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CRISES IN THE CLUSTER LIFE-CYCLE

Lilla Knop,
Silesian University of Technology
Lilla.Knop@polsl.pl, Slawomir.Olko@polsl.pl

Slawomir Olko
Silesian University of Technology
Lilla.Knop@polsl.pl, Slawomir.Olko@polsl.pl

Abstract:
Industrial clusters and innovative networks became very important instruments of contemporary political economy as well as innovation policy. Especially during the period of current global crisis we can observe the growing tendency to business cooperation on regional level. The paper contains the model of development of industrial cluster, defining the stages of the cluster development as well as the typical crises corresponding to the development stages. The main goal of the article is presenting the model of the cluster creation process, the crises of cluster initiative which can appear and the recommendation for tempering of their effects. The model will be used to analysis of chosen clusters in Poland which are on the different stage of development. The practical approach of the model was based on observations and empirical studies that taken place in clusters in Poland - there is a part of researches, which are realized in project: The models of cluster management financed by Ministry of Science and Higher Education[1].

Keywords: industrial clusters, Poland.

[1] Project no. N N 115 244436 *"The models of cluster management",* realized 2009-2011, financed by Ministry of Science and Higher Education, project leader: Lilla Knop.

1. CLUSTER LIFE-CYCLE

The Grainer's model of organization's life cycle may relate to each type of organization including cluster. While defining the cluster the researchers refer the most often to M. Porter's approach according to which "Clusters are a geographically proximate group of interconnected companies and associated institutions in a particular field linked by commonalities and complementarities. Clusters encompass an array of linked industries and other entities important to competition including governmental and other institutions – such as universities, standard setting agencies, think tanks, vocational training providers and trade associations" (Porter, 1998). However, we should be aware of differences between typical organization described in management sciences that has organization boundaries, aims and owners demarcated (etc. enterprise) and cluster which is an organization created on principles of freedom.

Bergman E. M. (2008) has surveyed the contemporary approaches to the cluster life-cycle. The Bergman's theory was enhanced by concepts of other researchers including authors of this paper (see Table 1). It is worth noticing that in straight majority of approaches four stages are singled out and in addition the final stage is the stage referring to the stagnation (petrification, stagnating, exhaustion etc.). Meanwhile the observations of the mature clusters in the USA and Europe show that the maturity stage may lead for developmental transformation on condition of overcoming the crisis of identity. Therefore the analysis of the cluster life-cycle that takes into consideration crises occurring in particular phases of development is a useful tool for the rationalization of clustering process.

Table 1: Cluster life-cycles approaches

Cluster life-cycle sources	Cycle stages identified	Featured stage(s)	Evidence supplied	Principal purpose of contribution
Tichy (1998)	creation growth maturity petrification	All	Literature review, case illustrations and policy examples	Pose relevant policy actions at various cluster cycle stages
Swan (2002)	critical mass take-off peak entry saturation	All	'Entry' firm simulations modelled for tech-intensive clusters	Frameworks to evaluate UK/US bio-tech and computer clusters
Brenner (2004)	entry exit growth	All	Population ecology modelling of cluster	Propose complete cluster theory and life-cycle
Lorenzen (2005)	arise decline shift	All	Contribution of edited volume, editorial overview	Develop editorial framework
Hassink and Shin (2005)	positive negative	Lock-ins	Contribution of edited volume, editorial overview	Develop editorial framework
Bergman (2005)	formative growth	Maturity	Literature review, cluster survey	Sustainability factors tested

	maturity petrification		evidence, simple correlations	
Knop and Olko (2008)	identification initiative innovative development maturity transformation	all	Literature review, surveys of regional clusters in Silesia, Poland	KST model (knowledge, structure, trust); crises in the cluster life-cycle

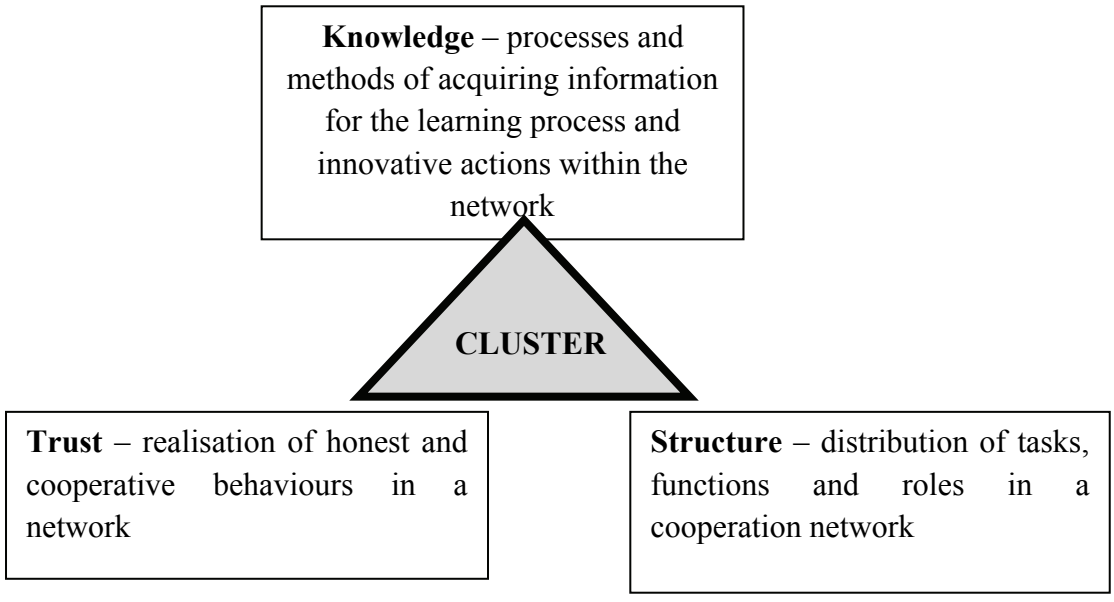
Source: Author's own studies based on Bergman, 2008; Knop & Olko, 2008.

2. CLUSTERING CONCEPTION – BASIC MECHANISMS OF THE CLUSTER DEVELOPMENT

The proposals of clusters creation stages were put forward by many researchers (see Table 1). Taking into consideration the basic stages of the process of cluster development and the results of study and empirical research (conducted in Poland) the model of the cluster life-cycle has been proposed, described by the authors of the paper (Knop & Olko, 2008). The model has the following stages:

I. *Identification* – a group of regional entitles (enterprises, scientific and administration units) identify a possibility of cooperation
II. *Initiative* – within the group an initiative persons identify specialization and knowledge to obtain/create
III. *Innovative development* – development of cluster based on carried project by cluster member or by cooperation and existing business networks within the cluster
IV. *Maturity* – during the stage of maturity cluster develops its structures and social responsibility, however, with decreasing its primary dynamics
V. *Transformation* – new ideas are the beginning of new networks and structures which results new cluster

Picture 1: Model KST (Knowledge, Structure, Trust) - three mechanisms of the cluster development



Source: Stachowicz & Knop, 2009; Knop, Krannich & Olko, 2009.

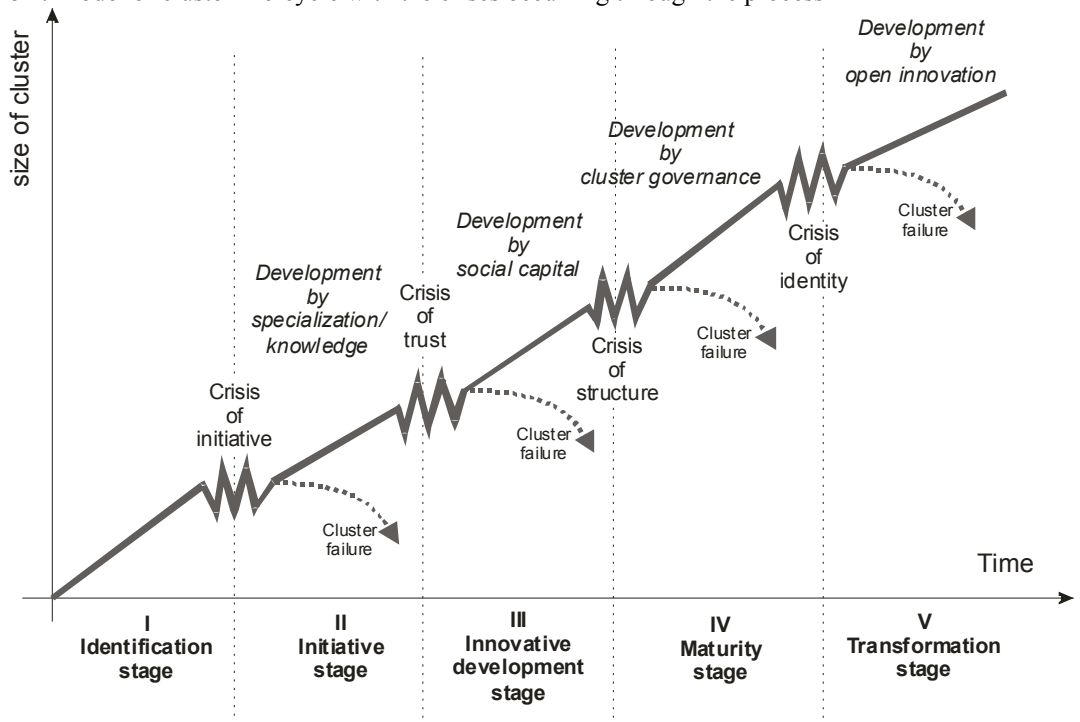
The applied Model of Cluster Organization Process (Stachowicz, 2006a) assumes the existence of three mechanisms of clusters management rationalization: building and rationalization of knowledge management (K), defining coordination and structure (S) dimensions of clusters, shaping trust (T) in clusters (see Picture 1). The essence of this approach is based on keeping a harmony of development of these mechanisms on every stage of cluster life-cycle. Weakening of that harmony causes crises whose reason is – according to the cognitive approach – the lack of different elements of knowledge: on the scope of cooperation, trust, structure, social capital.

3. CRISES IN THE CLUSTER LIFE CYCLE

According to the approved assumptions the authors propose the model of the cluster life-cycle (see Picture 2) that takes into consideration the possible crises that appear during the process of cluster's development. This model presents the cluster's development on two-dimensional axis using the following variables:

- Time – understood as an organizational time of developmental process, so it is a relative time, depending on situational factors.
- Size of cluster – may be presented as an absolute number of subjects creating cluster, so called critical mass, that is the number of subjects in cluster in relation to the total number of subjects in the sector and the complementary subjects in the region. However in more precise analyses we should examine the component factors of cluster's maturity that take into consideration such factors as: the growth of competition level of cluster, the growth of innovativeness level of cluster, the growth of social capital of cluster, the growth of trust (Fukuyama, 1997), reducing of transactional costs in relation to the external subjects. [2]

Picture 2: Model of cluster life-cycle with the crises occurring through the process



[2] These factors have been investigated in researches regarding development of clusters in the province of Silesia. The results are presented in the paper: Knop, Krannich & Olko, 2008.

Below the particular phases of the approved model were characterized, together with the occurring crises and the ways of their solutions.

I identification stage – identification of business organizations, support units, research and development centers, required in order to verify cooperation possibilities. This is the time for meetings with initiators and experts, presentation of benefits from cooperation, encouraging the assessment of own competences versus the competition and potential cooperation partners. This is the planning stage of a potential cluster. The main objective of this stage is to define the type of partners for potential cooperation in a cluster, identifying the domains activities, network of connections, internal functions and operational systems as well as initial planning of the possible conditions for mutual cooperation.

Table 1: Description of the I-st stage: identification

Goals	The main objective of this stage is to define the type of partners for potential cooperation in a cluster, identifying the domains activities, network of connections, internal functions and operational systems as well as initial planning of the possible conditions for mutual cooperation.
Innovation	Dependent on assumed principles of cooperation, however it is stressed that the basic assumption of cluster is development of innovation. An innovation constitutes a motivational factor for potential participants of cluster for undertaking further activities.
Knowledge	At this stage one deals with knowledge globalization, i.e. generally accessible knowledge is acquired by each organization. Information is presented by coordinating or initiating entities and aims at pointing out concrete benefits resulting from the creation of a cooperation network and clusters. financing – most frequently, the means originate from external sources (top-down initiative); leaders or initiative groups rarely use their own funds for such activities, unless they are certain about the project's success (bottom-up initiative).
Structure	Coordinating entity is usually the organization, which acquired the means or initiative groups; all organization works are done by the main initiators and the degree of formalities of the activities depends on the method of settlement of the acquired means or the power of the leader. financing – most frequently, the means originate from external sources (top-down initiative); leaders or initiative groups rarely use their own funds for such activities, unless they are certain about the project's success (bottom-up initiative).
Trust	The level of trust depends on the scope of previous cooperation initiatives; the higher the frequency of previous cooperation, then better conditions for creating future clusters; in general, the level of trust is quite low and organizations are rather reserved about cooperation proposals.

The choice of the form of cooperation (including cluster) generates a range of questions and problems presented by employed subjects, which triggers the *crisis of initiative*. Regardless of it is the top-down or the bottom-up initiative, the divergence of expectations and emerging of new organizations requires specification of an idea for cooperation. The less common goals, links (vertical and horizontal) and experiences of cooperation, the smaller possibilities of success of cooperation. Some participants adopt skeptical attitude towards cooperation, the opportunistic approaches are dominant.

In the II stage occurs the crisis of initiative, the solution of the *crisis of initiative* is based on the development by specialization – it is the first period of development that may last for several weeks or months. The first problems, topics and specializations appear, around which cooperation may be focused. The potential of the group is still dispersed but also encouraged

to further actions aiming at creating partnership relations. This is a cluster organization stage, which is the most important because it shapes and conditions the form of the initiative. The following activities are of key importance:

- mobilizing potential partners to share information and realize the necessity to recognize and define the potential, common business objective,
- defining the common vision of development, mission and a strategic goal,
- making the cluster partners undertake formal obligations including: mobilizing the realization of formal obligations at the institutional level, shaping the potential of social capital and increasing such potential).

Table 3: Description of the II-nd stage: inintiative

Goals	Specification of principles of cooperation that are based on keeping a competitive advantage (scale benefits, complementary competences, better use of potential) and/or innovation development (the ideas for new technologies, products)
Innovation	Dependent on the approved principles – the technological clusters are considered as more innovative. However it is worthy noticing that the cooperation of that type generates innovations in scope of marketing and organizational activities.
Knowledge	The network participant expects concrete information and topical trainings. More frequent meetings help diffuse knowledge, by sharing own experience and ideas, participants shape new, wider horizons of operations, which strengthen or reduce the need for cooperation.
Structure	Initially, coordination is based on support units or initiating groups and depends on their means; however, at this stage, the first ideas regarding development of cooperation and defining the roles of each network participant and the scope of further cooperation emerge; the majority of actions still remains in the hands of coordinators or initiating units. financing – external means allow the initiation of activities, the network subjects are sceptical towards engaging their own means to develop cooperation.
Trust	Trust level is still low – the first common and contradictory interests emerge, related mainly to the realization of efficiency expectations, they are mainly related to guarantees of appropriate competences and expectations that activities of the network participants are going to be regular, correct and predictable (Sztompka, 2002);

Generation of common ideas breeds many doubts connected with mutual trust regarding the reliability and anticipation of partners' actions – the crisis of *trust emerges*. The employed subjects express their fears regarding the scope of engagement and the benefits resulting from it. The intellectual property protection is placed under a question mark.

The social relation during *the IIIrd stage of innovative development* leads to problems with trust among the cluster members. The solution of the crisis of trust is based on the *development by social capital* (Stachowicz, 2006b; Putnam, 2000). The basic activity is to support a communication in a network based on responsibility and honesty of cluster's members. A result of that process is working out the commonly shared values of special significance that is attributed to them by cluster's participants[3]. Thanks to it the emotional engagement of cluster's participants in the processes of cooperation is obtained.

[3] Eg. The Decalogue of Silicon Valley.

On this stage the potential and needs of the involved organizations have been initially recognized and realization of the first joint projects commenced. The level of trust between organizations increases, which results in the realization of joint projects related to the basic, most frequently shown areas of cooperation: e.g. joint advertising, common product package development strategy, establishing a network coordinating organization. It should be assumed, that the established cluster would develop through both an increase in market activity and individual, innovative development of each of the cluster participants as well as through adding new entities, which bring new competences required in the development process. This process also requires supervision and monitoring on the part of the cluster initiators until the stage of the cluster's independence, i.e. the maturity stage.

Table 4: Description of the III-rd stage: innovative development

Goals	Realization of common innovative projects. Working out the commonly shared values.
Innovation	This stage depends on the approved specializations and the principles of cooperation. The innovativeness of ventures is not only seen from the angle of new products or technologies but first of all of improvement of building organizational and social bonds among cluster's participants.
Knowledge	Exchange of information between the cluster participants is based on diffusion of knowledge necessary to realize the first common projects.
Structure	The network participants create formalized networks seeing an opportunity in joint actions and methods of financing; the most frequently chosen organization forms in Poland are associations and consortia. Continued financing depends on the involvement of participants and searching for new ways of financing the cluster operations.
Trust	Increase of trust is connected with realization of joint projects with axiological expectations related to the quality of activities; the network participants pay attention that all parties are involved in a responsible, just and honest manner (Sztompka, 2002);

The growth of trust generates the needs of bigger or smaller formalization of cluster's activities and the development of new competences that cause very often the *crisis of structure.* This crisis concerns not only the determination of organization form but first of all the problems connected with development of new competences that are indispensable for continuous initiating, animating, coordinating and controlling the network's activity (network competences). The development of knowledge and trust generates the need of development of new competences and links between the cluster's members.

In the model in *IV stage (maturity)* occurs crisis of structure. The solution of the crisis of structure is based on the *development by cluster governance* – finding out the path of development is based on working out of new ways of keeping the strategic advantage of a cluster. Cluster governance is about the intended, collective actions of cluster actors to upgrade a cluster in order to build and maintain a sustainable competitive advantage as a cluster. In our view, cluster governance is specifically aimed at facilitating and improving processes of innovation (Gilsing, 2000). In other words, it is aimed at the main strategic issue facing the actors involved in processes of innovation in a cluster. It is concerned with the question 'how the value chain itself is moving', how it can be reconfigured and where possible new synergies can be found (Graziano & Vesan, 2008).

On this stage positive external effects increase and relations between the cluster participants are not only connected with realization of the planned joint projects but also with current operations. The increasing trust level enables the creation of new products, which unite the cluster participants' potentials, building a common image, introducing standards and internal certification systems, etc., as well as initiatives, for which the competences of individual organizations are not sufficient. This stage requires achieving operational excellence, independent diagnosis of market trends, preparing strategies and increasing competences in strategic management. The length of the stage depends on the above mentioned factors as well as changes in the markets. Frequently, the cluster maturity stage requires improvement of technology and rationalization of the existing structures, processes and procedures as well as reformulation or reorientation of the strategy (it may be necessary to use professional consultants services).

Table 5: Description of the IV-th stage: maturity

Goals	Use of the obtained cooperation advantage
Innovation	In technology clusters (e.g. biotechnologies, ICT, bioenergy, etc.) implementation of innovations is the systematic process. In traditional clusters (based on scale effect, access to the market etc.) the frequency of introducing of innovations is considerably lower.
Knowledge	Stage related to creating formal and tacit knowledge of a cluster. The cluster's competitive potential is based on its formal knowledge and an effective communication system; the existing and appearing tacit knowledge is related to maintaining the cooperation and competition principles; in order to maintain the competitive edge, individual participants of a cluster have and develop the tacit knowledge, thanks to functioning within the cluster;
Structure	All accepted forms of cooperation undergo verification and participants assess the approved methods of the cluster operations coordination; methods of creating and realization of new projects, methods of communication and coordination of the cluster operations are specified in detail. Defining the principles of financing the activities is the main priority of this stage of clusters creation. Defining a financial share of a network participants shows their influence on decisions and operations of the cluster.
Trust	Trust of the network participants will result in working out certain relation standards, which will improve the cluster's operation; standards will define the allowed limits of behaviors; they are a kind of safety device against the actions, which disturb the stability of relations. The approved standards in relations can be seen as an important mechanism regulating a long-term exchange and reducing opportunistic attitudes (Światowiec, 2006). Long-term relation maintenance is based on creating a code of ethics. It increases trust that other participants of a cluster will perform their actions conscientiously, having in mind the common future and shaping the appropriate relation behaviors.

The process of maturing of cluster is connected with exhaustion of development possibilities in given shape of cluster. The participants express their dissatisfaction resulting from the lack of new ideas, partners, new concepts. The *crisis of identity* emerges – the fall of activity and discouragement for further cooperation occurs.

The last stage of our model - *Vth Transformation stage* is connected with the crisis of identity. This crisis could be resolved by *open innovation* (Chesbrough, Vanhaveberke & West, 2006). Innovative cluster as an innovative system is based mainly on knowledge transfer and is initiated through direct contacts between people (Wolfe, Davis & Luckas, 2005). A high level of knowledge equals a high level of trust. Thanks to the rationalization of these mechanisms, supported by efficient coordination, we develop social capital, which is a driving wheel of the shaped cluster. Establishing relationships of non-market character favours exchange of information and knowledge by, for example, informal cooperation and assistance in managing business activities. However, there is a risk that the lack of transformation activities may cause the gradual decline of a cluster. The research of Andersson`s team (2004) results is that it often becomes necessary in the maturity stage to separate individual companies from an overgrown cluster, which could create their own clusters. Such separated and independent clusters often function in a continuous process of cooperation and competition (co-opetition) with the main units of the "origin cluster".

4. CONCLUDING REMARKS

1. The presented model of a cluster life-cycle may constitute a useful cognitive, analytical and project tool in the processes of creation and development of networks of cooperation of that type. The use of a model of cluster life-cycle and the mechanisms shaping it (model KST) gives a new view for the complexity of an issue, its dynamics and the necessity of taking into account the soft elements of management like: social capital, trust.
2. Consciousness of crises that may take place on particular stages of cluster's development and the causes of that crises constitutes a premise for looking for new preventive mechanisms that simultaneously create the basics for further cluster's development. The presented model lets for preparation of cluster's participants for inevitable crisis situations and ways of their solutions and usage for further development.
3. The essence of rationalization of the process of cluster's development is continuous harmonizing of three mechanisms (KST model: knowledge, structure, trust) describing the presented model of a cluster life-cycle. Monitoring of these mechanisms is an indispensable activity that let for balancing them in the process of cluster development (balanced cluster mechanisms).

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