



## ENERGY CLUSTER – AN ATTEMPT IN CHARACTERISATION AND DEFINITION

Joanna Gronkowska

### Summary

Clusters are an organisational and economic phenomenon. This paper attempts to answer what an energy cluster actually is and whether it meets the requirements of a cluster in the classical approach of economic sciences.

The Act of 20 February 2015 on renewable energy sources (Ustawa OZE 2015) introduced the concept of an ‘energy cluster’. It was aimed at, among others, increasing energy security and environmental protection through an efficient use of renewable energy sources. In the literature on the subject, there is no single universally applicable definition of a cluster, it can only be considered in its various aspects. The concept of a cluster has so many applications, associations and meanings that in many respects it has become a ‘chaotic idea’ due to flattening and equalising different types, processes and spatial scales of economic location within one universal concept. However, the main doubt concerns the very definition of a cluster.

The paper considers the organisational attributes of clusters, based on the analysis of the following aspects:

- a) Cluster in historical terms. Overview of cluster and network definitions:
  - i. Overview of cluster definitions
  - ii. Overview of network structure definitions
- b) Energy cluster. Forms of interorganisational relations and the typology of energy clusters
  - i. Forms of interorganisational relations in an energy cluster
  - ii. Energy cluster against in relation to organisational network typology
  - iii. Energy cluster as a form of company network – common features and differences
- c) An attempt in characterisation and definition of an energy cluster

### Keywords

energy cluster • network structure • cooperation • business alliance

### 1. Introduction

Clusters are an organisational and economic phenomenon and, as J. Kaźmierski has noted, their functioning has already been observed in many countries around the world [Kaźmierski 2012, p. 9]. They are created in virtually all sectors of the economy, such as industry, services, high-tech.

This paper attempts to answer what an energy cluster actually is and whether it meets the requirements of a cluster in the classical approach of economic sciences. The Act of 20 February 2015 on renewable energy sources [Ustawa OZE 2015] introduced the concept of an ‘energy cluster’ as a civil law agreement, which may include natural persons, legal persons, scientific units, research institutes or local government units, regarding the generation and balancing of demand, distribution or trading of energy from renewable energy sources or from other sources or fuels, within a distribution network with a rated voltage lower than 110 kV, in the area of operation of this cluster not exceeding the boundaries of one powiat within the meaning of the Act of 5 June 1998 on powiat self-government (Dz.U. 2016 poz. 814) or 5 municipalities within the meaning of the Act of 8 March 1990 on municipal self-government (Dz.U. 2016 poz. 814); the energy cluster is represented by a coordinator who is a cooperative, association, foundation or any member of the energy cluster designated in the civil law agreement, hereinafter referred to as the ‘energy cluster coordinator’.

According to M.E. Porter’s definition, a cluster is a geographical concentration of interconnected enterprises, specialized suppliers, service providers, enterprises operating in related sectors and associated institutions in particular fields, competing with each other, but also cooperating [Porter 1998, p. 200, Porter 2000, p. 15–34, Pilarska 2013, p. 19].

The analysis of the literature on the subject allows to conclude that a cluster is a kind of network with five permanent distinctive features, which must occur simultaneously [Skawińska and Zalewski 2009, p. 173, Barczak 2016, p. 195]:

- spatial concentration of entities competing with each other in a region,
- concentration of companies within one or several similar sectors,
- informal and formal cooperation of enterprises, local institutions and organizations of a horizontal and vertical nature,
- specialization of entities in a cluster,
- flow of knowledge, technology and innovation between entities of a cluster.

Additional features:

- involvement of entities representing enterprises, research organizations and administration,
- high level of interaction between the entities involved,
- network openness and durable nature,
- rather well-defined network boundaries,
- competition as the dominant nature of the relationship,
- achieving external benefits as a whole and benefits for individual cluster members,
- formalized cooperation of entities,
- designated entity acting as a coordinator,
- openness to cooperation, for example with academia.

In the above list of features, a term ‘coopetition’ appears meaning a type of relationship between competitors that simultaneously compete and cooperate with each other [Cygler 2007, p. 61, Skawińska and Zalewski 2009, p. 171]. So, if there is no mention of competition in the definition in the act on renewable energy sources, the question remains: what is an energy cluster? In search of an answer to this question, the *desk research* method was applied, based on the study of source documentation and information contained in foreign and Polish scientific publications.

## 2. Cluster in historical terms. Overview of cluster and network definitions

According to E. Skawińska and R.I. Zalewski [Skawińska and Zalewski 2009, p. 19–21], the oldest example of a cluster described in the literature comes from the period 4000–3500 BC in the area of today’s southern Iraq. In this area, there were special spheres for strictly defined types of crafts and specialized markets, with developed legal rules, management methods, production and exchange of goods and services. It is believed that the theoretical roots of the conception of cluster can be traced back to the 18<sup>th</sup> century in the works of the father of modern economics, Adam Smith. According to Smith, the choice of one industry as the dominant industry in a given country allowed to increase the amount of produced goods. It is believed that the first to use the term ‘industrial districts’, which is often interchangeably applied with the word ‘cluster’, was William E. Hearn, in whose name the term appears as early as 1863. On the other hand, Alfred Marshall is said to be the founder of the theory of clusters. In his work, the *Principles of Economics*, published in 1890, he stressed the importance of the benefits that can be achieved thanks to the ‘concentration of many small companies of a similar nature in one town, in other words, thanks to the industry location’ [Marshall 1925, p. 258, Pilarska 2013, p. 10].

The notion of the industrial district as a socially, economically and territorially separated unit, characterized by the active presence of both the community and specialized companies operating in naturally and historically limited areas, gained a ‘new life’ later, when economists became interested in the path of industrial development pursued in certain regions of Italy known as ‘third Italy’. This region went through a rapid development in the 1970s, especially its small and medium industrial companies, and was related primarily to the strong concentration of these companies in specific sectors and locations. The main features of these districts were determined, such as: geographical proximity, sector specialization, domination (advantage) of small and medium-sized enterprises, close cooperation, but also competition between companies, striving for innovation, socio-cultural identity (uniformity) in favour of building trust, active support authorities at both local and regional level [Becattini 1991, p. 86, Hamphrey and Schmitz 1995, p. 2–3, Bellandi 2007, p. 7, Pilarska 2013, p. 14–16].

In conclusion, geographic, specialized clusters of related economic entities have functioned in the economy for centuries, but only since the M.E. Porter’s work in 1990 (*The Competitive Advantage of Nations*) the term ‘clusters’ became popular [Skawińska and Zalewski 2009, p. 19].

‘There is no single universally applicable definition of a cluster... it is only considered in its various aspects’ in the literature on the subject [Jacobs and de Man 1996, p. 425]. This is very well described by R. Martin and P. Sunley, who claim that ‘(...) the notion of a cluster has so many applications, associations and meanings that in many respects it has become a «chaotic idea» due to flattening and equalizing different types, processes and spatial scales of economic location within one universal concept’, however, ‘(...) the main doubt concerns the very definition of a cluster’ [Lis and Lis 2014, p. 21, Martin and Sunley 2003, p. 10]. The above statements are illustrated by the cluster definitions presented in Table 1.

**Table 1.** Overview of cluster definitions

No.	Year	Author	Network definition
1	1992 / 1996	M. Enright	A set of related enterprises, representing the same or a similar industry or service sector, located in the same area (geographical proximity). Concentration of economic entities in a close proximity
2	1995	R. Rabelotti	A grouping of spatially concentrated and enterprises specialised to a sector (mainly small and medium-sized) with links based on market and non-market exchanges of goods, information and labour, which are connected by a common culture and social origin (translated into a specific code of behaviour), supported by a network of public and private local institutions
3	1996	C. DeBresson	Innovative clusters are not a mere concentration of independent business entities, but networks of interconnected, cooperating enterprises at an industry level
4	1996 / 1998	P. Swann, M. Prevezer	Groups of enterprises that work together within one sector in a specific geographic area. Clusters are defined as groups of companies within one industry sector located in one geographic area. A cluster means a large group of companies from related sectors in a specific location
5	1996 / 1997	S. Rosenfeld	Geographically concentrated, similar, related or complementary enterprises with active channels for business transactions, communication and dialogue, having access to specialised infrastructure, labour market and services, facing the same opportunities and threats. It is a system of which membership is based on mutual dependence and contribution to the functioning of this system. Clusters of companies which have the opportunity to create synergy effects through geographical proximity and close cooperation, regardless of the scale of employment
6	1997	B.A. Lundvall, S. Borras	The region where innovations are delivered by regional networks of innovative entities and local clusters as a result of cooperation with research institutions will be at a higher level of development
7	1998	E.J. Feser	Clusters are not so much related and cooperating entities, but rather related and supporting institutions that gain a competitive advantage through a network of connections

8	1998	T. Padmore, H. Gibson	Concentration of enterprises in a definite area, whose economic success is determined by their interactions and facilitated by geographical proximity
9	1998 / 2001	M.E. Porter	Geographical cluster of interconnected companies, specialized suppliers, service providers, companies operating in related sectors and related institutions in particular fields, competing with each other, but also cooperating. A group of enterprises and cooperating institutions related to and complementing each other. A cluster is a group of geographically closely interrelated companies and related institutions in a given field, connected by similarities and complementarity
10	1998	P. Swann, M. Prevezer	A large group of companies from similar sectors concentrated in one geographical area and cooperating with each other
11	1999	J. Simmie, J. Sennert	Highly related enterprises and/or service sector companies cooperating within the supply chain and respecting the same market principles
12	1999	T. Roelandt, P. den Hertog	Supplier networks and closely connected companies that create added value within a supply chain
13	1999	I.W. Munnich	The cluster is first of all a strategy of economic development which ensures economic growth in a coordinated and effective manner
14	1999	UNIDO	Sectoral and geographic concentration of companies that produce and sell a range of related and complementary products, therefore facing common challenges and opportunities
15	2001	C. Crouch, H. Farrell	The tendency of locating enterprises in close proximity to enterprises with a similar business profile, despite being previously absent in a given area
16	2001	L. van den Berg, E. Braun, W. van Winden	In most definitions, clusters are defined as localized networks of specialized entities, which are closely related to each other in the production process through the exchange of goods, services and/or knowledge
17	2002	P. Cooke	Companies cooperate and compete with each other within a specific market segment, use common local infrastructure and identify with the same vision of industry and region development form a geographical cluster with horizontal and vertical links.
18	2002	B. Asheim, A. Isaksen	The strength of the arguments in favour of regionalisation stems from the fact that regional level of operations and specific local and regional resources are still important for companies, especially when they make efforts to become competitive on the global market (...). Companies in clusters, when searching for innovations, rely on unique regional and local resources and mutual cooperation
19	2002	T. Brodzicki, S. Szultka	A spatially concentrated cluster of enterprises simultaneously competing and cooperating with each other in certain aspects as well as institutions and organizations, connected by a system of mutual relations of formal and informal nature, based on a specific development trajectory (e.g. technology, sales markets)

Table 1. cont.

No.	Year	Author	Network definition
20	2002	C. Steinle, H. Schiele	Clusters are treated as localized sector agglomerations of symbiotic organisations that can achieve better business results through interactions ( <i>club-like</i> )
21	2003	European Commission	Clusters are groups of independent enterprises and related institutions which: cooperate and compete; are geographically concentrated in one or more regions, although a cluster may even be global in scope; specialize in a specific field, are connected by common technologies and skills; include modern (science-based) or traditional industries; can be institutionalised (by a coordinator) or non-institutionalised. The way of organising a production system and a territory in which enterprises operate, characteristic for entities and other organisations that are geographically concentrated and specialize in the same fields, develop mutual market and non-market relations and contribute to the innovation and competitiveness of their members
22	2003	M.P.V. van Dijk, Å. Sverrisson	Clusters are relatively dense networks of companies and organisations whose value chains are interconnected, but not necessarily by what we usually mean by economic transactions
23	2004	P. Morosini	Socio-economic unit characterised by a social community and a set of economic entities located in close proximity, in a particular geographic region
24	2004	OECD	Concentration in a given area of related (vertically and / or horizontally) enterprises operating in the same sector (industry or services) together with related institutions
25	2005	P. Masell, L. Kebir	Clusters can be defined as non-random geographical agglomerations of companies with similar or closely complementary production capacities
26	2005	Statistics Poland (GUS)	Networks of related enterprises, their suppliers and customers, scientific and educational institutions, special government agencies and so-called bridging institutions that provide technical and consulting services, as well as financial and insurance institutions
27	2005	PARP	Spatial concentration of enterprises, institutions, organisations interconnected by an extensive network of formal and informal relations, based on a common development trajectory (e.g. technological, common target markets, marketing strategy, etc.), simultaneously competing and cooperating in certain aspects of operation
28	2006	Ch. Pitelis, R. Sugden, J.R. Wilson	A cluster is a concentration of companies with a specific type of activity, usually located in one geographic dimension, horizontally and (preferably) vertically related and characterised by a connection between sectors (in the context of object-institutional setting) that cooperate or compete on the local or international market

29	2006	Ministry of Economy	Spatial and sectoral concentration of entities operating for the benefit of economic development or entrepreneurship, and at least ten entrepreneurs conducting business activity in one or more neighbouring voivodeships, competing and cooperating in the same or related industries, and connected with an extensive network of formal and informal relations, whereby the entrepreneurs constitute at least half of the entities operating within the cluster
30	2009	Ö. Söllvell	Clusters are companies dealing not only with the flow of goods and services, but also focused on creating knowledge, increasing profits and innovation in the broad sense
31	2009	M. Gorynia, B. Jankowska	The group of enterprises and other entities (associations, chambers of commerce and industry, scientific institutions, etc.) operating in close proximity, is characterized by an above-average intensity of various links and relationships, and these relations to a large extent go beyond typical market relationships (confrontational, competitive). There are advantages of shared location and cooperation within this group of companies (external economies of scale, synergy effect, positive externalities, diffusion effect, etc.). The cluster is 'an island of cooperation in the assessment of competition'.
32	2010	A.M. Kowalski	An innovative tool to support cooperation between individual entities in innovative processes, in particular R&D units, enterprises using the results of their works and business environment institutions supporting the commercialisation of technologies
33	2013	L. Knop	A group of entities coming from various environments: business, science, local government and civil society, consciously operating in a specific ecosystem, focused on a specific territory and/or around an established specialisation
34	2014	A.M. Lis, A. Lis	Sectoral and geographical concentration of enterprises linked by trade and non-trade dependencies within a community of values and goals that binds them to some extent, while cooperating and competing using the synergy effect
35	2014	CLOE	Groups of interconnected industries, small and medium-sized enterprises (SMEs) and organisations that increase their competitiveness by interacting with each other. They can be customers, suppliers, researchers, partners or rivals, concentrated in certain geographic regions
36	2016	PARP	Geographical cluster of independent entities representing a specific economic specialisation, cooperating and competing with each other within the value chain. Cooperation within the cluster is formalised, it is implemented both vertically and horizontally, and is aimed at achieving the assumed common goals. The cluster is a source of benefits and creates new value for all types of entities participating in it, such as enterprises, universities and other scientific units, business environment institutions, public administration and other supporting organisations

Table 1. cont.

No.	Year	Author	Network definition
37	2017	PARP	A cluster is a geographical concentration of specialised entities, interconnected by mutual interactions, operating in related or complementary industries, at the same time cooperating and competing with each other, including, in particular: enterprises, research organisations, business environment institutions, public entities. It is a specific form of production organisation, consisting in the concentration of flexible enterprises running complementary economic activities in a close proximity. These entities simultaneously cooperate and compete with each other, they also have relations with other institutions operating in a given field. The basis for the creation of the cluster are cooperative relations between entities, generating the processes of creating specific knowledge and increasing adaptability

Source: Author's study based on: Kaźmierski [2012], p. 68; Martin and Sunley [2003]; Rosenfeld [1996], p. 7; Rosenfeld [1997], p. 4, 7; Porter [2000], p. 16; Porter [2001], p. 246; Porter [1998], p. 200; Cegle and Dini [2015]; ETCoI [2015]; Morosini [2004], p. 307; Matusiak [2005], p. 81; Ministerstwo Gospodarki, Dz.U. 06.226.1651, 2006; Gorynia and Jankowska [2009], pp. 274–275; Kowalski [2010]; Lis and Lis [2014], p. 81; Knop [2013], p. 33; Söllvell [2009], p. 15; CLOE [2014]; Pitelis et al. [2006], p. 20; Munnich [1999], p. 10; Feser [1998], p. 26; Van Dijk and Sverrisson [2003], p. 185; Gorynia and Jankowska [2008], p. 100; OECD [2004], pp. 5, 20; EU [2003], pp. 9, 16; Enright [1996], p. 191; Swann and Prevezer [1996], pp. 1, 139; Padmore and Gibson [1998], p. 57; Rabelotti [1995], p. 30; Cooke [2002], Gorynia and Jankowska [2008], p. 35; Maskell and Kebir [2014], p. 1; DeBresson [1996], p. 161; Steinle and Schiele [2002], p. 850; Lundvall and Borrás [1997], p. 39; Swann and Prevezer [1998], p. 1; Roelandt and den Hertog [1999], p. 9; Simmie and Sennett [1999], p. 51; Crouch and Farrell [2001], p. 163; Van den Berget et al. [2001], p. 187; Asheim and Isaksen [2002], p. 4; Maskell and Kebir [2005], p. 1; UNIDO [2001], p. 9; Brodzicki and Szultka [2002], p. 46; Gorynia and Jankowska [2007], p. 319; GUS [2005], p. 132; Ministerstwo Gospodarki [2008]; PARP [2017]; PARP [2017a]; Hołub-Iwan and Wielec [2014], p. 9; Drelich-Skulska et al. [2014], p. 24–25; Kazojć [2016], pp. 59–61; Pilarska [2013], pp. 20–24; Lis and Lis [2014].

Thus, there is no doubt that we lack a clear definition of a cluster. According to B. Glävan, ‘the definitional flexibility of the cluster concept completely prevents its operationalisation, making it an ideal tool for politicians’ [Glävan 2008, p. 52; Lis and Lis 2014, p. 39]. In the light of the conducted analysis, it seems justified to extend the considerations to business networks.

As already pointed out by G. Becattini [Becattini et al. 2009], Italian industrial districts have evolved towards local integrated manufacturing networks (*filière*) and thus into broader structures that can be described as cluster-type structures. Despite many common elements, such as spatial concentration, the proximity of entities or the existence of mutual competition and cooperation, they differed from industrial districts basically in that they are more flexible [McDonald and Belussi 2002, p. 15]. Nowadays, they are not limited only to traditional branches of the economy, but are often targeted at sectors that are the carriers of modernity, in which innovative processes take place [Pilarska 2013, pp. 17–18]. Thus, the *cluster* cooperation models and *industrial districts* form the basis for considering business networks [Barczak 2016, p. 23; Rosińska 2005a, p. 372]. The network approach is used in such areas of research and practice as: strategic management (relations of competition, cooperation and cooptation), logistics



management (supply and distribution chains), entrepreneurship, knowledge and innovation management or relationship marketing [Barczak 2016, p. 23; Gancarczyk 2012, p. 61).

In papers devoted to network research, there are various definitions of this notion. Common phrases include *network organisations* [Phillips 2010, p. 533 et seq.; Higgins and Maciariello 2004, p. 203 et seq.), *interorganisational network* (see e.g.) [Baker and Faulkner 2002, p. 520), and *network structure* [Mukherjee 2009, p. 23; Sproull and Kiesler 1992, p. 132 et seq.), ‘network company’ or just ‘networks’ [Barczak 2016, p. 53]. There are many definitions of network structures due to the different forms of relationships between network participants. The most important of them, taking into account the essence of clusters, are presented in Table 2.

**Table 2.** Overview of network structure definitions

No.	Year	Author	Network definition
1	1986	H.B. Thorelli	A network is a set of two or more organisations committed to a long-term relationship
2	1998	P. Drucker	A network of institutions (or their parts), companies, teams and people located in different places, organised into loosely connected and non-transparent structures, which share a common goal – working (providing services or selling products) for the same customer
3	1998	P. Dwojacksi, B. Nogalski	The network as a relatively permanent grouping of autonomous, specialised units and enterprises participating in a system of mutual cooperation according to market principles
4	1999	J. Sydow	An organised, polycentric form of economic activity, often strategically directed by one or several enterprises, seeking to achieve a competitive advantage. It is expressed in relatively stable, cooperative rather than competitive relations between legally independent, but economically at least interdependent enterprises
	2001	Strategor	The basic components of the network are the so-called Nodes and connections between them, which – translating into practice – means linking elements of various organisations and institutions into various network combinations (depending on the needs), and their number and nature are determined by the number and type of relations between the nodes. The relations between the components of the network can be multilateral and have a different character: bureaucratic – orders, applicable standards, procedures; economic material and financial transactions; operational – joint action, collective decision making, use of the same resources; cultural – sharing values, community of opportunities and threats; informative availability of information sources, exchange and sharing of information
6	2002	M.J. Hatch	An organization where hierarchical coordination has been replaced by horizontal relations, formal relations between organisational units have been changed to links between partners, which are different organisations, and assets are divided so that the producer of the finite whole is not any single organisation of the network, but the network as a whole

Table 1. cont.

No.	Year	Author	Network definition
7	2004	D. Delporte-Vermeiren, P. Vervest, F. van Heck	The interorganisational network in business can be a set of relations between the so-called focusing actor and external actors dependent on them, working together on the implementation of a specific service for the client
8	2005	K. Łobos	An interorganisational network (network organisation) is 'a set of more than two independent organizations that are linked with the following characteristics: – decisions on resources are made not only integrally by the parties to the transaction (as is the case in the market), but also collectively by cooperating parties; – the flow of resources between the cooperating partners is repetitive, not ad hoc; – the mutual expectations of the cooperating partners cover a further horizon; – the information available to the cooperating parties is much more extensive than in the case of market coordination; – the form of coordination between the cooperating parties is negotiation, and not competition'
9	2005	K. Perechuda	A set of legally independent business units implementing various undertakings and projects coordinated by the integrator's company, which has distinctive (key, basic) competences
10	2010	Z. Olesiński	A system of various groups of organizations, the elements of which are: enterprises, local government units, state government institutions (they ensure the implementation of the policy of supporting banks and other financial institutions needed to finance the operations of enterprises, business support organisations and research and development institutions)
11	2012	J. Niemczyk, E. Stańczyk-Hugiet, B. Jasiński	Two concepts of networks: 1) structures describing a specific form of operation (cooperation) of private and or public entities, 2) forms being a new structure created by the mentioned entities, which pursue a common goal

Source: Author's study based on: Thorelli [1986], p. 37; Drucker [1998]; Dwojacki and Nogalski [1998], p. 69; Sydow [1999], p. 103; Strategor [2001]; Hatch [2002], p. 195; Delporte-Vermeiren et al. [2004]; Łobos [2005], p. 167; Perechuda [2005]; Olesiński [2010], p. 66; Niemczyk et al. [2012], p. 9; Barczak [2016], p. 54–58.

Taking into account the above list, the main distinctive features of a network structure are [Barczak 2016, p. 59, Niemczyk et al. 2012, p. 10]:

- Multilateral relations between network components,
- Diversified nature of network relations (bureaucratic, economic, cultural, information),
- Shared use of resources by network participants,
- Repetitive nature of resource flows between partners,
- Market-based coordination mechanisms,
- Negotiations and agreements as a form of coordination of activities between cooperating parties,
- Striving for cooperation,

- Autonomy of the units (with a significant scope of cooptation),
- Long-term (strategic) nature of cooperation between network participants,
- Increasing the potential of knowledge and innovation,
- A shared value system,
- Low level of horizontal integration and hierarchy,
- Flexibility,
- Benefits of cooperation (synergy effect).

It can be noticed that in the case of network structures, there is also cooptation, as a special type of relationship between partners with a simultaneous relationship of competition and cooperation. At the same time, however, as in the case of clusters, the concept of networks is still not a fully explored and structured concept. Therefore, it is important to indicate the key attributes of interorganizational relations in the network and to classify them so that relations in the energy cluster can be defined.

### 3. Energy cluster. Forms of interorganisational relations and the typology of energy clusters

The following is an attempt to develop forms of interorganisational relations in an energy cluster against the background of their various characteristics presented in the literature.

The literature on the subject presents a variety of typologies of organisational networks. Table 4 shows an attempt to develop an energy cluster type against their background.

On the basis of the presented analysis, it can be concluded that an energy cluster bases its activity on cooperative relations. There cannot be any competitive relations when a subject of cooperation is taken into account. At this point, it is necessary to return to the definition of cooptation, in terms of the dependencies occurring between entities in the energy cluster, understood as a 'dyadic and paradoxical relationship between two companies that cooperate within the same operations, and compete within other activities' [Bengtsson and Kock 1999; Wiśniewska and Janasz 2015, p. 184]. The common features and differences between the networks of companies, classic cluster and energy cluster are presented in Table 5.

Table 3. Forms of interorganisational relations in an energy cluster

No.	Forms of interorganisational relations	Description	Forms of interorganisational relations in an energy cluster
1	Collaboration in the same operations	through link, e.g. producer – producer	Cooperation in the implementation of a specific project - through links independent of the type of basic operations
	Collaboration between different operations	through links, e.g. manufacturer – supplier	
	Cooperation in the implementation of a specific project	through links independent of the type of operations	
2	<b>Relations by type of interaction</b>		
	Cooperation	cooperation of entities	Cooperation of entities
	Coordination	organising activities carried out by many entities	Coordination – organising activities carried out by many entities (coordinator role)
	Control	entities supervision	
	Conflict	conflict of interests of entities	
	Competition	competition of entities	
	Coopetition	simultaneous cooperation and competition	Coopetition – cooperation within the same activities, and competition within the boundaries of other activities
	Co-production	joint ventures carried out by entities	Co-production – joint ventures carried out by entities

3	Mutual independence	<p><b>Relations due to the distribution of power</b></p> <p>independent actors have freedom of action</p> <p>the entities are linked by loose cooperation with one of them having more power (coordinator)</p> <p>the entities are connected by a close relationship in which they are closely dependent</p>	the entities are linked by close cooperation with one of them having more power (coordinator)
	Unequal independence		
	Interdependence		
4	<b>Relations in regard to the nature of the relationship</b>		
	Organisational relationships	through ownership of the companies participating in the network by other board appointments by the owners of the parent company, etc.	
	Market relations	through the customer-supplier relations:	
		– vertical backward relations (with suppliers)	
		– vertical frontal relations (with buyers)	– vertical frontal market relations (with buyers)
		– direct horizontal relations (with industry actors)	direct horizontal market relations (with industry actors)
– indirect horizontal relations (with actors from outside the industry)			
Regional relations	proximity to company headquarters, common area of operations	regional relations: proximity to company headquarters, common area of operations	
Informal relationships	family, political ties, etc.		
5	<b>Relations due to voluntary participation</b>		
	Forced relations	Relations with the consent of the participating parties	Relations with the consent of the participating parties

Table 3. cont.

No.	Forms of interorganisational relations	Description	Forms of interorganisational relations in an energy cluster
6	Hostile relationship	<p><b>Relations based on the degree of cooperation</b></p> <p>organisations are ruthlessly fighting each other with all available means; the impact of conflict is destructive not only on the warring organizations, but also on their environment</p>	
	Competitive relationship	<p>confrontation generally proceeds according to a specific legal course, can have a positive impact on the environment (increasing the level of functioning of the organisation); a conflict leading to destruction can be turned into a competitive conflict</p>	
	Neutral relationship	<p>in this case, the relationship between the organisations is irrelevant, the transmission of information is sporadic and does not cause any reaction in the recipient; it does not generate synergy</p>	<p>organizations form a certain compact whole with strong and deep formal and informal links, generating strong synergy</p>
	Friendly relationship	<p>is characterised by a certain cooperation, although it is of an individual nature; generates synergy</p>	
	Partnership relationship	<p>mutual contacts are intense, even familial, there are strong formal and informal connections; generates synergy</p>	
	Cluster-type relationship	<p>organisations form a certain compact whole with strong and deep formal and informal links, generating strong synergy</p>	

<b>Relations based on the direction of cooperation</b>	
Vertical cooperation	so-called vertical cooperation - cooperation within the production chain, e.g. on the supplier-manufacturer or manufacturer-distributor line
Horizontal cooperation	so-called horizontal cooperation – cooperation between units with a similar business profile, e.g. through mergers. It includes cooperation between companies operating in similar market segments (both product and geographical) and can lead to a creation of cluster structures
7	horizontal cooperation, horizontal cooperation - cooperation between economic units with different business profiles. It includes cooperation between companies operating in similar market segments (both product and geographical) and should lead to a creation of cluster structures
<b>Relations according to the complexity of establishing transactions, the possibility of codifying transactions and the involvement of suppliers in transactions</b>	
Market relations	
Modular relations	
Collaborative relationships	Collaborative relationships
Serf relationships (slave)	
Hierarchical relationships	
8	
<b>Relations according to the source of the relation</b>	
Internal relational resources	resources used to create internal knowledge (general knowledge absorption capacity, general competences)
9	resources used to shape external relational resources (general competences, customer relations management skills) resources used to shape external relational resources (general competences, customer relations management skills)
External relational resources	relational resources located outside the company (company image and reputation, trust)

Table 3. cont.

No.	Forms of interorganisational relations	Description	Forms of interorganisational relations in an energy cluster
10		Relations according to the directions of relations	
	From strategic centre to peripheral relations		From strategic centre to peripheral relations
	From horizontal to vertical relations		
	From complementary relations to competitive relations		
	From narrow relations to broad relations		
	From complex (network) relations to simple relations (between two entities)		From complex (network) relations to simple relations (between two entities)
	From dominant relations according to the content of the relation and its type to subordinate relations		
	From relations that have little impact on the added value of a strategic centre to relations that have a significant impact on the added value of a strategic centre	From relations that have little impact on the added value of a strategic centre to relations that have a significant impact on the added value of a strategic centre	

Source: Author's study based on Barczak [2016], pp. 68–70.



Table 4. Energy cluster in the context of organisational network typology

No.	Type of network	Description	Type of network in an energy cluster
1	Intraorganisational networks	the interior of the organisation creates a network structure of connections between the elements of the organisation	Interorganisational networks: business–public–legal alliances
	Interorganisational networks	business networks, outsourcing networks, franchise networks, alliance networks, public-law networks	
2	<b>Method of coordination</b>		the strategy is jointly formulated and coordination is carried out by a separate entity that represents the interest of the whole group, assumes a coordination and control function in certain areas to which the participants of the network agree
	Asymmetric networks	dominates the central entity that formulates the strategy and coordinates the operations of the entire system	
	Symmetrical networks, bilateral coordination	the strategy is jointly formulated and coordination is based on common agreements	
3	<b>The level of dependence and formalisation of relationships</b>		
	Integrated networks	consist of distributed units that almost or financially belong to one group or one economic organism	consist of distributed units that almost belong or financially belong to one group or one economic organism
	Contract networks	base their activities on concession or franchise agreements concluded between independent partners	
	Federated networks	are created by any group of legal or natural persons who are aware of their needs and are looking for ways to satisfy them on their own	
Networks of direct relations	have traditionally been used for penetration in areas of life such as religion or politics, but are now also used in economic life		

Table 4. cont.

No.	Type of network	Description	Type of network in an energy cluster
4	Dominated networks	<p style="text-align: center;"><b>Relations between the participants in the cooperation</b></p> <p>they are created when an enterprise has bilateral ties with many, usually smaller partners. Their advantages include the possibility of basing the functioning of the system on the high and stable quality of co-operators' activities and the certainty of the existence of permanent orders, as well as the limited risk of functioning due to the association with a large partner</p>	<p>Dominated networks are created when an enterprise has bilateral ties with many, usually smaller partners. Their advantages include the possibility of basing the functioning of the system on the high and stable quality of co-operators' activities and the certainty of the existence of permanent orders, as well as the limited risk of functioning due to the association with a large partner</p>
	Peer-to-peer networks	<p>are created when coalition partners develop strong connections and work together in a variety of configurations. This system can be configured depending on the market needs and development opportunities. The dependencies between the participants guarantee significant opportunities to quickly react to changes in the environment, resulting from the high flexibility of the structures and activities of the group</p>	<p>Peer-to-peer networks are created when coalition partners develop strong connections and work together in a variety of configurations. This system can be configured depending on the market needs and development opportunities. The dependencies between the participants guarantee significant opportunities to quickly react to changes in the environment, resulting from the high flexibility of the structures and activities of the group</p>
	Social networks	<p>are based on mutual interactions between employees of the enterprises, which create a potential for cooperating of entities ready to take action if necessary. It is particularly effective when processed and shared information is difficult to evaluate under market conditions. Usually, this form is not accompanied by formal contracts or capital dependencies</p>	<p>Peer-to-peer networks are created when coalition partners develop strong connections and work together in a variety of configurations. This system can be configured depending on the market needs and development opportunities. The dependencies between the participants guarantee significant opportunities to quickly react to changes in the environment, resulting from the high flexibility of the structures and activities of the group</p>
	Bureaucratic networks	<p>are typically created in situations where the involvement of individual entities is easier to measure with a gradual progression of this value. The legal basis for this agreement are cooperation agreements, and typical examples are licensing or franchising</p>	<p>Peer-to-peer networks are created when coalition partners develop strong connections and work together in a variety of configurations. This system can be configured depending on the market needs and development opportunities. The dependencies between the participants guarantee significant opportunities to quickly react to changes in the environment, resulting from the high flexibility of the structures and activities of the group</p>
	Networks based on property rights	<p>their form refers to economic groups searching for synergy in a system of cooperation of their own companies. The most popular arrangement of this type is capital venture, the strategic goal of which is to operate in risky industries which, despite their considerable potential, have not yet been accepted by the market</p>	<p>Peer-to-peer networks are created when coalition partners develop strong connections and work together in a variety of configurations. This system can be configured depending on the market needs and development opportunities. The dependencies between the participants guarantee significant opportunities to quickly react to changes in the environment, resulting from the high flexibility of the structures and activities of the group</p>

Structure of network	
Internal networks	arise within an organisation
Stable networks	based on long-term contracts, organised around the dominant form (coordinator)
Dynamic networks	loose alliances of companies
<b>Structure of management and stability of connections</b>	
Ring network	no leadership organisation or hierarchy, a rotational leader plays a steering role, it is possible to launch all agreed connections
Ring network with a coordinating organisation	stable and systematic coordination, asymmetry of positions and roles, the leadership organization may influence the operations of other entities, but cannot function without them, or decide on their existence
Ring network with lead organisation	the leading entity is independent of its circle of suppliers and subcontractors, but it can transform this circle, power is asymmetric and hierarchical
<b>Nature of relationships between partners</b>	
Prosumer networks	producer and consumer at the same time
Supplier networks	they include a subcontracting agreement between the client (central company) and suppliers of intermediate production elements; producer networks created as a result of co-production agreements that allow competing producers to combine production capacity, financial and human resources to expand their product offer and geographic reach
Customer networks	create terminable connections of production companies with distributors, marketing channels, commercial intermediaries supplementing the product with various elements and target users on domestic or international markets
Standard coalitions	are concluded by entities capable of imposing standards on a global scale in order to conform a certain number of companies to the patterns of their own product or its compatibility with it
Technological cooperation networks	enable the acquisition of projects, products and production technologies, joint production and technology development as well as generic exchange, scientific knowledge and results of scientific and research works
5	Stable networks – based on long-term contracts, organised around the dominant form (coordinator)
6	Ring network with a coordinating organisation – stable and systematic coordination, asymmetry of positions and roles, the leadership organisation may influence the operations of other entities, but cannot function without them, or decide on their existence
7	Prosumer networks (producer and consumer at the same time)
	Technological cooperation networks – enable the acquisition of projects, products and production technologies, joint production and technology development as well as generic exchange, scientific knowledge and results of scientific and research works

Table 4. cont.

No.	Type of network	Description	Type of network in an energy cluster
8	Star networks with a leading company	<p style="text-align: center;"><b>Features of the network structure</b></p> one company plays a major role in the network all entities have equal rights in the network weakly formalized, in which the intensification of contacts depends on the current needs constituting a territorial corporation of economic activity, often with a high degree of formalization	Star networks with a leading company – one company plays a major role in the network
	Nodal connection networks		
	Temporary networks		
	Regional networks		Regional networks – constituting a territorial corporation of economic activity, often with a high degree of formalization
9		<b>Design features</b>	
	Systems of relations with network features existing within the organisation		Systems of relations with network features between enterprises conducting various activities, additionally complementing each other with systems of relations with network features between enterprises running a joint project (mixed interorganisational networks)
	Systems of relations with network features between an enterprise and its environment		
	Systems of relations with network features between enterprises conducting related activities, additionally complementing each other (interorganisational networks)		
10		<b>Features of relationships</b>	
	Social networks		Economic networks
	Economic networks		
	Organisational networks		Design networks
	Other networks		

Degree of intensification of market features	
11	Organisational networks
	Networks of relative relationships
	Market networks
<b>Mode of origin</b>	
12	Networks as results of gradual tightening or one-time establishment of long-term cooperation by independent enterprises
	Networks as results of investments leading to the inclusion of new (created or purchased) cells by at least one company implementing an expansion strategy
	Networks as results of transformations within the structure of a large, centralised enterprise
<b>Nature of network system</b>	
13	Alliances and joint ventures
	Supplier-recipient systems
	Branches of enterprises
	Strategic business units
	Bought-out, acquired or sold companies, cooperating with them
<b>Alliances and joint ventures</b>	

Table 4. cont.

No.	Type of network	Description	Type of network in an energy cluster
14	Types of cooperation		
	Cooperative networks		Cooperative networks
	Franchise and license networks		
	Other network forms, e.g. agency networks		
	Strategic alliance networks		Strategic alliance networks (partnership agreements between competitors)
	Holding networks, concerns		
15	Type of links between network participants and the frequency of occurrence of a given type of cooperation		
	Cooperative networks		Cooperative networks
	Outsourcing networks		
	Franchise and agency networks		
	Clusters		Clusters
	Strategic alliances		
	Holding networks		Strategic alliance networks (partnership agreements between competitors)
	Public-private partnership		
16	Place in value chain		
	Horizontal networks		
	Vertical networks		Multidimensional networks
	Multidimensional networks		

Degree of organisation		
17	Structured networks	
	Unstructured networks	
18	Network density	
	Dense networks	Clusters
	Linear networks	
	Clusters	
19	Network centralization	
	Monocentric networks	Monocentric networks
	Polycentric networks	
	Non-centralised networks	
20	Territorial scope	
	Local networks	Local networks
	Regional networks	
	National networks	
	International networks	
	Global networks	

Source: Author's study based on Barczak [2016], pp. 83, 86–89; Brilman [2002], pp. 426–427; Cygler [2002], p. 156–157; Dolińska [2002], p. 23; Domański and Marciniak [2003], p. 3–4; Castells [2007], p. 195; Korenik [2003], p. 20; Penc [1999], p. 9; Koźmiński [2004], p. 40; Lichtarski [1993], p. 421; Niemczyk et al. [2012], p. 108.

**Table 5.** Energy cluster as a form of company network – common features and differences

Business networks	Porter cluster	Energy cluster
<b>Common features</b>		
loose connections		
reciprocity of benefits		
voluntary union		
investing in building relationships		
transfer of resources between units		
creating and strengthening information channels		
independence of individuals in economic and legal terms		
interdependence of entities on resources controlled by other companies		
<b>Differences</b>		
no territorial restrictions	spatial concentration of entities	spatial concentration of entities
cooperation	competition and cooperation	co-production and cooperation
implementation of own goals by individual network entities	activation of a region	activation of the region
inward action	existence of an entrepreneurial company	existence of an entrepreneurial company (coordinator)
	outdoor operation	inwards and outwards operation

Source: Author's study based on: Skawińska and Zalewski [2009], p. 170; Santarek et al. [2005]; Rosińska [2005b]; Brodzicki and Szultka [2002].

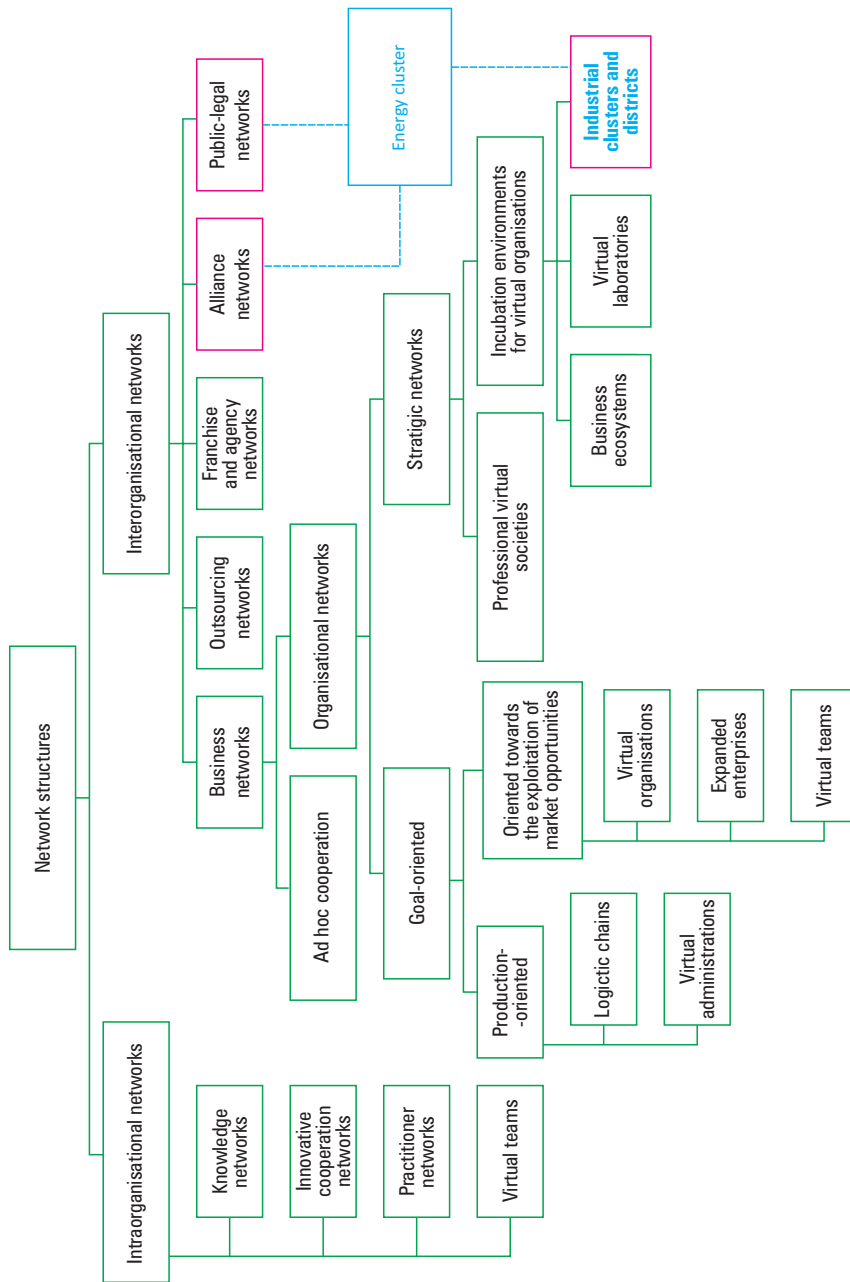
#### 4. An attempt in characterisation and definition of an energy cluster

Taking into account the above considerations, it is possible to start an initial assignment of an energy cluster against the background of network structures, which is illustrated in Figure 1.

Energy cluster, in effect of its situation in the scheme of network structures, is an interorganisational network, and a business-public-legal alliance, which can be treated as a specific 'economic office'. This corresponds to M.H. Bestem's statement that 'a cluster of companies is a collective company' [Best 2001, p. 81; Skawińska and Zalewski 2009, p. 175]. The description of a network enterprise proposed by M. Castells also seems to be very accurate here:

'[It is] the organizational form built around business projects resulting from the cooperation between different components of different firms, networking among themselves for the duration of a given business project, and reconfiguring their





Source: Author's study based on Barczak [2016], p. 84; Camarinha-Matos and Afsarmanesh [2003], pp. 33–46; Dzidowski 2011, p. 90.

Fig. 1. Energy cluster in relation to network structures

networks for the implementation of each project. [...] Thus, the network enterprise is neither a network of enterprises nor an intra-firm, networked organization. Rather, it is a lean agency of economic activity, built around specific business projects, which are enacted by networks of various composition and origin: the network is the enterprise. While the firm continues to be the unit of accumulation of capital, property rights (usually), and strategic management, business practice is performed by ad hoc networks. These networks have the flexibility and adaptability required by a global economy subjected to relentless technological innovation and stimulated by rapidly changing demand' [Castells 2001, pp. 80–81; Barney 2008, pp. 100–101].

This allows us to conclude that entities in an energy cluster, become a part of an industry, despite not belonging to it initially, by creating a network of strategic alliances. At the same time, they remain with their core business and therefore there is no competition in the implementation of the alliance. Therefore, for an energy cluster not competition, but rather energy security and ecology is the goal.

Summarising the above considerations and at the same time taking into account the importance of prosumers as producers and consumers and cooperation as cooperation within the same activities, and competition within other activities, the following definition of an energy cluster can be proposed:

Regional interorganisational network, which is a business-public-legal alliance, constituting a concentration of mutually related prosumers, cooperating in the implementation of a specific project, through ties independent of the type of basic operation; the entities work closely together, and one of them has predominant power (the coordinator).

## References

- Asheim B., Isaksen A.** 2002. Regional Innovation Systems: The Integration of Local Sticky and Global Ubiquitous Knowledge. *Journal of Technology Transfer*, 2, 1.
- Baker W.E., Faulkner R.R.** 2002. Interorganizational Networks. In: *The Blackwell Companion to Organizations*. Ed. A.C. Baum. Blackwell Publishers Ltd., Oxford.
- Barczak B.** 2016. *Koncepcja oceny efektywności struktur sieciowych*. Wydawnictwo Uniwersytetu Ekonomicznego w Krakowie, Kraków.
- Barney D.** 2008. *Spółeczeństwo sieci*. Wydawnictwo Sic!, Warszawa.
- Becattini G.** 1991. Italian Industrial Districts: Problems and Perspectives. *International Studies of Management and Organization*, 21, 1.
- Becattini G., Bellandi M., De Propris L.** 2009. *Handbook of Industrial Districts*. Edward Elgar Publishing, Cheltenham.
- Bellandi M.** 2007. Industrial Districts and Waves of Industrialization: A Rich and Contested Terrain. *Italian Journal of Regional Science*, 6, 2.
- Bengtsson M., Kock S.** 1999. Cooperation and Coopetition in Relationship between Competitors in Business Networks. *Journal of Business & Industrial Marketing*, 14, 3.
- Best M.H.** 2001. *The New Competitive Advantage. The Renewal of American Industry*. Oxford University Press, Oxford.
- Brilman J.** 2002. *Nowoczesne koncepcje i metody zarządzania*. PWE, Warszawa.

- Brodzicki T., Szultka S.** 2002. Koncepcja klastrów a konkurencyjność przedsiębiorstw. *Organizacja i Kierowanie*, 4 (110). Warszawa.
- Camarinha-Matos L.M., Afsarmanesh H.** 2003. A Roadmap for Strategic Research on Virtual Organizations. In: L.M. Camarinha-Matos, H. Afsarmanesh. *Processes and Foundations for Virtual Organizations*. Kluwer Academic Publishers, Boston.
- Castells M.** 2001. *The Internet Galaxy: Reflections on the Internet, Business and Society*. Oxford University Press (Polish edition: *Galaktyka internetu*. Rebis, Poznań 2003).
- Castells M.** 2007. *Spółczesność sieci*. PWN, Warszawa.
- Cegle G., Dini M.** 2015. SME Cluster and Network Development in Development Countries: The experience of UNIDO. UNIDO Private Sector of Development Branch Investment Promotion and Industrial Capacity Building Division, Vienna 1999, p. 2: [http://unido.org/fileadmin/user\\_media/Services/PSD/Clusters\\_and\\_Networks/publications/ceglie\\_dini.pdf](http://unido.org/fileadmin/user_media/Services/PSD/Clusters_and_Networks/publications/ceglie_dini.pdf)
- CLOE.** 2014. What is a cluster? Regional Stakeholders. Cluster Linked Over Europe. <http://www.clusterforum.org>
- Cooke P.** 2002. *Knowledge economies: Clusters, learning and cooperative advantage*. Routledge, London.
- Crouch C., Farrell H.** 2001. Great Britain: Falling through the Holes in the Network Concept. In: C. Crouch. *Local Production Systems in Europe: Rise or Demise?* Oxford University Press, Oxford.
- Cygler J.** 2002. Organizacje sieciowe jako forma współdziałania przedsiębiorstw. In: M. Romanowska, M. Trocki. *Przedsiębiorstwo partnerskie*. Difin, Warszawa.
- Cygler J.** 2007. Kooperacja – nowy typ relacji między konkurentami. *Organizacja i Kierowanie*, 2.
- DeBresson C.** 1996. Why innovative activities cluster. In: C. DeBresson. *Economic Interdependence and Innovative Activity: An Input-Output Analysis*. Edward Elgar, Cheltenham, UK, 149–164.
- Delporte-Vermeiren D., Vervest P., Van Heck E.** 2004. In Search of Margin for Business Networks: The European Patent Office. *European Management Journal*, 22, 2.
- Dolińska M.** 2002. Działalność organizacji wirtualnych w sieci powiązań. *Organizacja i Kierowanie*, 107, 12.
- Domański R., Marciniak A.** 2003. *Sieciowe koncepcje gospodarki miast i regionów*. CXII, KPZK, PAN, Warszawa.
- Drelich-Skulska B., Jankowiak A.H., Mazurek S.** 2014. Klastry jako nośnik innowacyjności przedsiębiorstw i regionów. Czy doświadczenia azjatyckie można wykorzystać w warunkach gospodarki polskiej? Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław.
- Drucker P.** 1998. The New Organisation. *Harvard Business Review*, 1–2.
- Dwojacksi P., Nogalski B.** 1998. Tworzenie struktur sieciowych jako wynik restrukturyzacji scentralizowanych przedsiębiorstw. *Przegląd Organizacyjny*, 4.
- Dzidowski A.** 2011. Ocena efektywności współpracy przedsiębiorstw w strukturach sieciowych. In: H. Brdulak, E. Dulinić, T. Gołębiowski. *Współpraca w łańcuchach dostaw a konkurencyjność przedsiębiorstw i kooperujących sieci*. Zeszyty Naukowe Kolegium Gospodarki Światowej, 32, Warszawa.
- Enright M.J.** 1996. Regional Cluster and Economic Development: A Research Agenda. In: U.H. Staber, N.V. Schaefer, B. Sharma. *Business Networks: Prospects for Regional Development*. Walter de Gruyter, Berlin.
- ETCoI.** 2015. *European Trend Chart on Innovation. Thematic Report Cluster Policies, Covering Period up to March 2003*. European Commission Enterprise Directorate General, p. 3. [http://www.cnel.gov.pt/document/cluster\\_policiesreport.pdf](http://www.cnel.gov.pt/document/cluster_policiesreport.pdf)

- EU. 2003. Final report of the expert group on enterprise clusters and networks. European Commission – Enterprise Directorate General.
- Feser E.J. 1998. Old and new theories of industry clusters. In: *Clusters and Regional Specialisation: On Geography, Technology and Networks*. Pion, London.
- Gancarczyk M. 2012. Koncepcja sieci z perspektywy teorii kosztów transakcyjnych. *Contemporary Management Quarterly*, 3.
- Glävan B. 2008. Coordination failures, clusters theory and entrepreneurship: A critical view. *The Quarterly Journal of Austrian Economics*, 11(1).
- Gorynia M., Jankowska B. 2007. Koncepcja klastrów jako sposób regulacji zachowań gospodarczych. *Ekonomista*, 3.
- Gorynia M., Jankowska B. 2008. *Klastry a międzynarodowa konkurencyjność i internacjonalizacja przedsiębiorstwa*. Difin, Warszawa.
- Gorynia M., Jankowska B. 2009. Kooperacja w klastrze jako instytucja gospodarki rynkowej na przykładzie trzech klastrów z Wielkopolski. *Prace Naukowe Uniwersytetu Ekonomicznego we Wrocławiu*, 74. *Ekonomia 3. Mikroekonomia i ekonomia instytucjonalna*. Wydawnictwo Uniwersytetu Ekonomicznego we Wrocławiu, Wrocław.
- GUS. 2005. *Działalność innowacyjna przedsiębiorstw w sektorze usług w latach 2000–2003*. GUS, Warszawa.
- Hampfrey J., Schmitz H. 1995. *Principles for Promoting Clusters and Networks of SMEs*. UNIDO, Vienna.
- Hatch M.J. 2002. *Teoria organizacji*. Wydawnictwo Naukowe PWN, Warszawa.
- Higgins K.L., Maciariello J.A. 2004. Leading Complex Collaboration in Network Organizations. A Multidisciplinary Approach. *Advances in Interdisciplinary Studies of Work Teams*, 10.
- Hołub-Iwan J., Wielec Ł. 2014. *Opracowanie systemu wyboru Krajowych Klastrów Kluczowych (Raport I „Charakterystyka krajowego klastra kluczowego w oparciu o analizę źródeł wtórnych”*. PARP, Warszawa.
- Jacobs D., de Man A.P. 1996. Clusters, industrial policy and firm strategy: A menu approach. *Technology Analysis and Strategic Management*, 8(4).
- Kazojć K. 2016. *Model transferu technologii w klastrach morskich w Polsce*. CeDeWu, Warszawa.
- Każmierski J. 2012. *Rozwój i zarządzanie strukturami*. Wydawnictwo Uniwersytetu Łódzkiego, Łódź.
- Knop L. 2013. *Zarządzanie klastrem. Koncepcje, strategie, modele*. Wyd. Politechniki Śląskiej, Gliwice.
- Korenik S. 2003. *Dysproporcje w rozwoju regionów Polski – wybrane aspekty*. Wydawnictwo Akademii Ekonomicznej we Wrocławiu, Wrocław.
- Kowalski A.M. 2010. Kooperacja w ramach klastrów jako czynnik zwiększania innowacyjności i konkurencyjności regionów. *Gospodarka Narodowa*, 5–6.
- Koźmiński A.K. 2004. *Zarządzanie w warunkach niepewności: Podręcznik dla zaawansowanych*. PWN, Warszawa.
- Lichtarski J. 1993. *Współdziałanie gospodarcze przedsiębiorstw*. PWE, Warszawa.
- Lis A.M., Lis A. 2014. *Zarządzanie kapitałami w klastrach. Kapitał społeczny, kulturowy, ekonomiczny i symboliczny w strukturach klastrowych*. Difin, Warszawa.
- Lundvall B.A., Borrás S. 1997. *The Globalising Learning Economy: Implications for Innovation Policy*. Brussels: Report for DG XII, Commission of the European Union.
- Łobos K. 2005. *Struktury sieciowe*. In: R. Krupski. *Zarządzanie przedsiębiorstwem w turbulentnym otoczeniu*. PWE, Warszawa.
- Marshall A. 1925. *Zasady ekonomiki*, t. 1. Wydawnictwo M. Arcta, Warszawa.

- Martin R., Sunley P.** 2003. Deconstructing clusters: chaotic concept or policy panacea? *Journal of Economic Geography*, 3(1).
- Maskell O., Kebir L.** 2005. What Qualifies as a Cluster Theory. DRUID, Working Paper, nr 05–09.
- Maskell P., Kebir L.** 2014. What Qualifies as a Cluster Theory? DRUID Working Paper No. 05–09. <http://www3.druid.dk/wp/20050009.pdf>
- Matusiak K.B.** 2005. Innowacje i transfer technologii. Słownik pojęć. PARP, Warszawa.
- McDonald F., Beluss F.** 2002. Industrial Districts: A State of the Art Review. Project West-East ID Industrial Districts Re-Location Processes: Identyfying Policies in the Perspective of the European Union Enlargement. Instituto G.Tagliacarne, Rome.
- Ministerstwo Gospodarki. 2006. Rozporządzenie Ministra Gospodarki z dnia 2 grudnia 2006 roku w sprawie udzielania przez Polską Agencję Rozwoju Przedsiębiorczości pomocy finansowej niezwiązanej z programami operacyjnymi.
- Ministerstwo Gospodarki. 2008. Rozporządzenie Ministra Gospodarki z dnia 1 września 2008 roku (Dz.U. 161, poz.1003).
- Morosini P.** 2004. Industrial Clusters, Knowledge Integration and Performance. *World Development*, 32, 2.
- Mukherjee A.S.** 2009. Leading the Networked Organizations. *Leader to Leader*, 52.
- Munnich L.W.** 1999. Industry Clusters: An Economic Development Strategy for Minnesota Preliminary Report. University of Minnesota Service.
- Niemczyk J., Stańczyk-Hugiet E., Jasiński B.** 2012. Sieci międzyorganizacyjne. Współczesne wyzwania dla teorii i praktyki zarządzania. Wydawnictwo C.H. Beck, Warszawa.
- OECD. 2004. Clusters in Transition Economies (draft). OECD LEED Programme, Paris.
- Olesiński Z.** 2010. Zarządzanie relacjami międzyorganizacyjnymi. Wydawnictwo C.H. Beck, Warszawa.
- Padmore T., Gibson H.** 1998. Modeling regional innovation and competitiveness. In: J. de la Mothe, G. Paquet. *Local and Regional Systems of Innovation*. Kluwer Academic Publishers. Boston, Dordrecht, London.
- PARP. 2017. [http://www.pi.gov.pl/klastry/chapter\\_95882.asp](http://www.pi.gov.pl/klastry/chapter_95882.asp); [http://www.pi.gov.pl/PARP/chapter\\_96055.asp?soid=F7B02F71548C419C99DF4BD6CE9A412A](http://www.pi.gov.pl/PARP/chapter_96055.asp?soid=F7B02F71548C419C99DF4BD6CE9A412A)
- PARP. 2017a. Standardy zarządzania klastrem. [http://www.pi.gov.pl/PARPFiles/file/klastry/PARP\\_Standardy\\_zarzadzania\\_klastrem\\_2016.pdf](http://www.pi.gov.pl/PARPFiles/file/klastry/PARP_Standardy_zarzadzania_klastrem_2016.pdf)
- Penc J.** 1999. Strategie zarządzania. Placet, Warszawa.
- Perechuda K.** 2005. Dyfuzja wiedzy w przedsiębiorstwie sieciowym. Wizualizacja i kompozycja. Wydawnictwo Akademii Ekonomicznej we Wrocławiu, Wrocław.
- Phillips R.A.** 2010. Ethics and Network Organizations. *Business Ethics Quarterly*, 3.
- Pilarska C.** 2013. Klastry. Doświadczenia Polski i innych krajów Unii Europejskiej. Wydawnictwo Uniwersytetu Ekonomicznego w Krakowie, Kraków.
- Pitelis C., Sugden R., Wilson J.R.** 2006. Cluster and Globalisation. *The Development of Urban and Regional Economies*. Edward Edgar, Northampton.
- Porter M.E.** 1998. *On Competition*. Harvard Business School Press, Boston.
- Porter M.E.** 2000. Location, Competition and Economic Development: Local Clusters in the Global Economy. *Economic Development Quarterly*, 14(1).
- Porter M.E.** 2001. Porter o konkurencji. Wyd. PWE, Warszawa.
- Rabelotti R.** 1995. Is There an Industrial District Model? Footwear Districts in Italy and Mexico Compared. *World Development*, 23(1), 29–41.
- Roelandt T.J., den Hertog P.** 1999. Cluster Analysis and Cluster-Based-Policy Making: The State of the Art. In: *Boosting Innovation: The Cluster Approach, Regional Clusters in Europe*. OECD, Paris.

- Rosenfeld S.A. 1996. *Overachievers: Business Clusters that Work. Prospects for Regional Development*. Regional Technology Strategies. Inc. Carborro NC.
- Rosenfeld S.A. 1997. *Bringing Business Cluster sinto Mainstream of Economic Development*. European Planning Studies, 5, 1.
- Rosińska M. 2005a. *Podjęcie sieciowe jako element koncepcji poprawy konkurencyjności przedsiębiorstw we współczesnej gospodarce (na przykładzie strategii rozwoju przedsiębiorczości Unii Europejskiej)*. In: Ed. J. Bilski. *Polska na rynku Wspólnoty Europejskiej. Gospodarka światowa na progu XXI wieku, t. 2*. Łódzkie Towarzystwo Naukowe, Łódź.
- Rosińska M. 2005b. *Sieci biznesowe jako forma integracji celu optymalizacji warunków działania na rynku globalnym – ujęcie teoretyczne*. In: Ed. E. Najlepszy. *Biznes międzynarodowy a internacjonalizacja gospodarki narodowej*. AE, Poznań.
- Santarek K., Kosieradzka A., Rafalski R. 2005. *Struktury sieciowe przedsiębiorstw*. Wyd. Politechniki Warszawskiej, Warszawa.
- Simmie J., Sennett J. 1999. *Innovation in the London Metropolitan Region*. In: D. Hart. *Innovative Clusters and Competitive Cities in the UK and Europe*. Oxford Brookes School of Planning, Working Paper No. 182.
- Skawińska E., Zalewski R.I. 2009. *Klastry biznesowe w rozwoju konkurencyjności i innowacyjności regionów. Świat – Europa – Polska*. Polskie Wydawnictwo Ekonomiczne, Warszawa.
- Söllvell Ö. 2009. *Clusters – Balancing Evolutionary and Constructive Forces*. Ivory Tower Publishers, Stockholm.
- Sproull L., Kiesler S. 1992. *Connections: New Ways of Working in the Networked Organization*. Long Range Planning, 2.
- Steinle C., Schiele H. 2002. *When do industries cluster?: A proposal on how to assess an industry's propensity to concentrate at a single region or nation*. *Research Policy*, 31 (6), 849–858.
- Strategor. 2001. *Zarządzanie firmą. Strategie, struktury, decyzje, tożsamość*. PWE, Warszawa.
- Swann P., Prevezer M. 1996. *A comparison of the dynamics of industrial clustering in computing and biotechnology*. *Research Policy*, 25(7), 1139–1157.
- Swann P., Prevezer M. 1998. *A Comparison of the Dynamics of Industrial Clustering in Computing and Biotechnology*. Oxford University Press.
- Sydow J. 1999. *Mitbestimmung in Unternehmensnetzwerken – Eine betriebswirtschaftliche Analyse*. In: Eds: B. Frick, W. Streeck, N. Kluge. *Die wir Folgen der Mitbestimmungschafflichen*. Campus, Frankfurt, New York.
- Thorelli H.B. 1986. *Networks: between Markets and Hierarchies*. *Strategic Management Jouran*, 7.
- UNIDO. 2001. *Development of Clusters and Networks of SMEs*. UNIDO, Vienna.
- Ustawa OZE o odnawialnych źródłach energii. Dz.U. 2016, poz. 925, 1579 (luty 20, 2015).
- Van den Berg L., Braun E., Van Winden W. 2001. *Growth Clusters in European Cities: An Integral Approach*. *Urban Studies*, 38, 1.
- Van Dijk M.P., Sverrisson Á. 2003. *Enterprise clusters in developing countries: mechanism of transition and stagnation*. *Entrepreneurship & Regional Development*, 15(3).
- Wiśniewska J., Janasz K. 2015. *Innowacje i procesy transferu technologii w strategicznym zarządzaniu organizacjami*. Difin, Warszawa.