recent technological accomplishments, reduction in costs of current activities, and, at the same time, achievement of a permanent, above-average increase in competitiveness of the cluster entities. The crucial role in the analyzed cluster is determined by cluster's coordinator that is Gdansk Construction Cluster Limited Liability Company which coordinates consortium of 52 enterprises from the Pomeranian region, mainly from the construction industry, employing over 3,000 employees. GKB cooperates with local government units, state administration and scientific-research environments, including Gdansk University of Technology and Polish Institute of Passive Housing. The main goal of analyzed cluster is inspiring actions aiming at simplification of administrative procedures, significant from the point of view of the investment process, contribute to increase investment attractiveness of the whole region through the development of product-technological platforms and promotion of regional brands. The main object of cooperation between the cluster entities is construction effective in terms of energy (PARP, 2011). The fields scope of the cluster activity is presented in Figure 3.

Figure 3. Chain of values and competences of the Gdańsk Construction Cluster.



Source: PARP (2011). Clusters in the Pomeranian voivodeship. Warszawa.

GKB offers to the cluster participants services with regard to (Gdański Klaster Budowlany, 2015):

- organization of joint product orders and services necessary for conducting basic activities,
- organization of joint distribution channels of products and services being offered,
- combination of particular offers of companies in complex services with regard to design and construction,
- exchange of market information by means of product-technological platforms available for the cluster participants, – obtaining orders.
- The offer product of the Gdansk Construction Cluster concerns three major specialization areas (PARP, 2011):
- effective construction in terms of energy, based on technical and organizational solutions, ring very low coefficients of demand for thermal energy and electric energy from the network;
- thermal modernization of cubature facilities, consisting in modernization of existing facilities, installations, heating devices and lighting, in a way enabling to obtain, in the long run, the best operational parameters;
- design of gas stations using the most recent accomplishments of both heating, thermal insulation and lighting technologies, which shorten standard, actual period of depreciation of outlays by 50%.

The analyzed cluster is associated with projects on the eco-innovative construction solutions that concerns effectiveness, ecology and energy sector as the effect of the synergy. It was identified as the one of the most successful construction cluster since in 2010, the Gdańsk Construction Cluster received the title of key cluster in the Pomeranian Province within activities on the design of estate of multifamily passive houses. The cluster is also organizer of the conference on *„New development possibilities, SMART 3E construction, efficiency-ecology-energetics"*.

Construction called Smart 3E, the effectiveness of ecology, energy is the field of activity of Baltic Eco-Energy Cluster, that includes 176 entities, and Klimopomerania Cluster that includes 12 entities. The sale of mentioned clusters' products is estimated at 2 billion PLN per year, and exports at 0.4 billion PLN. Along with housing associations it was decided to allocate an amount of 40 million PLN for investments connected to the green building. All activities related to the production, services and implementation of new technologies are carried out in accordance with the principles of the sustainable development as the three main aspects - social, economic and ecological. The planned ventures will be guided by innovation and cross-regional dimension of specialization. The Gdansk Construction Cluster cooperates on the eco-innnovations within cooperation network with the Green Building Cluster of Lower Austria. The main field of this cooperation is exchange of information on the construction of low-energy buildings.

3. The Central Polish Construction Cluster

The Central Polish Construction Cluster was founded on 12 December in 2008 and it was initiative of three entities (Regional Development Agency *"ARREKS"*, ASM Centre for Market Research and Analysis and Technical University of Lodz) involved in the project REG CON, co-financed from EU funds. Cluster coverage includes the central Polish region with a particular focus on Łódź and Mazowieckie province and

the region Kleszczów. The location of the cluster wasn't determined only by direct access to mineral resources (coal, lignite, clay, sand, chalk lake and others) and useful waste materials (ash from burning coal and synthetic gypsum), but also by convenient transport links with other regions of the country and the concentration of suppliers technologies, products and services. A characteristic element of the region economy, except of the mining and energy sector, is formation of the construction industry focused on innovative solutions.

The mission of the Central Polish Construction Cluster is to encourage small and medium-sized enterprises to cooperate in order to implement new technologies in the construction and transformation of the building sector in an innovative industry that meets the expectations of the region's inhabitants. The mission of the cluster is implemented in six areas:

- the brownfield revitalization of urban areas in Lodz and rehabilitation of the environment within the municipality Kleszczów;
- the sustainable development in the construction and environmental engineering;
- recycling of the construction materials, promotion of new technologies for highly processed materials used in construction, promotion of new methods in geotechnical foundation;
- promotion of safety at the construction site;
- creation of an effective strategy in the areas of marketing, public relations and human resources;
- increasing interest in and commitment to the cluster members in the implementation of joint innovative projects.

Strategic objectives of the cluster include:

1. Strengthening cooperation between SMEs of the construction industry in the region, in order to implement larger projects, which individual companies would not be able to implement organizational reasons and financial services.
2. Development and promotion of a single, strong brand bringing together SMEs in the construction industry in the region, in order to increase clout at the regional, national and international levels.
3. Establishing cooperation with universities on technical fields and mathematics and natural sciences, as well as secondary schools in order to promote and encourage young people to education in the fields of technical profile and construction.
4. Cooperation of SMEs in the construction industry in the region, in order to facilitate access to financing investments, including through loans, which small companies have limited access.
5. Development of export products and construction services by companies from the region, which will help expand markets and increase profits.

4. The Cluster of Construction Innovations

Construction Innovation Cluster is a joint initiative of the Foundation for Entrepreneurship and Culture Support in Bielsko – Biała in Poland and University of Technology and Humanities in Bielsko-Biala, Polish Chamber of Commerce Building and companies from the construction sector. Formalized cooperation initiative was

formed in September 2010 and it is continued to build its brand on the basis of new cluster's participants. The mission of the network connections is a support of the enterprises development through cooperation of research institutions, business environment of the business arena innovative construction industry. Construction Innovation Cluster have the following goals of the activity:

- increasing the companies competitiveness (through introduction of innovative technical solutions and technologies);
- enabling participants to establish relationships that lead to cooperation;
- creating conditions for generating investment projects based on the Cluster's members resources;
- establishing cooperation with domestic and foreign business organizations, clusters and entrepreneurs, participation in international fairs and trade missions;
- creation of the center for certification of building materials;
- initiating exports of goods and services cluster members to foreign markets;
- the use of the scientific and business resources of clusters' members to conduct research on the eco-innovative solutions within construction;
- organization of cluster members in consortia and commercial companies in order to submit tenders for public contracts and private;
- initiating cooperation with regional authorities;
- common obtaining grants from the EU.

The cluster cooperates with similar cluster entities in Czech Republic and Slovakia.

5. Development of the energy-efficient construction network in Western region of Poland

Wielkopolska Renewable Energy Cluster is a network of the energy - efficient construction that was founded in 2013 as the initiative of Polish Chamber of Commerce of Importers, Exporters and Cooperation within implementing the project *"Promotion and development of Wielkopolska Renewable Energy Cluster - network of energy-efficient construction"* financed from the Wielkopolska Regional Operational Program in the scope of measure No 1.6. The project is aimed at enhancing the competitiveness of the construction companies from Western region in Poland within renewable energy sources, with a particular focus on the intelligent systems and industrial automation for (Polish Chamber of Commerce of Importers, Exporters and Cooperation, 2015):

- spreading of the energy saving technologies application in the construction,
- the development of specialist expertise on economic and environmental benefits resulting from energy-efficient construction,
- development of cooperation between construction companies with universities and scientific research institutions to identify technological needs, conduct research, transfer of knowledge and technology,
- identify and collect best practices of investment and using the experience of companies and universities (members of the cluster),
- joint promotion created within the cluster networks, whose aim is to realize the potential and future customers about the benefits of ecological and economical use of facilities are built in as low-energy standard.

The main goal of the clusters' project is strengthening the competitive position of Wielkopolska enterprises by supporting the development of links between enterprises and business environment institutions, including research units operating as part of Wielkopolska Renewable Energy Cluster.

Conclusion

The sustainable development today is a determinant of the activities within political, environmental, social, economic, both internationally and nationally conditions. Eco-innovations a the element of the sustainable development idea is one of the elements of Polish clusters initiatives within energy-efficient construction solutions.

The key goal of the clusters in Poland is cooperation of companies and research entities within partnership network that is aimed at realization of the advanced project supported by European funds. Polish construction clusters combine the capabilities of many market actors in order to accelerate their development and enable the innovation transfer and promote industrial cooperation with universities. The most important benefits of cooperation in clusters include: the knowledge exchange, experience and technology joint offers, which reduces many important for business operations costs (e.g. marketing and promotion, logistics, etc.), the efficiency improvement through synergy of the cluster's enterprises innovativeness and competitiveness increase.

Bibliography

1. DZIERŻANOWSKI, M. (2012). Directions and assumptions cluster policy in Poland by 2020. Recommendations of the Working Group. Cluster Policy. PARP. Warszawa.
2. PARP (2011). Clusters in the Pomeranian voivodeship. Warszawa.
3. FORAY, D., DAVID, P.A, HALL, B. (2009). Smart Specialisation – The Concept. Knowledge Economists Policy Brief No. 9, June 2009.
4. Guide to Research and Innovation Strategies for Smart Specialisation (RIS 3). (2012). Smart Specialisation Platform. http://s3platform.jrc.ec.europa.eu/home).
5. Gdański Klaster Budowlany. http://gkb.com.pl/ogloszenia/aktualnosci/# download 15.09.2015
6. MURA, L., LÖSTER, T. (2012). Innovations activities in the sector of small and medium enterprises, Acta Oeconomica Universitatis Selye, Vol. 1, No. 2, pp. 149 – 158.
7. OECD (2011), Towards Green Growth, Organizacja Współpracy Gospodarczej i Rozwoju, Paryż.
8. Oslo Manual, OECD, EUROSTAT, Paris 2008, p. 48
9. Polish Ministry of the Economy, Department of Innovation and Industry. (2013). Program of the Enterprises Development by 2020. The executive program for the Strategy for Innovation and Economic Efficiency WORLD IS CHANGING. Warszawa.
10. Polish Chamber of Commerce of Importers, Exporters and Cooperation. (2015) http://www.pcc.org.pl/projekty/aktualnie-realizowane/promocja-i-rozwoj-wielkopolskiego-klastra-energii-odnawialnej-siec-powiazan-budownictwa-energooszczednego-644.html download 15.09.2015.

11. PORTER, M. (1990). The Competitive Advantage of Nations.
12. The First Polish Cluster of the Passive and Energy-Efficient Construction, (2008), The Agreement on Cooperation in the framework of a project called: "The first Polish Cluster of Passive and Energy Efficient Construction". Katowice.

Correspondance address:
Ing. Renata Stasiak-Betlejewska, PhD., Institute of Production Engineering,
Faculty of Management, Czestochowa University of Technology, Armii Krajowej 19B,
42-200 Częstochowa, e-mail: *renatastasiak@wp.pl*