# 13

# DEVELOPMENT OF CLUSTER THEORY – BIBLIOGRAPHY STUDY

## 13.1 DEFINITION AND TYPOLOGIES OF A CLUSTER

Clusters constitute one of many concepts of territorial forms of production organization which include among others: „industrial district", "industrial cluster", "production chain", "growth pole", "innovation environment", "local production system". Concepts synonymous to clusters are presented in Table 13.1.

**Table 13.1 Synonymous concepts to the concept of clusters**

| Concept | Researcher |
|---|---|
| **Industrial district** | A. Marshall, G. Becattini |
| **Growth pole** | F. Perroux, O. Hirschman |
| **Development blocks** | Dahmen E. |
| **Competence blocks** | A-Ch. Fridh |
| **Industrial complex** | I, Drejer, F., (S. Kristensen K. Laursen) |
| **Production chains** | D. Jacobs, A. P. De Man |
| **Technopoles** | Castells M., Hall P. |
| **Innovative systems** | Lundval, Edquist, H., J. Braczyk, P. Cooke, M. Heidenreicha |
| **Innovative milleux** | Researchers of Groupe de Recherche Européen sur les Milieuc Innovateurs |
| **Learning regions** | Asheim, Simmie |
| **Networks** | OECD |

Source: [4]

Most scholars who deal with the discussed issue believe that the clusters theory was created by Alfred Marshall (1842-1924). He studied selected industrial centers in Great Britain paying attention to their location and production profile. The result of his studies was the concept of industrial district, which explained the reasons and benefits of companies working in geographical vicinity. He presented his observations in a book called Principles of Economic.

Among other scholars who developed the theory of clusters there are: Francois Perroux, Giacomo Becattini, Paul Robin Krugman and Michael E. Porter. F. Perroux introduced the concept of a "growth pole" understood as a grouping of industries around a central core of key industry. The premise of the concept proposed by the

French economist was that growth poles affect the polarization of economic growth [22].

G. Becattini, who studied Italian industrial agglomerations, drew on Marshall's theory and noticed that the reason behind the agglomerations' successes were industrial districts as defined by Marshall. Additionally, Becattini highlighted the importance of social and cultural conditions for the local production. He defined industrial district as a social and territorial unit where local companies merge with local communities and their traditions [1].

Krugman is believed to have created the theory which explains the reasons for global urbanization. According to this American Nobel-winning economist, operating within clusters brings about economies of scale relating to transport and trade costs [19]. The term 'cluster' in the economic sense was first used by Michael E. Porter. According to Michael Porter "a cluster is geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions in particular fields that compete but also co-operate" [23]. The other definitions of a cluster which can be found in the literature are presented below:

- cluster is a geographically bounded concentration of similar, related or complementary business, with active channels for business transactions, communication and dialogue, that share specialized infrastructure, labour markets and services. And that are faced with common opportunities and threats [25];
- cluster – localized agglomerations of firms in the same or related industries [8];
- cluster is a group of inter-related industries. They have two key elements. Firstly, firms in the cluster must be linked. Secondly, groups of inter-linked companies locate in close proximity to one other [38];
- cluster is a group of business enterprises and non-business organizations for whom membership within the group is an important element of each member firm's individual competitiveness. Non-business are often a critical element in the success of the cluster [2];
- cluster is sectoral and geographical concentrations of enterprises that produce and sell a range of related or complementary products and, thus, face common challenges and opportunities [34];
- clusters are geographically proximate firms in vertical and horizontal relationship, involving a localized enterprise support infrastructure with share developmental vision for business growth, based on competition and cooperation in a specific market field [6].
- a cluster is a process-conditioned structural and functional organizational system which operates according to the laws and administrative regulations in a certain socio-economic environment and whose efficiency is affected by its external as well as internal environment together with the patterns in which these coincide with and influence one another, which in turn are all affected by common systemic processes, especially those of homeostasis, synergy, entropy, specialization and equivalence [21].

On the basis of these definitions we can see that the attributes of a cluster which are given most frequently are the following:

- geographical proximity of connected enterprises operating in related sectors,
- interactions and horizontal and vertical interconnections between firms and public and scientific research institutions,
- competition and cooperation.

Using different definitions of a cluster and different identification methods leads to a conceptual and empirical confusion. Therefore, numerous attempts at classifying clusters are made in the literature [3, 4, 10, 11, 24, 29, 30, 38]. According to Jacobs and de Man all clusters can be divided into three categories stressing the diverse nature of economic activities taking place in them [11]:

- a regional concentration of business activity of firms from related sectors, usually connected with knowledge centers (science and research centers, universities etc.),
- vertically integrated production chains, narrowly defined sectors, in which the successive stages of the production process are the cluster's core; networks around the core of the cluster's largest firms,
- clusters as entire sectors or industries defined on the basis of highly geographically aggregated data.

According to Meyer – Stamer there are three types of clusters defined on the basis of their organisational structure [11]:

- clusters similar to Italian industrial districts, where there are connections mainly among specialized companies in SME sector. Companies within this type of cluster are highly specialized, mutually competitive and they trust their partners. The cooperation of the companies within such a type of cluster allows them to be flexible within their field, makes them highly productive and creates a great innovative potential.
- hub-and spoke clusters, where there are hierarchical connections among local companies and a large group of companies in SME sector. This type of cluster relies mainly on the power of big corporations, and at the same time is flexible and uses its many advantages mainly relating to the cost.
- satellite clusters with the key participation of small and medium enterprises which depend on outside companies, whose location advantage mainly relates to lower production costs.

Similar typology is presented by A. Markusen [20]. Apart from the three types mentioned above he proposes a fourth type, so called state-based industrial district. The basis of such a cluster are public or non-profit institutions such as a research unit, a university or government administration. The development of companies within such a cluster depends on whether it is possible to transfer technologies from the "base" institution to other cluster entities.

Rosenfeld, after Enright suggested a classification according to the cluster's stage

of development, paying special attention to the role of social capital. On this basis he distinguished the following [25]:

- active clusters – those which have achieved a critical mass and whose members function as an effective system using the existing potential for creating a competitive edge within the cluster. An important element of clusters of this type are social institutions creating a friendly atmosphere,
- latent clusters – clusters which have achieved a critical mass due to the number of firms from a given sector, but which cannot yet make use of synergy effects due to the absence of relevant public institutions,
- potential clusters – clusters which could come into existence if additional conditions/resources were provided. Usually these are clusters which require support from the state in the form of financial resources.

According to Gordon and McCann, there are three forms of territorial organization of production clusters. [9]:

- the model of pure agglomeration,
- the industrial-complex model,
- the social-network model.

The differences among the above forms regard mainly:

- the size of the companies within the groups,
- the nature of relations between the companies,
- the characteristics of the area,
- analytical approach.

According to Gordon and McCann it is crucial to match the studied subject with the forms of the production organization identified by scientists. Specialist literature divides clusters by the character of the activity. Thus, there may be defined four types of clusters [26]:

- industrial clusters,
- agricultural and food production clusters,
- service clusters,
- advanced technology clusters.

Another classification of clusters will be connected with the country of their origin. There are three models of clusters [37]:

- the Italian model – based on informal connections between companies with strong family bonds,
- the Danish model – there, a network broker coordinating the cluster activities plays and important part,
- the Dutch model – characterized by a cooperation of enterprises with a research and science institution.

According to M.H. Best there are two models of clusters: static and dynamic. Static clusters work with limited innovations taking advantage of the economics of location.

Dynamic clusters, however, are characterized by being innovative, by their constant perfection of processes, employees and services. According to Best most industries work on the basis of the static cluster model [26]. The criterion of cluster classification adopted by OECD is their innovative character. The Organization of Economic Co-operation and Development distinguished the following [36]:

- clusters based on knowledge – clusters grouped around research institutes and universities due to an immediate access to basic and public research done by these institutions,
- clusters based on economies of scale – systems based on large scale of production, and the innovative efficiency of the companies is based on the knowledge gained elsewhere, especially with regard to innovations of production process,
- clusters relying on the supplier – the companies tend to acquire technologies, mainly as capital good and intermediate products; their innovative character is defined by the ability to cooperate with the service providers,
- clusters of specialized suppliers – the companies spend considerable amounts on research and product innovations and usually cooperate closely with clients and users.

UK Department of Trade and Industry has applied the following typology of clusters [38]:

- clusters based on the value added chain,
- aggregation of related sectors,
- regional clusters,
- industrial districts,
- network,
- innovative environment.

Dijk and Sverisson propose a similar cluster typology. Main criterion is the cluster development stage. The scientists define the following types of clusters [10]:

- local cluster – companies situated close to one another, their operation is mainly imitating products,
- local market – geographical grouping of the companies operating within similar industries which concentrate mainly on product development, looking for niches and developing sales strategies,
- local network – there is a division of labour between the companies; the main operation is connected with complementary activities and gaining access to entities within supplementary industries and to clients,
- innovation cluster – its characteristic feature is developing innovations which can be later imitated in different locations,
- industrial area – a concentration of cooperation connections within an identifiable group of companies.

Researchers working within the project called SIECI {NETWORKS} carried out in Poland, in Silesia proposed the following models of clusters [16]:

- traditional cluster (regional, industrial) – small and big companies produce goods that belong to traditional sectors; the companies compete with one another (horizontal model) or operate along the value chain; the cluster may have a fixed structure, however, it is not essential, there might be informal agreements based on high level of trust; the cluster may be represented by a leader or a coordinator who will be responsible for gaining funds for its development; the value of traditional cluster for the economy lies in maintaining the production and consequently jobs and creating an industrial centre of a certain reputation and competitive potential; traditional clusters may still be discovered and supported thanks to regional and national programs offering financial support, among other things,
- innovation cluster – innovation-oriented cluster seeking financial support and know-how, within the cluster there are competing entities as well as R&D units, which may act as coordinators; the development of innovation clusters is affected by regional and national policies which focus on the development of businesses; so far in Poland clusters of this type have been organized and based on a leader or a group of leaders (Dutch model); trust is limited due to the innovative character of the ideas,
- network cluster – the companies within the cluster make up an organized network which has got a network broker gathering information on the sources of innovation, units completing the innovations and providing other business-related services; such network provides the flow of information as far as carrying out innovation programs is concerned.

The above classification is based on three mechanisms identified in the course of research which influence the structure of the cluster model:

- shaping of trust within clusters,
- structure and streamlining of knowledge management,
- specification of coordination and structure dimensions of clusters.

On the basis of the above cluster classification it can be observed that many authors stress the network character of the connections between the members of the cluster [7, 9, 10, 16, 23, 25, 30]. It must be emphasized, however, that one cannot identify cluster as network. The differences and similarities between a cluster and a network are shown in Table 13.2. According to Caron and Pouder clusters can be divided into two main types: technological and industrial. The researchers believe that these two types of clusters evolve from different regional resources and their growth depends on various technological industries. Besides, they gather resources in different ways, they have different capacities and they develop different competitive advantages.

Table 13.3 presents the differences between technological and industrial clusters.

**Table 13.2 Network versus luster**

| Cluster | Network |
|---|---|
| **Similarities** | |
| Investing in the creation of relationships<br>Creating and strengthening information channels<br>Transfer of resources between firms<br>Economic and legal independence of the companies<br>Mutual benefit<br>Dependence on resources controlled by other companies | |
| **Differences** | |
| Clusters have open 'membership'<br>Clusters are based on social values that foster trust and encourage reciprocity | Networks have restricted membership<br>Networks are based on contractual Agreements |
| key benefits:<br>Clusters generate demand for more firms with similar and related capabilities<br>Clusters attract needed specialized services to a region | key benefits:<br>Networks make it easier for firms to engage in complex business,<br>Networks allow firms access to specialized services at lower cost |
| Clusters take both cooperation and competition<br>Companies concentrated in a certain location<br>Clusters have collective visions<br>Action on the outsider | Networks are based on cooperation<br>Geographical proximity is not important<br>Networks have common business goals<br>Action insi de |

Source: [25, 26]

**Table 13.3 The differences between technology and industry clusters**

| Feature | Technology luster | Industry luster |
|---|---|---|
| **Regional redources** | Inventors with idiosyncratic technical knowledge<br>Entrepreneurs with idiosyncratic entrepreneurial insight<br>Accumulated entrepreneurial experience (knowledgeable attorneys, investors etc.)<br>Institutional infrastructure: universities, research units, venture capital, networks, labs, large customers | Suppliers, distributors, skilled labor<br>Ondustry-specific specialists, consultants, service providers<br>Institutions such as trade associations |
| **Source of regional competitive advantage** | Technology transfer capability in the region<br>Different markets | Tier suppliers with related products and services, reduced costs of supply, reduced supply uncertainty |
| **Growth driver** | The formation of new businesses, including spin-offs | Attracting new subcontractors, suppliers and competitors, and thus, easier access to the entire network |
| **Key regional vulnerability** | Uncertainty about the effects of technology implementation (possible boom or bankruptcy). The risk of using one technology, hence the need for greater diversification | The dependence of the region from one industry. |
| **Strategic analogy** | Diversification associated with the ability to create synergies by sharing resources | The concentration of one type of industries with vertical linkages |

Source: [5]

## 13.2 CLUSTER DEVELOPMENT PROCESS

Most definitions quoted in chapter 1 present a static (structural) nature of a cluster. However, some researchers (Rosweld, Motoyama, Stachowicz, Mrozowicz, and Góra) see cluster as a dynamic structure based on relations and connections among the entities within. They believe that clusters should be seen as a process. A process is a set of interconnected resources and activities which transform the input state into the output state. A development of any system is a chronological series of changes to this system. Thus, a cluster development process is understood as a set of resources and activities existing from the moment of a cluster's formation to its decline or transformation.

Mrozowicz [21] stresses the importance of dynamic functions carried out within a cluster and proposes a cluster model that demonstrates the relations between the static elements of a discussed structure and dynamic processes carried out within the structure (see Table 13.4).

**Table 13.4 Structural and functional attributes of a cluster**

| **Structural attributes of a cluster**<br>**Cluster as an organizational structure** | **Functional attributes of a cluster**<br>**Cluster as an organizational process** |
|---|---|
| Government institutions, local government, authorities and administration of different levels<br>Universities, research and development centers, science institutes<br>Bridging institutions, business environment, consulting companies, business incubators, development agencies, technology transfer centers, industry associations<br>Financial, insurance, consulting, technical and legal institutions<br>Enterprises, manufacturers, suppliers, clients, service providers, sales centers<br>Infrastructure and industrial parks together with superstructure<br>Government and a programs<br>Policy of land utilization of a given administration area | Generating and maintaining the market advantage by applying consistent policy as a result of proper recognition and use of specific local resources<br>Aggregation of entities up to the cluster critical threshold<br>Local concentration of cluster entities<br>Cooperation and competition within functional bonds (formal and informal)<br>Vertical and horizontal cross-sector connection networks within same or similar industries<br>Transfer of organization resources (production, knowledge, marketing strategy, etc.)<br>Creating the atmosphere of internal identity, organization culture and ethical behavior towards key partners and competitors<br>Creating and promoting local business culture and innovations |

Source: [21]

## 13.3 CLUSTER'S LIFE CYCLE

Clusters have their life cycles. An appropriately identified development stage of a cluster is an important element in developing a proper policy for its development. One of the most comprehensive sources on clusters mentions 5 cycles of a cluster's life [39]:

- agglomeration – a region has many firms and institutions, however, there is no co-operation,
- formation phase – co-operation and network connections appear between the entities of the agglomeration;
- development phase – the cluster continues to develop, the number of entities and the strength of connections between them increase; the region becomes

an attractive place for new firms; the cluster starts being visible;

- the mature form – the critical mass is achieved; the cluster has relationships with external entities and regions; internal dynamics in the form of the creation of new spin-up, spin-off and joint-venture firms is visible.
- the decline or transformation phase – endogenous and exogenous changes taking place on the market e.g. those connected with technology or recipient's needs may lead to the cluster's decline; to prevent it the cluster evolves into another one or divides into several clusters focusing its activity around new industries, technologies or products.

L. Knop proposes a cluster life model accounting for crises that may occur during its development. According to the author of the model, recognizing their reasons at various stages makes it possible to seek new preventive measures, which are in turn the basis for the cluster's further development. Figure 13.1 presents the discussed model.

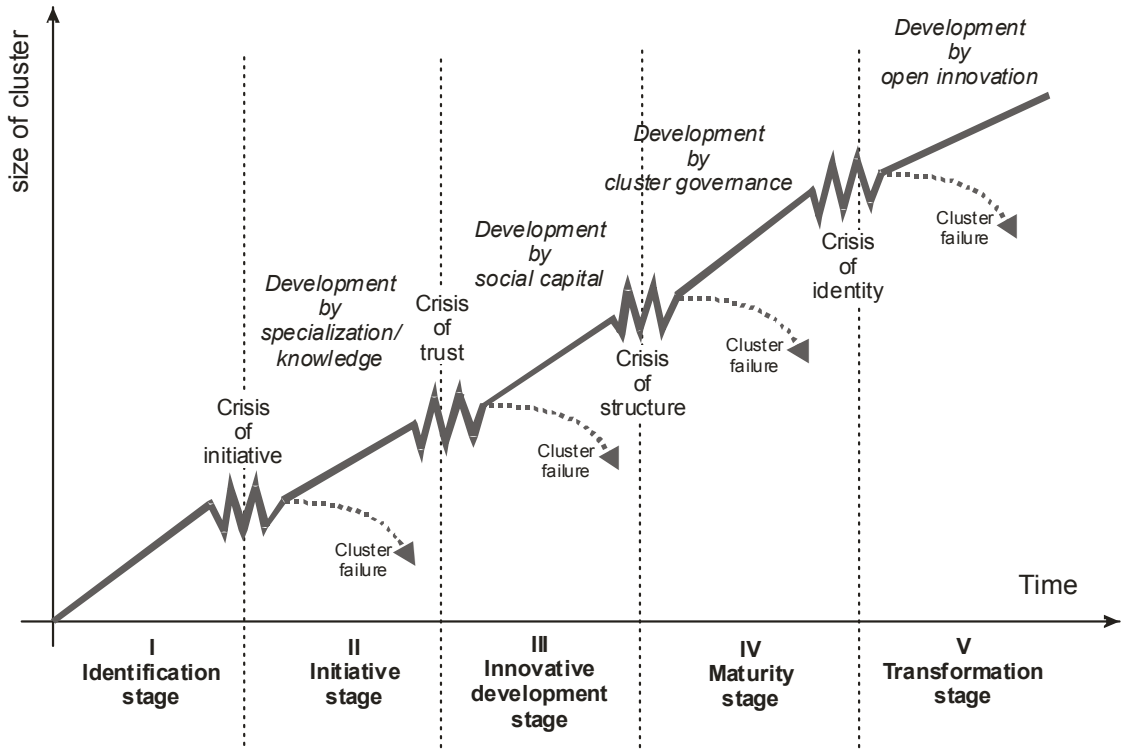


**Fig. 13.1 Model of cluster life-cycle with the crises occurring through the process**

Source: [13]

## 13.4 STAGES IN THE FORMATION AND DEVELOPMENT OF CLUSTERS

Many new guides have appeared in recent years on the process of formation and development of clusters/cluster initiatives. (for example [33, 34, 35, 38, 39]). The stages of cluster building suggested by various institutions are shown in Table 13.5.

It is a fact that one universal model for cluster formation and development cannot be created. However, as the table above indicates, 4 basic stages can be identified for all the clusters:

- identifying a cluster,
- preparing the vision and the mission,
- working out a co-operation strategy,
- implementing the plan and monitoring.

**Table 13.5 Cluster formation stages**

| No | Cluster linked over Europe [33] | International Organisation For Knowledge Economy and Enterprise Development [39] | National Research Council of Canada [40] |
|---|---|---|---|
| 1 | Building social capital | Building trust | Diagnosis: the analysis of the region and social capital |
| 2 | Strategic connections development | Connections | Activation: identifying a support person/group and the most important players |
| 3 | Defining the vision and strategy | Indicating the vision and strategy | Action plan: Where are we going ? |
| 4 | Taking action | Undertaking an activity | Implementation: starting and maintaining the process. |

Different activities are undertaken in different stages (Table 13.6) and different methods and tools are used for these activities.

**Table 13.6 Activities undertaken in respective cluster development stages**

| Development stage | Activities |
|---|---|
| **Identifying a luster** | Building an interest and participation<br>Defining key industries<br>Specifying the cluster's strong and weak points<br>Analyzing the enterprises |
| **Preparing the vision and the mission** | Formulate a technological specialization<br>Defining activities to be undertaken<br>Preparing a road map for the cluster<br>Specifying methods for monitoring and activity assessment |
| **Working out a cooperation strategy** | Choosing a desired management structure<br>Specifying an entity to manage the cluster<br>Preparing an R&D program |
| **Working out a co-operation strategy** | Preparing a program to develop the cluster's competitive position |
| **Implementing the plan and monitoring** | Integrating partners in order to achieve the critical mass<br>Financing<br>Managing the luster<br>Checking whether the activities within the cluster are compliant with the needs of the main players |

Source: [33]

Stachowicz proposed a particularly interesting Model for the Cluster Organization Process. According to him a cluster process is a social capital management process. The concept of the model is based in the assumption that clustering should be organized, analyzed, and assessed in three dimensions [27]:

- streamlining the notion, realization, completion and development of the clustering purpose
- streamlining clustering as a process of social capital management,
- streamlining clustering as a learning process – organizing the organization knowledge.

Accepting Stachowicz's assumptions and adopting three streamlining mechanisms of cluster management on the basis of social capital (chosen mechanisms of streamlining of cluster management on the basis of social capital: 1 - forming trust within clusters, 2 - forming and streamlining knowledge management, defining clusters' coordination and structural dimensions), the research team working on SIEĆ project proposed a clustering model and characterized its individual stages. Table 13.7 presents the list of the stages of cluster formation and development as well as the streamlining mechanisms of clustering.

**Table 13.7 The stages of cluster formation and mechanisms to rationalize the process of clustering**

| Cluster formation stages | Knowledge management | Coordination of activities, the structure of the cluster | Confidence | Funding |
|---|---|---|---|---|
| **Stage I - the identification of needs** | Selective globalization of knowledge | Loose form of meetings arranged by the principal initiator | The low level of confidence | External |
| **Stage II - the cluster initiative** | Concentrated globalization of knowledge + selective "diffusion of knowledge" | Thematic meetings - ideas of participants, the implementation of the central coordinating | Trust based on the realization of efficiency expectations. | External |
| **Stage III - the increase in cluster** | Concentrated diffusion of knowledge | Appointment of the Organization Coordinating the operation of the cluster | Trust based on expectations of axiological. | External + internal |
| **Stage IV - the maturity of the cluster** | Creating new knowledge | Developing standards of the network | Creating relational norms | Internal + external |
| **V stage - the transformation** | Transfer and diffusion of new knowledge for innovative projects | Entrepreneurial super organizations | Development of social and professional relations | Internal + external |

Source: [15]

Knop and Olko analyze the applied degree of formality in the cooperation networks activities and formalization cycles of network activities and observed that the network form does not emerge immediately but is shaped in the process of evolution (see Fig. 13.2). After analyzing several dozen of cooperation networks and clusters the researchers formed a model that accounts for the specifics of the cluster formalization in the system of changes to the degree of formality over time [14].

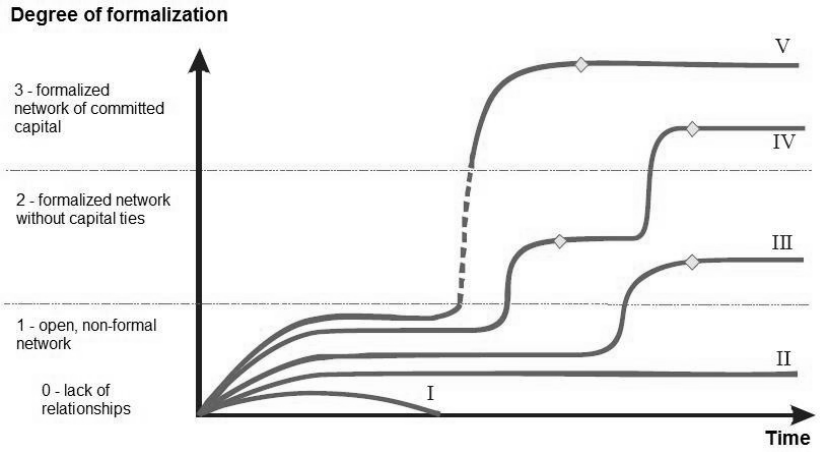


**Fig. 13.2 Processes of the network's formalization**

Source: [13]

The cycles presented in Figure 13.2 have the following qualities [14]:

I – Network entities at the initial stage of formalization share knowledge and recommend one another, however, due to lack of perspectives the network disintegrates;

II – Network is open, informal and acts in this form permanently;

III – Initially the network is open. After some time of acting together on the basis of mutual trust the members of the network decide to start a formal cooperation e.g. and an alliance based on an agreement, a society, a foundation. Starting a formal relation may be the basis for capital formalization, which is a next step in the formalization process;

IV – A cooperation network initially is open and informal in character and then progresses to the second level of formalization (capital form). Within the cycle the structure passes all degrees of formalization which allows the members of the network to build their mutual trust gradually.

V – A cooperation network starts out as an open network where the first formalization step is to take a capital form i.e. the third degree of formalization.

## CONCLUSIONS

The approaches to clusters presented in chapters 2 and 3 show that a cluster is a complicated form, which must be seen as both a structure and a process in relation with socio-economic conditions within the cluster and its environment.

The typologies presented in thi paper deal with numerous and very diverse criteria. Their choice may depend on the aim of the research being carried out as well as on the sector under analysis, the number and the kind of cluster members under review, the cluster's size, the market strategy applied etc. Unfortunately they are not sufficient to classify the cluster explicitly, which means that at the same time one cluster can be put into at least two categories within one classification. A good example may be the typology proposed by OECD, British Department of Trade and Industry, van Dijk and Sverisson, and scholars involved in project SIEĆ.

On the basis of literature research it can be stated that activities, methods and tools for cluster formation and management have already been developed. Their choice depends of course on the cluster's development stage. The activities, methods and tools suggested in numerous guides are mainly concerned with the formation of cluster initiatives.

In studies dealing with the process of formation and development of clusters the work of Polish scholars plays an important role. The model of cluster life cycle and the mechanisms of its formation presented in this chapter provide a new perspective on the complexity of clustering and imply that it is necessary to account for such management components as social capital and trust.

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# DEVELOPMENT OF CLUSTER THEORY – BIBLIOGRAPHY STUDY

***Abstract:*** *The Cluster Theory raises a lot of interest among scientists and government institutions. Internationally, there have been many studies published and empirical research conducted which help broaden the knowledge of clusters. The analysis of literature presented in this article indicates that the comprehension of the nature of creation and development of clusters requires knowledge of management, economics and economic sociology. The Cluster Theory must be viewed in relation to questions such as: regional development, relations within regional business structures, innovation, competitiveness and social capital.*

***Key words:*** *Cluster definitions, cluster attributes, clusters types, cluster dynamics*

# ROZWÓJ TEORII KLASTRÓW – STUDIUM LITERATURY

***Streszczenie:*** *Teoria klastrów wzbudza duże zainteresowanie zarówno wśród naukowców jak i instytucji rządowych. Na arenie międzynarodowej powstało wiele prac oraz przeprowadzono liczne badania empiryczne, które pozwoliły zgłębić wiedzę o klastrach. Zaprezentowana w niniejszym artykule analiza literaturowa wskazuje, iż zrozumienie istoty tworzenia i rozwoju klastrów wymaga wiedzy w zakresie nauk o zarządzaniu, ekonomii i socjologii gospodarczej. Teorię klastrów należy rozpatrywać w odniesieniu do co najmniej takich kwestii jak: rozwój regionalny, relacje w ramach regionalnych struktur działalności gospodarczej, innowacyjność, konkurencyjność firm oraz kapitał społeczny.*

***Słowa kluczowe:*** *Definicje klastra, atrybuty klastra, typy klastrów, dynamika klastra*

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