

# BUILDING e-CLUSTERS

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## *Abstract*

E-clusters are strategic alliance in TIMES technology sector (Telecommunication, Information technology, Multimedia, Entertainment, Security) where products and processes are digitalized. They enable horizontal and vertical integration of small and medium companies and establish new added value e-chains. E-clusters also build supply chains based on cooperation relationship, innovation, organizational knowledge and compliance of intellectual properties. As an innovative approach for economic policy and new e-business strategy e-clustering has very important role for old clusters renovation and growth in region affected by economic crisis and other adversities. This paper analyzes building of horizontal and vertical e-clusters. Results of this analysis can be used for transformation of old clusters, innovation of cluster's products, processes and added value chains.

The structure analysis of horizontal e-clusters oriented to suppliers or customers, and horizontal Marshallian e-clusters explain how those can enter in large e-supply chains. Various organization forms, topology of cooperation and innovative process in vertical e-clusters are analysed and focussed on e-logistic systemstructure and development.

**Keywords:** e-cluster, cooperation, e-supply chains, e-logistic

## 1. INTRODUCTION

Small and medium enterprises (SME) from TIMES technology sector, universities and research institutes, customers, government and other stakeholders established **TIMES clusters** or **e-clusters** which enclose processes of cooperation, innovation and process oriented knowledge management. E-clusters have infrastructure which accelerate knowledge distribution, reduce transaction costs, stimulate competition and cooperation, enforce specialization and internationalization of the economic and cluster-specific relations etc. (Hansen, 2004). **E-clustering** is a macroeconomic concept of building clusters in TIMES technologies sectors that support a wide concentration of rivals, customers and suppliers as well as their focus on specialization, efficiency and innovation, digitalization of the internal cluster processes and processes between clusters (Hansen, 2005). It is an innovative approach for economic policy and new e-business strategy for older clusters based on continuous improvement of value-added chain and product innovations that result in speeding growth of clusters and region (Bangura, 2009).

E-cluster is defined as information network that integrates industry, universities and research institutes. Its functions are support for company promotion and marketing, business administration, cluster management, information management on industrial

complexes and neighbouring regions, as well as for management of database of industries, universities and research institutes<sup>11</sup>.

E-clusters are based on factor and demand conditions, related and supporting industries, structures of companies and rivalry which M. E. Porter arranged in a diamond-shaped diagram. This paper will focus on cluster structures and suggests definition of e-clusters as a business network that horizontally or vertically integrate companies in TIMES sector. In this way e-clusters build procurement and distribution of e-channels and e-supply chains, provide product and processes innovation and apply knowledge and other local strengths for growth of productivity and attainment global competitive advantage (Davidović, 2013). This definition also implies generic horizontal and vertical e-clusters, and logistics of e-cluster definitions (see Chapter 2).

Chapters 3 and 4 will analyse how to build horizontal and vertical e-clusters and their e-logistics, as well as how to transform horizontal to vertical e-cluster (see Chapter 4). This e-cluster structure analysis implicates basic models and characteristics of cooperation processes and their impact on e-cluster logistics.

There is a difference between the terms “e-clustering” and “building e-clusters”: e-clustering is a macroeconomic concept and strategy, while building e-cluster is a formation of cluster’s organization.

## 2. e-CLUSTERS AND e-CLUSTERING

**E-cluster** is a geographic concentration of interconnected TIMES companies, specialized suppliers, service providers, companies in related industries, and associated institutions (universities, research institutes, standards agencies and trade associations) in a particular field that compete but also co-operate (Hansen, 2004; Porter, 1998).

E-clusters can be classified into horizontal and vertical. **Horizontal e-clusters** share common factors: same TIMES technology, digitalized working processes, skills and other organizational knowledge, market for end digital products and same suppliers or customers. Horizontal e-cluster is usually a group of TIMES SMEs that work the same level of a value chain. Between members of a cluster there is no digital products flow (no interchange); while the cooperation is oriented only to common performance in the market (see Chapter 3).

**Vertical e-clusters** consist of members and partners linked through buyer-seller relationship supported by e-business system. All members and partners enter in cluster e-value chain and participate in the realization of common end products or cooperative projects. Vertical e-clusters set up a common value e-chain, e-procurement and e-distribution channels or chains, and supply e-chain with a new added value. Structure of vertical e-cluster is determined by a topology of cooperation process (see Chapter 4).

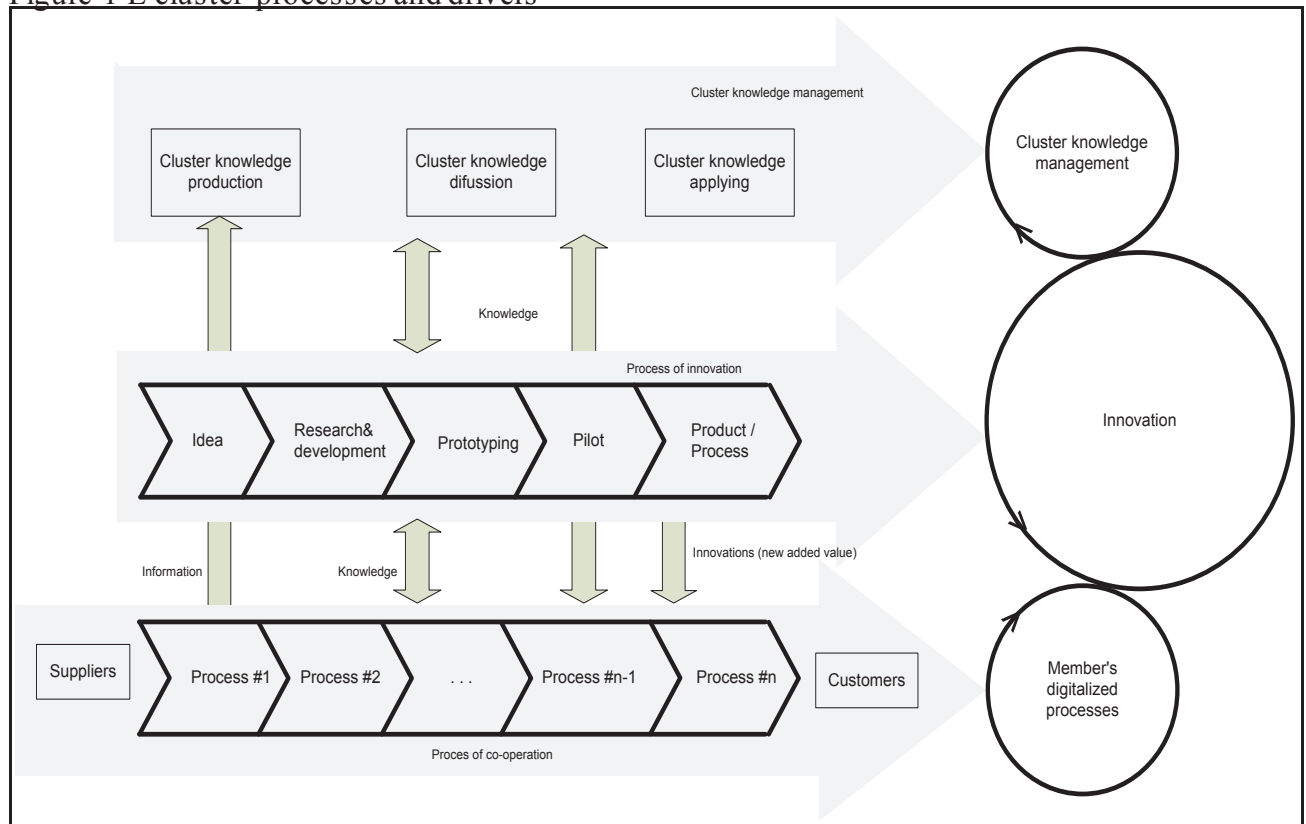
E-clusters as regional clusters have the ability to offer knowledge, relationship and motivation which can’t be matched by their distant rivals (Porter, 1998). Building e-clusters include fostering their local strengths and a collaborative environment organization where job and innovative digital products creation and new entrepreneurial innovations are able to flourish and can reap the tangible returns (Porter, 1998). E-clusters therefore need an organization of three mutually dependent digitalized processes: cooperation, innovation of

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<sup>11</sup> The Industrial Complex Cluster Program of Korea, Ministry of knowledge economy of Korea and KICOX – Korea Industrial Complex Corporation Cluster, November, 2010 [available at [www.kicox.kr](http://www.kicox.kr) or [www.e-cluster.net](http://www.e-cluster.net)]

digital products and processes, and cluster knowledge management. Innovations and knowledge are the main drivers of e-clusters competitiveness and growth (see Fig 1).

Figure 1 E-cluster processes and drivers



Source: Author (based on Hansen, 2005; Davidović, 2013)

**Process of innovation** enables improvement of digital products and digitalized cooperation processes through the following phases:

- idea,
- research and development,
- prototyping,
- pilot construction,
- implementing the innovation (digital product or digitalized process);

Results of innovation increase cluster productivity and originate spiral growth of cluster knowledge.

**Organizational knowledge management** includes next phases:

- creating or production,
- diffusion or distribution and
- applying;

E-clusters can organize knowledge management either as a function of cluster management or as cooperative projects (Davidović, 2012).

The universities, research institutes and consulting organizations participate in processes of innovation, creating and diffusion of organizational knowledge.

The process of cooperation in horizontal e-clusters is very simple, as it is oriented only towards common performance of cluster in domestic and international market. Horizontal e-clusters can use suppliers and customers e-services or set up own procurement and sales

e-channels (see Chapter 3). The cooperation in vertical e-clusters is structured as a project, production, end product's structure or relationships between cluster members (see Chapter 4).

**E-logistics** consists of processes necessary to transfer the goods sold over the internet to the customers. It provides "supply chain integration that can eliminate intermediaries such as wholesaler or retailers and fosters the emergence of new players like logisticians, whose role is to adapt traditional logistics chains to take into account the requirements of e-business" (Groznić & Kovačić, 2004). E-clusters integrate the e-logistic in process of cooperation, since digital products transfer is directed from external/internal seller to internal/external buyer (seller's up-load to buyer or down-load on demand of buyer).

**An e-cluster e-business system** is e-logistics subsystem that supports (Davidović, 2013):

- a safety interchange of intangible products, e-services, money and information,
- a cooperation of relationships based on business processes restructuring and improvement,
- standardized electronic transactions in interchange between members and partners,
- a realization of cluster's cooperative projects and digital products, and
- a performance of cluster in the domestic and international market.

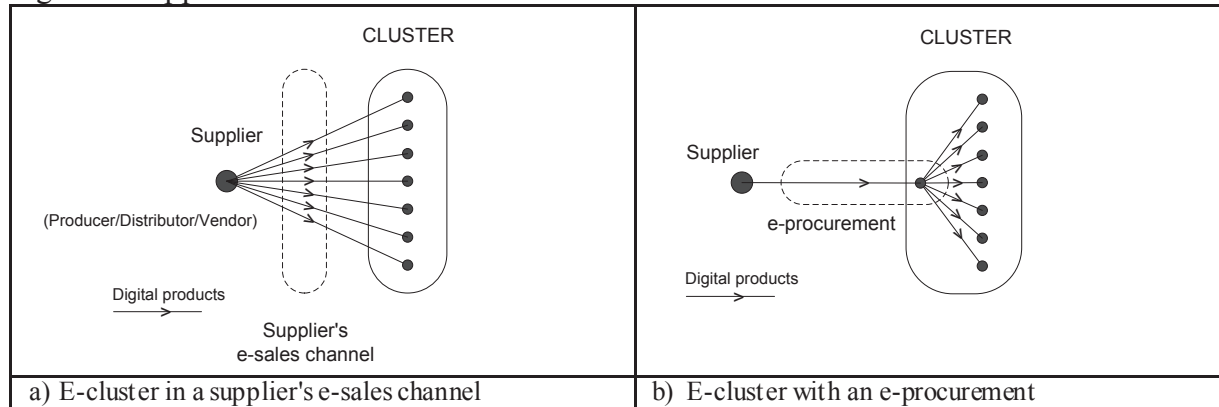
**E-clustering** is a part of macroeconomic politics and strategy that fosters the networking of TIMES companies and other participants in new value-added chains. The objective is to bundle the potentials and competences in e-clusters as a driving force and an accelerator for the economic and technological development of a region (Hansen, 2004). Building e-clusters is a key activity in the e-clustering policy or strategy implementation, because wrong model can prejudice relationships between cluster members or raise investment, and therefore slowdown the growth of e-cluster. Following analysis showcases a potential organization of horizontal and vertical clusters, transformation from a horizontal to a vertical e-cluster, and various combinations of topologies that get more effective performance of clusters in the global market.

### **3. BUILDING HORIZONTAL e-CLUSTER**

#### **3.1. Supplier oriented horizontal e-clusters**

If members of horizontal e-cluster are supplier oriented then e-cluster either enters in supplier's e-sales channel or links with a supplier over own e-procurement (see Fig. 2a and 2b).

Figure 2 Supplier oriented horizontal e-clusters



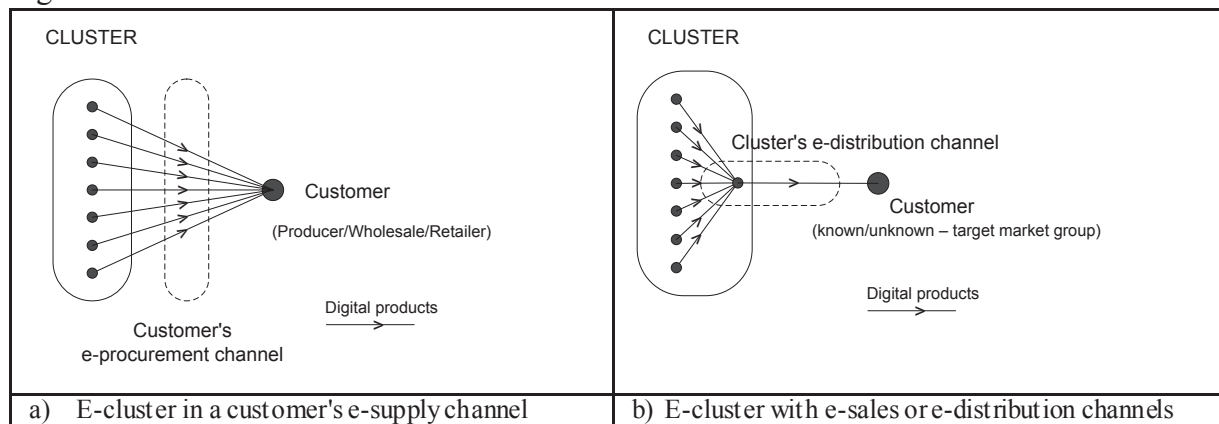
Source: Author

A supplier is any producer, distributor or other vendor of digital products. Products flow from a supplier to members of e-cluster. Every member adds a new value and can compete to others. E-procurement is an e-service of a member, partner or a cluster management.

### 3.2. Customer oriented horizontal e-clusters

When members of horizontal e-clusters are customer oriented then e-cluster enters in a customer's e-supply chain or builds an own e-distribution channel (see Fig. 3a and 3b).

Figure 3 Customer oriented horizontal e-clusters



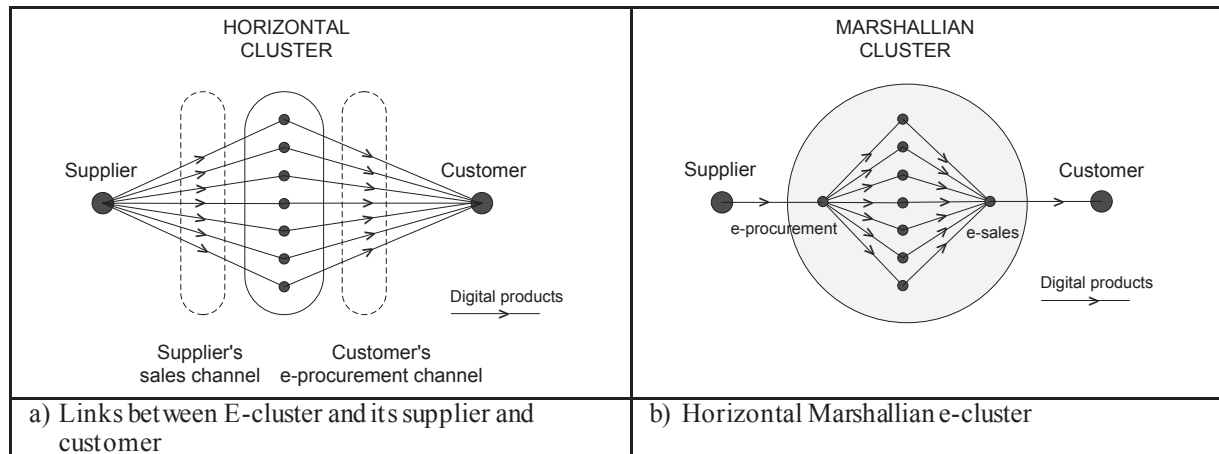
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Customer is a producer, a distributor, a wholesaler or a retailer of digital products. E-sale is a service of member, partner or cluster management. If cluster has adequate e-distribution channel (for example, Web shop) then any member of a cluster can deliver their digital products to unknown consumers directly or over fully automated cluster's e-sales function. Every member can compete to others in common using cluster's e-distribution channels and another market sectors.

### 3.3. Marshallian e-clusters

Interconnections between horizontal e-cluster, a larger supplier and a customer shown in Fig. 4a are theoretically possible, but taken risks maybe unacceptable for customer, supplier or cluster. The structure known as Marshallian cluster<sup>12</sup> is a better solution (see Fig. 4b), because it provides integration in supply chains created by other producers and larger buyers of digital products.

Figure 4 Integration of horizontal e-clusters in other supply chain and Marshallian horizontal e-cluster



Source: Author

Basic structure of horizontal Marshallian e-cluster is a result of integration topologies in Fig. 2b and 3b. Members provide services in a producer's supply chain such as development, sales, maintenance, help desk or education. For example, a cluster of small software companies uses provider's software and every member has all intellectual property rights needed for new software products development and their distribution to a known customer.

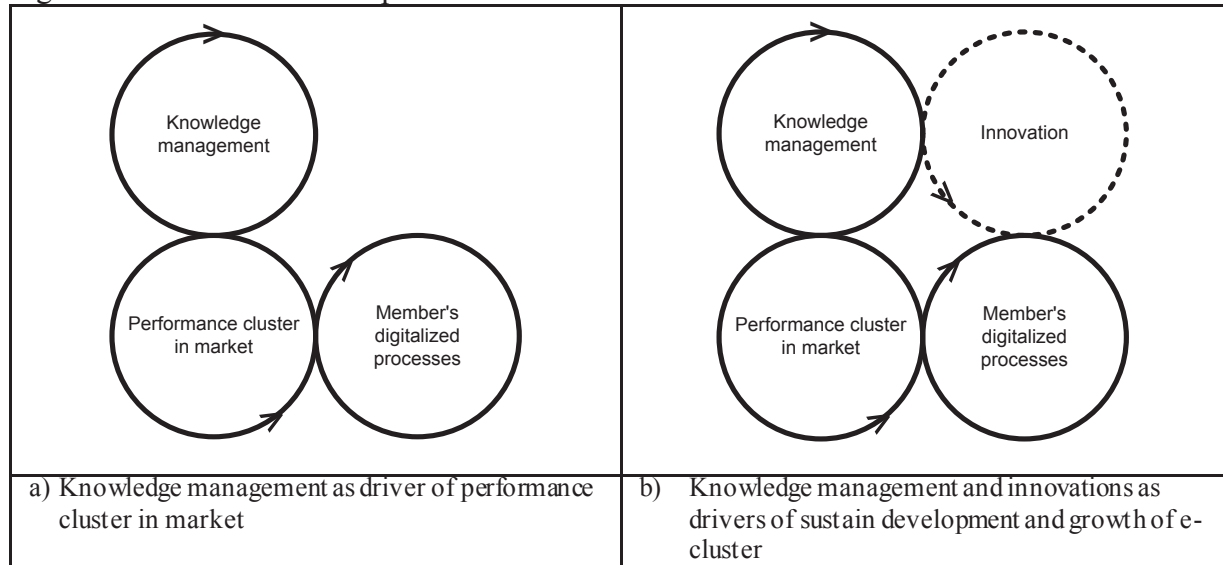
### 3.4. Performance of e-clusters in the market

A group of SMEs from TIMES technology sectors is a horizontal e-cluster when it has e-procurement and/or e-distribution channels. Through horizontal cluster, members can jointly enter markets and thus exploit human and other resources with greater efficiency (see Fig 5a).

Cluster knowledge management supports acquisition, diffusion and applies new organizational knowledge (know-what, know-why, know-how, know-who, know-where and know-when) and so improves the cluster performance in market. Knowledge management can organize as process, task or cooperative project (Davidović, 2012). However, sustain development of horizontal e-cluster necessitates the innovation of members' digitalized processes, services and products (see Fig 5b).

<sup>12</sup> This cluster model has equivalent topology as Marshallian industrial district; Alfred Marshall (1842-1924)

Figure 5 Relations between processes in horizontal e-cluster



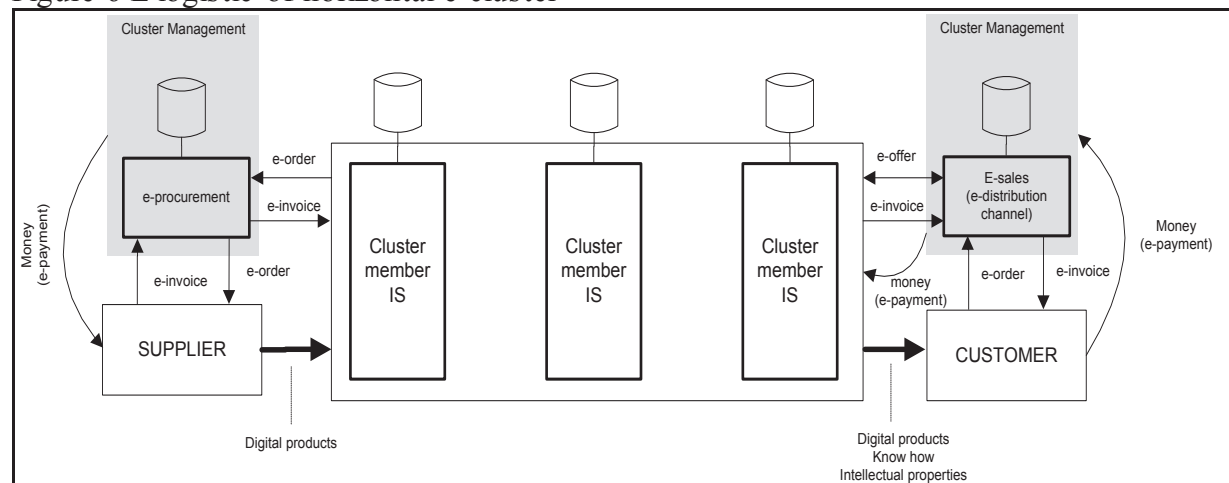
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Horizontal e-cluster needs a good relationship with universities, research institutes, consulting companies and creative people. This is a way for new value-added chains building and transforming horizontal e-clusters in more efficient vertical e-clusters (see Chapter 4).

### 3.5. E-logistics of horizontal e-clusters

E-procurement and e-sales are parts of e-logistics in horizontal e-clusters. E-procurement collects and combines members' e-orders in one cluster e-order to a supplier. E-payment can do a cluster member direct to a supplier or across the cluster account (see Fig 6).

Figure 6 E-logistic of horizontal e-cluster



Source: Author (based on Davidović, 2011)

Horizontal e-cluster can organize e-sales over indirect distribution e-channels (Fig. 3a) or direct distribution e-channels (Fig. 3b). Indirect distribution e-channels are producers and



customers supply chains or e-portals. Direct distribution e-channels are marketing e-channels, Web shops and e-portals (Davidović, 2011).

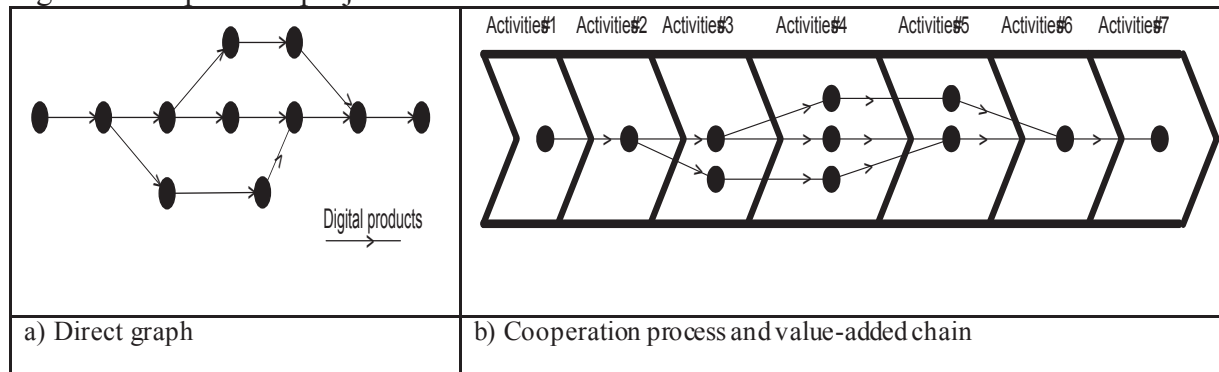
E-logistics of horizontal e-cluster is an e-business system. Basic application framework of e-procurement and e-sales are e-order, e-offer, e-invoice and e-payment. If the cluster does business with know-how and intellectual properties then e-contract need include. Digital products up-load and down-load are function of e-sales.

## 4. BUILDING VERTICAL e-CLUSTER

### 4.1. Cooperative projects oriented e-clusters

Structure of **cooperative projects oriented e-clusters** is described with a directed graph in Fig. 7a.

Figure 7 Cooperative projects oriented e-cluster



Source: Author

The nodes determine project activities. Directed branches are correspondent the interrelations between members in project realization. Each cluster member or partner can realize one or more activities which add a new value. Directed graph can include activities of innovation process, procurement, product realization, delivery of the product to the customer and post-sales e-services. Cooperative project can be one time or regularly recurring by orders of customers. Members and partners realize project activities and sub-processes that build value-added chain as in Fig. 7b.

### 4.2. Topology of e-clusters oriented to common end product

**E-clusters oriented on common product** can have four types of topology:

- Linear chain (see Fig. 8)
- Star (see Fig. 10 and 11)
- Tree (Hierarchical organization, see Fig. 12)
- Network (see Fig. 9b).

Network is a generic topology, while chain, star and hierarchical organization are their special cases: a linear chain is correspondent to a path, while a star and hierarchical organization correspond to a tree in the network. The cluster topology depends of technology, product structure, and relationships in the cluster.

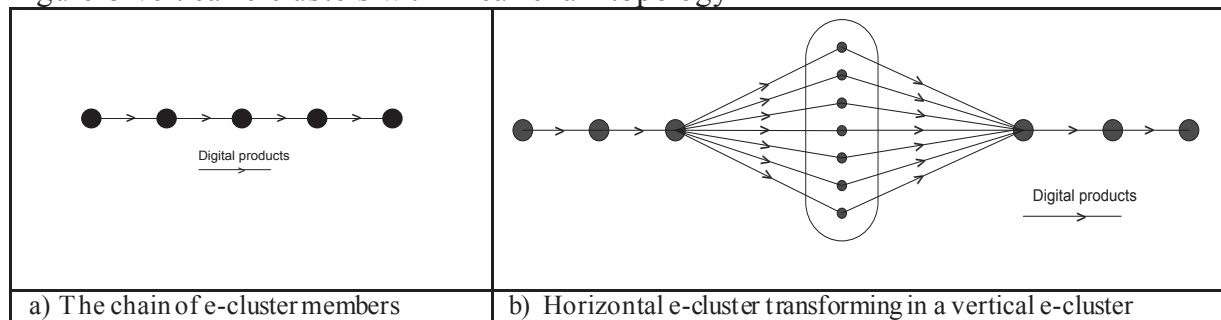


### 4.3. Cooperation process as linear chain

When e-cluster builds the chain of activities, or sub-processes and value-added chain as in Fig. 8a, then every member of the chain is an internal seller and buyer, except of the first and the last. The first member is an external partner (supplier) or a cluster member as an internal seller, while the last member in the chain is an internal buyer that delivers products to customer or known external buyer. Every member can organize their own procurement or uses e-procurement services of a cluster organized as in Fig. 2b.

Horizontal e-cluster can transform to vertical e-cluster when buildings its own supply chain with new members and partners such as in Fig. 8b. This model is also typical for e-clusters that gather SMEs due to necessary capacity of production or assortment of products and services.

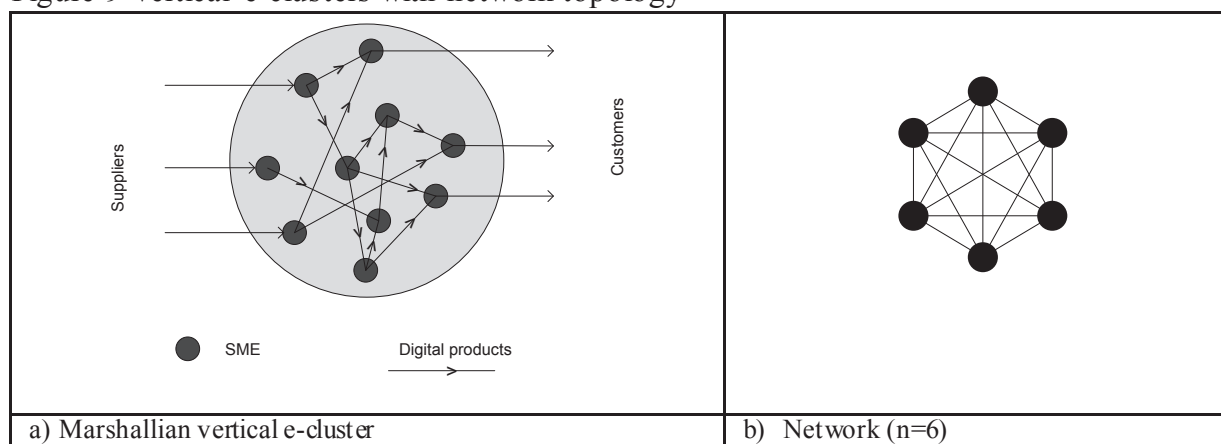
Figure 8 Vertical e-clusters with linear chain topology



Source: Author

In vertical Marshallian e-cluster (see Fig. 9a) exists links between members and partners which result with new added values for customers. This topology is derived from horizontal e-cluster topology (see Fig. 4b) and building linear chain between several members and external partners as in Fig. 8a. Marshallian clusters can derive from network, too (see Fig. 9b). In Marshallian clusters there is no dominant member.

Figure 9 Vertical e-clusters with network topology



Source: Author

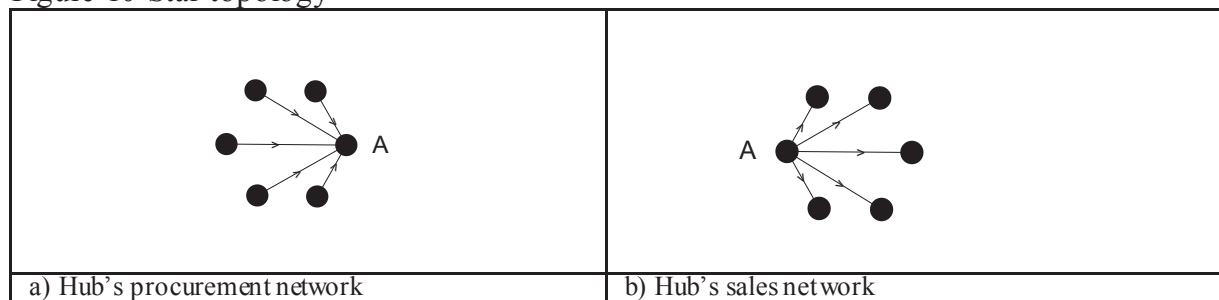
#### 4.5. Network topology

Network topology (Fig. 9b) is appropriate for complex creation of creative products, process of innovation and knowledge management processes. Links between members of network are directional or bidirectional. Cluster management system and e-logistics are more complex in large networks and multiply relationships between members, hence building vertical e-cluster should be based on business cases which need e-logistics with simple topology. The network of a cluster can be divided in the simplest topologies that correspond to business cases based on end digital products (in multiproduct clusters), cooperation processes or tasks (linear chain, star, hierarchical structures), cooperative projects (in cluster oriented to projects) or their combinations.

#### 4.6. Vertical e-cluster models based on star topology

Organization models of clusters have star topology (see Fig. 10a and 11b). Node A is a hub or a centre that corresponds to dominant members in hub-and-spoke clusters, satellite platform cluster and state centred cluster models.<sup>13</sup> Other nodes correspond to the members – internal sellers (Fig. 10a) or the internal buyers (Fig. 10b). Direction of branch shows the flow of products; in Fig. 9a it performs input of A, in Fig. 10a output of A. Networks on Fig. 9a and 9b correspond to procurement and sales network or channels.

Figure 10 Star topology

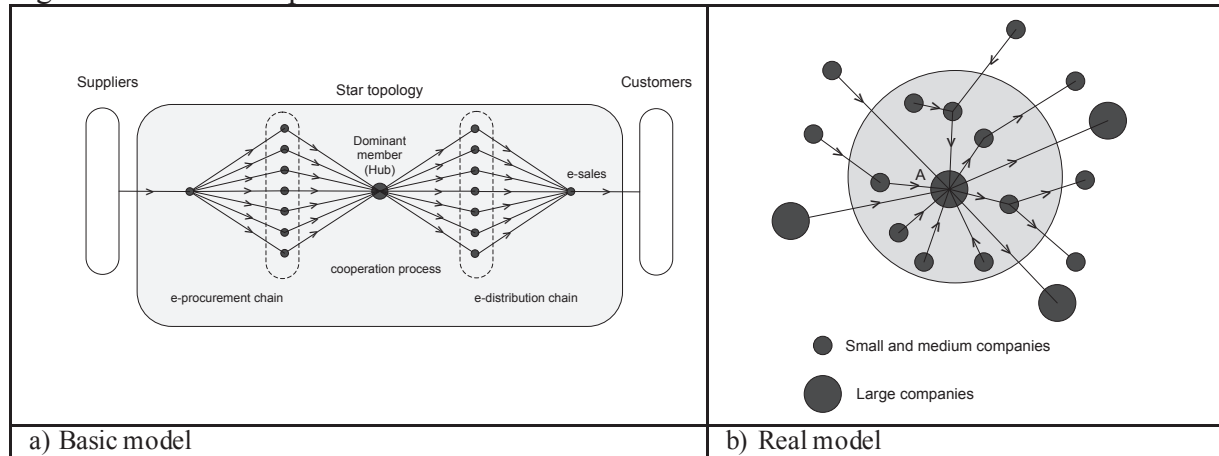


Source: Author

Basic structure of **hub-and-spoke cluster** is a combination of star topologies from Fig. 10a and 10b (see Fig. 11a). A member in the real structures can link with dominant member A over linear chain (see Fig. 11b). In this model every dominant member has its own e-procurement and e-sales network, post-sales e-services etc. The hub-and spoke e-clusters have two or more star topologies, relating to number of dominant members (leaders) in cluster. Hub links each other hubs; no direct linkage between other members (SMEs) to other stars exists.

<sup>13</sup> These terms take from Boja [10]

Figure 11 Hub-and-spoke vertical e-clusters



Source: Author

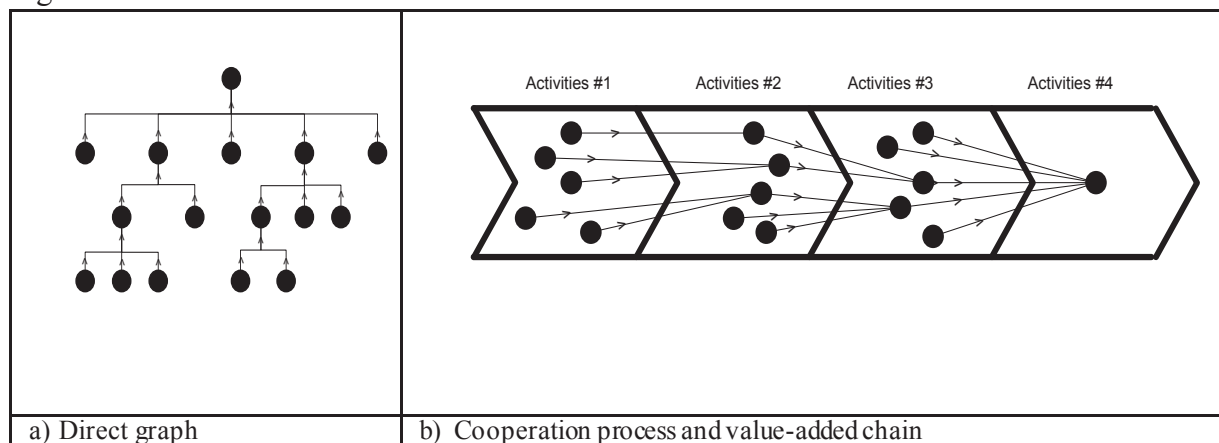
The **state centred cluster model** has topology shown in Fig. 11a (this model has only one hub). The **satellite platform cluster model** has two or more separate and independent star topologies that set up branch offices of multinational companies (Davidović, 2013; Boja, 2011).

#### 4.7. Hierarchical organization of e-clusters

Cooperation process in vertical e-clusters can organize hierarchy equivalent to end product structure or content (see Fig. 12a). Value added chain for this case is shown in Fig. 12b. One member can realize more activities on different stages of e-supply chain.

Hierarchy structured vertical e-cluster can be build from horizontal e-clusters when those specialize in production parts of digital end-products.

Figure 12 Hierarchic structured e-clusters

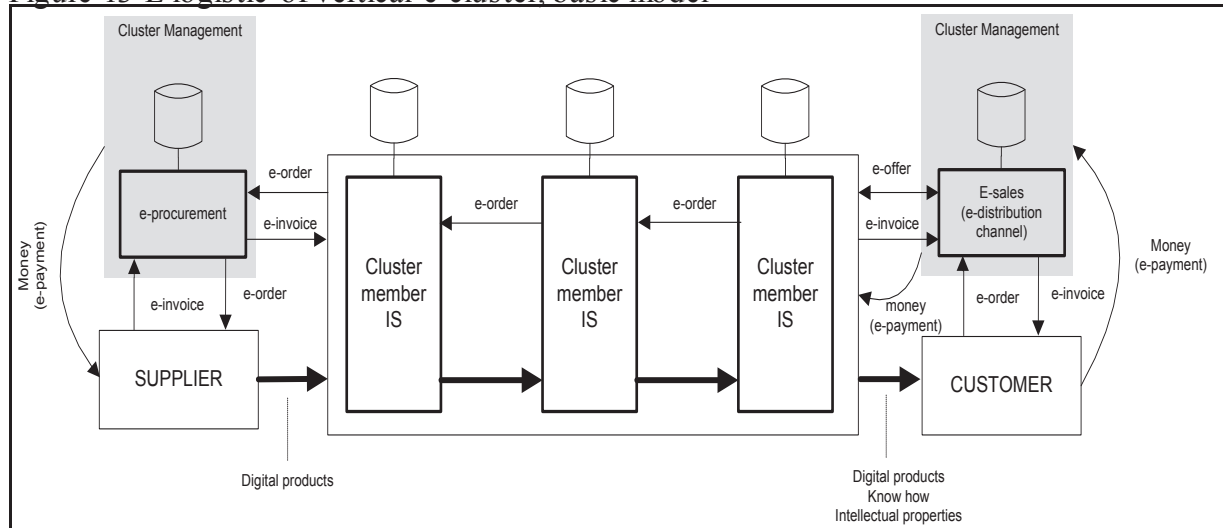


Source: Author

#### 4.8. Building e-logistics in vertical e-clusters

E-logistics in vertical e-cluster is an e-business system that supports procurement, cooperation and distribution processes (see Fig. 13).

Figure 13 E-logistic of vertical e-cluster, basic model



Source: Author

The project oriented e- clusters can use project management system and internet for digital products transfer. The product oriented e-clusters can implement supply chain management system or intellectual property management system for other intangible assets. These e-business systems can support cluster cooperation and innovation processes, and the performance of cluster in domestic and international markets. E-clusters with e-knowledge management are more competitive because knowledge and innovation are the key drivers of cooperation development (see Fig. 1 and 5b).

## 5. CONCLUSION

Building e-clusters is the first phase of implementation of e-clustering as macroeconomic politics or strategy. The choice of e-cluster organization structure determines its future market position and further development.

The development of horizontal clusters is oriented to building adequate e-logistics and positioning in a large supply e-chain which allows its building extension based on innovations and new value-added chain organization (linear chain, vertical Marshallian e-cluster). The attachment of one geographic concentration of SMEs TIMES companies with a dominant large TIMES company, multinational company branch office, state or public company results as a hub-and-spoke, satellite platform cluster or centred state cluster, respectively.

Project and common product oriented e-clusters develop structure equivalent with project or digital end-product structure, and innovate or renovate it according to customers' needs.

E-clusters develop e-logistic that is integrated in the cooperation process and includes an e-business system, process oriented cluster organizational knowledge management and innovation management. Universities and research institutes support sustain of e-cluster development based on new TIMES technologies or digitalized cooperation processes, digital products and e-services innovations.

This analysis can apply in old TIMES cluster renovation, too.

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