DESIGN OF A PERFORMANCE MEASUREMENT MODEL FOR INDUSTRIAL CLUSTERS IN TURKEY

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ABSTRACT

DESIGN OF A PERFORMANCE MEASUREMENT MODEL FOR INDUSTRIAL CLUSTERS IN TURKEY

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Despite the advantages and dominance of globalization in today's world economics; clusters, as a regional based development tool, still attract many researchers and policy makers from all over the world in order to obtain sustainable competitiveness. As a result of fast rising number of cluster development policies and initiatives, the importance of measuring the performance of clusters arises. The purpose of this thesis is to design a performance measurement model, which will be applied to industrial clusters in Turkey. A model framework is developed, based on expected outcomes of clusters which are classified as productivity, innovativeness, new business formations and social capital. Indicators are selected based on extensive literature survey under these four determinants, and a scorecard is developed. After the design phase, the performance of two cluster cases from Turkey is studied.

In order to improve clustering approach, it is important to monitor, measure identify the progress of clusters. It is believed that this work will be utile for policy makers to identify whether the interventions, incentives and promotions are beneficial for the desired purposes and whether they are used effectively.

Key words: Industrial Clusters, Performance Measurement, Regional Development, Cluster Policy

ÖZ

TÜRKİYE'DEKİ ENDÜSTRİYEL KÜMELER İÇİN PERFORMANS ÖLÇME MODELİ TASARIMI

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Günümüz dünya ekonomisinde küreselleşmenin baskınlığına ve getirdiği kolaylıklara karşın, bölgesel kalkınma aracı olarak kümeler, sürdürülebilir rekabetçilik avantajları nedeniyle, hala birçok araştırmacının ve politika belirleyenlerin ilgisini çekmektedir. Küme geliştirme politikaları ve girişimlerinin çoğalması sonucunda, kümelerin performanslarının ölçülmesi gerekliliği doğmuştur. Bu tezin amacı Türkiye'deki endüstriyel kümelere uygulanabilecek bir performans ölçme modeli geliştirmektir. Modelin çerçevesi, kümelerin artan yenilikçilik, üretkenlik, istihdam ve sosyal sermaye olarak beklenen çıktıları temel alınarak oluşturulmuştur. Bu dört ana unsur altında ölçütler ayrıntılı yazın taraması sonunda seçilmiş ve bir ölçüm cetveli hazırlanmıştır. Model tasarım aşamasından sonra, Türkiye'den iki küme örneğine ilişkin performans değerlendirme ön-çalışması yapılmıştır.

Küme çalışmalarını geliştirmek bağlamında kümelerin gelişmesini izlemek, ölçmek ve belirlemek önemlidir. Bu çalışmanın politika belirleyenler açısından, teşvik ve müdahalelerin istenilen amaca erişmek açısından yararlı olup olmadığının anlaşılması ve bu desteklerin etkili bir biçimde kullanılıp kullanılmadığının görülmesi açılarından yararlı olacağı düşünülmektedir.

Anahtar Kelimeler: Endüstriyel Kümeler, Performans Ölçme, Bölgesel Kalkınma, Küme Politikaları

to my beloved family

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CHAPTER 1

INTRODUCTION

In early days of industrialization, the comparative advantage which explains the international success was explained by factor conditions: the basic inputs such as land, labor, natural resources and capital of that nation (Porter, 1990). But in today's developing trade world, competition is not explained by factor conditions only. After World-War II, industries became more knowledge-intensive, and competition is internationalized with globalization (Porter, 1990). Therefore, as the competitiveness becomes more important for nations, seeking ways to be more competitive become the one of the most important aims for companies and nations.

Clusters are one of the ways of obtaining competitive advantage for countries where they are located. Clusters have advantages in increasing productivity, innovation, new business formation, while reducing costs (Porter, 1998). Moreover, in the long term, they enhance Gross Domestic Product, increase real income and therefore stimulate economic growth for the country (Norman and Venables, 2004; De Blasio and Di Addario, 2005; Teekasap, 2009). This attracts many governments in different countries to develop policies for clustering.

However, "the rush to employ cluster ideas has run ahead of many conceptual, theoretical and empirical issues" (Martin and Sunley, 2003). Since the cluster policies and initiatives are a subject of interest, the necessity to measure the performance of clusters rises.

Tracking the performance of a cluster in time is important for evaluating the influences of cluster measures and for the comparison of performance. Policy

makers want to have the information about whether the cluster is successful and whether it reached the conceived goals or not. This will help the policy maker to identify whether the interventions, incentives, promotions and financing are beneficial for the desired purposes and whether they are used properly. Furthermore, identifying the weaknesses of clusters is important for more interventions to improve the cluster (DTI, 2005).

This necessity initiated the idea of this thesis which aims to design a performance measurement model for industrial clusters in Turkey.

As a first stage the cluster fundamentals are discussed in Chapter 2. It starts with definitions of clusters, continues with the Porter's model and after giving some more detail about the characteristics of clusters, it passes to discussions of cluster development, policies and cluster initiatives with examples from Turkey. The purpose of this chapter is to provide the basics of clusters and provide the reasons for why there is a need for developing a performance measurement model for industrial clusters.

In chapter 3, the literature for performance measurement of clusters is reviewed. This chapter included previous studies on performance measurement of clusters as a whole. However, as it can be observed in more detail in this chapter, most of the studies includes frameworks but not detailed indicators on how to measure the performance. Therefore, in Chapter 4, after structuring the framework of the model, detailed survey on literature is covered to accumulate the indicators for performance measurement of a cluster. The basic idea of the model is to measure the outcomes of cluster which lead to economic growth and competitive advantage. Those are innovativeness, productivity, new business formations and social capital. These four determinants form the framework of the model.

Furthermore, a scorecard to perform performance measurement is constituted, which also includes a weighting for the indicators. The metrics are defined for indicators and an initial Dephi test is performed to have a general idea about the

distribution of weights for indicators, yet the results are not used since the distribution of weights are not significant and it is concluded that weighting should be done cluster specific.

In Chapter 5, the implementation steps are defined for the designed model and model is tested on two industrial clusters in Turkey. However, due to lack of collected data for indicators, the clusters could not be scored and only be evaluated under four determinants of the model.

This thesis is a comprehensive study covering wide range of literature and it is believed that the designed model for cluster performance measurement will be beneficial for the evaluation of clusters and will shed light on further studies on performance measurement.

CHAPTER 2

CLUSTER FUNDAMENTALS

2.1 Cluster Definitions & Taxonomy

2.1.1 Definitions

The roots of *cluster* definition lie to late 19th - early 20th centuries. Marshall introduces the term *industrial districts* in his *The Principles of Economics* (1890). He defines localized industries as: "An industry concentrated in certain localities is commonly, though perhaps not quite accurately, described as a localized industry." (ibid. p. 221) and explains the chief causes of localization of industries as *physical conditions* such as climate and soil and *demand conditions* such as rich people assembled in a region asking for high quality products (ibid. p. 223). Marshall also draws attention to knowledge sharing among the participants of the industrial districts which facilitates the dissemination of inventions and improvements. As he put it, "if one man starts a new idea, it is taken up by others and combined with suggestions of their own; and thus it becomes the source of further new ideas" (ibid. p. 225). He examined the industrial districts such as Sheffield and Bedfordshire in UK and observed high levels of localized knowledge with strong ties between local firms. As Harald Bathelt et al. emphasize, Marshall's saying "something in the air" refers to the 'atmosphere' existing in that region which makes that place special, nearly impossible to be imitated and therefore more sustainable in its advantageous position.

In 1990's the focus on localized industries increased and Porter introduced the term industrial clusters and defined it as (1998a, p.199):

> a geographically proximate group of inter-connected companies and associated institutions in a particular field, linked by commonalities and complementarities.

There are several definitions for the concept in the literature. Before going deeper in Porter's model, some other definitions given in the literature will be viewed.

As Rosenfeld put it: "A 'cluster' is very simply used to represent concentrations of firms that are able to produce synergy because of their geographic proximity and interdependence, even though their scale of employment may not by pronounced or prominent." (1997).

Cooke (2002, p.121) criticizes Porter's definition for being "a remarkable static portrayal" and he defines a cluster as:

> geographically proximate firms in vertical and horizontal relationships involving a localized enterprise support infrastructure with a shared developmental vision for business growth, based on competition and cooperation in a specific market field.

Tallman et al. (2004) stresses the interaction among the cluster members and defines clusters as being not just the agglomeration of firms in close-proximity, but a group in which there are frequent knowledge share and spill-overs.

Bekar and Lipsey (2001) focus on proximity of innovative firms and the complementary institutions as local universities and research centers, government laboratories and financial institutions, which are in close contact with those firms.

Sölvell illustrates Porter's definition in *Clusters – Balancing Evolutionary and Constructive Forces*, and extracts the "associated institutions" in Porter's definition as: public bodies, universities, finance institutions, media and

organizations for collaboration. This is a good illustration to observe all the related actors in a cluster and their interactions in one figure.

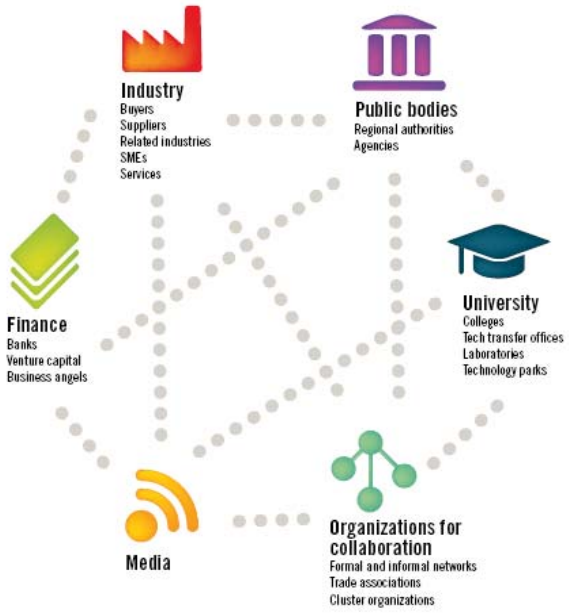

Figure 1 Sölvell's Clusters Balancing Evolutionary and Constructive Forces (source: Sölvell, 2009)

According to OECD (1999) definition, clusters can be characterized as:

- Firms i.e. networks of production of strongly interdependent firms,
- Knowledge producers such as universities, research institutes and R&D companies
- Bridging institutions such as consultants, intermediaries
- Customers

linked to each other in a value adding production chain. These elements are interdependent in input-output relationships, shared norms, conventions, social capital, human resources etc.

To sum all these definitions: a cluster is a group of firms both in vertical and horizontal dimensions working complementarily in the same area of industry, both cooperative and competitively. A group also has close connections with the institutions and research centers and government agencies, sharing knowledge via spill-overs.

2.1.2 Clusters as Systems

Dällenbach defines a system as an organized assembly of components in which there exist special relationships (Güven, 2010). Each component contributes towards the behavior of the system and its own behavior is affected by being in the system. The system has an outside - an environment - which provides inputs into the system and receives outputs from the system. Inputs can be uncontrollable or controllable (i.e. decision variables) outputs include measures of performance.

A system model specifies:

- the ***transformation processes*** or activities of the system
- the ***boundary***, i.e. the ***narrow*** and the ***wider systems*** of interest
- ***subsystems*** of the narrow system involved in transformation; the dynamic relationships i.e. ***processes***; stable relationships i.e. ***structure***
- uncontrollable ***inputs***; control inputs; decisions and decision rules
- ***outputs*** that are desired, undesired, planned, unplanned
- outputs serving as ***performance measures***

Depending on the extension of flows of the cluster, the environment of the cluster can be taken as the socio-economic region where the cluster is located or more broadly, the total of other regions and global markets. The region, where

the cluster is located, corresponds to the open socio-economic environment of the system. From this point of view, clusters are systems in which there is continuous flow of knowledge through linkages inside the cluster and linkages with other clusters and global market. Specialized human resources, infrastructure, capital resources, natural resources and social capital are the inputs to the system and co-operation, collaboration and rivalry drives the system to competitiveness by increasing productivity, innovations and new business formations. Through this competitiveness advantage, clusters ensure regional development.

Figure.2 is an example of cluster dynamics model (Smith and Brown, 2009).

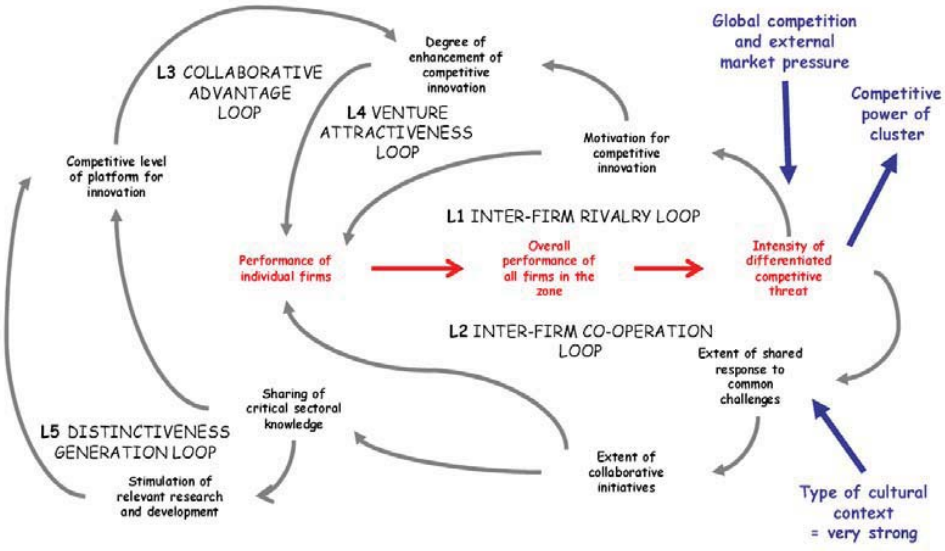

Figure 2 The cluster dynamics model
(source: Scottish Enterprise, 1998; Smith and Brown, 2009).

2.1.3 Porter's Diamond Model

In his *The Competitive Advantage of Nations* (1990), Porter investigates the sources for international competitive advantage by studying a wide range of nations and many industries with a starting question: "Why do some nations succeed and others fail in international competition?"

In seeking answers to the above question, he begins with identifying five competitive forces that determine industry competition. (ibid, p.35) Those forces are:

- The treat of new entrants
- The treat of substitute products or services
- The bargaining power of suppliers
- The bargaining power of buyer
- The rivalry among the existing competitors-competitive rivalry

In Figure.3 the illustration of these five forces is given:

Figure 3 Illustration of Five Competitive Forces (Source: Porter, 1990)

Each competitive force's strength is a function of industry structure, which is notable in international competition (ibid., p.35, 36).

Porter conceptualize the national environment, which promotes the creation of competitive advantage, with four determinants and two exogenous variables namely *Porter's Diamond*. In Figure.4 the "Diamond" illustration shows the determinants and their interconnection.

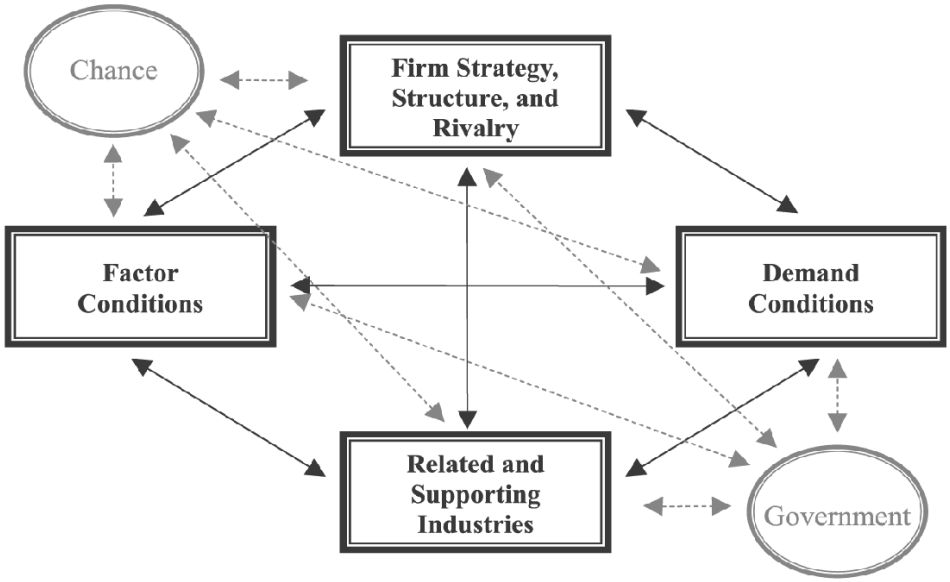

Figure 4 Porter's Competitiveness Diamond(source: Porter, 1990)

According to Porter's study, nations gain competitive advantage, when they have advantages in the "diamond" determinants. These determinants are briefly explained below.

Factor conditions are the inputs of the production such as human resources, physical resources, knowledge resources, capital resources and infrastructure.

Those factors can be both inherited by a nation or created. The factors which make more sustainable competitive advantage for nations are the created ones such as highly educated people, government or private founded research institutes and infrastructure.

Demand conditions are the home demand of a nation. Nations with more sophisticated and demanding local customers and specialized local demand are more competitive according to Porter (1990). Close proximity to demanding local customers is important for the producers to understand the customer needs and respond quickly. This pushes the producers for new products and innovations. The core design of a product reflects home market needs.

The third broad determinant of national competitive advantage is the *related and supporting industries*. Competitive supplier firms of related industries provide potential advantage in many other industries. For instance, in automotive industry, the main automobile producers gain competitive advantage if their suppliers are domestic competitive firms instead of foreign firms. Reaching inputs is more efficient, easy, rapid and cost-effective. Close contact and knowledge share between the producer and its suppliers ease developing new products, innovation and upgrading.

Related industries are those in which firms can share their activities and knowledge in value chain. The new opportunities for one industry are also beneficial for the related industries. When innovations are made in an industry, via information flow and technical interchange, the related industries also benefit. Success of one industry can pull through the relating products.

The fourth broad determinant of national competitive advantage is the *firm strategy, structure and rivalry*. The structure refers the context in which the firms are created, organized and managed. The local environment which encourages appropriate investment and continuous upgrading are more advantageous for firm competitiveness. The manner of management and

competition is affected by national conditions. Every nation has different characteristics which creates different tendencies for the industries. Local environments that encourage appropriate investment and sustained upgrading are more competitive.

In Porter's diamond, domestic rivalry is also important for nation's competitive advantage. In global competition successful firms are observed to be ones which compete domestically with pressure on each other to improve and innovate. Domestic rivalry is more effective and leads to more sustainable national advantage when the rivalry is in performance and technology instead of price wise.

After studying ten nations and many industries, Porter does not neglect the *chance* effect of nations some of which are acts of pure invention, major discontinuities in technology such as microelectronics and input costs such as oil shocks, shifts in world financial market and wars. Chance events create discontinuities which result in sudden and unexpected competitive advantage. For instance, World War II results in development of automotive and chemistry industries in Germany, though she is defeated.

The final variable in Porter's diamond is the *government*. Government can affect each determinant of the diamond either positively or negatively. Government policy has a crucial role on nations' competitive advantage, though it is partial. Government has a supportive role on the other determinants in a competitive nation and has a role in "creating favorable framework conditions" to facilitate the functioning of markets through dynamic competition policy, balanced macroeconomic policy or regulatory form (OECD, 1999). The government preferably impacts factor conditions in improving education, infrastructure and tax incentives, promoting R&D and competitiveness; and ensuring the availability of investment and risk capital (Bermann, 1990).

All these determinants of the diamond form a system, each of them affecting the others. It continually changes and restructures itself. For different types of industries, different determinants gain importance. For a resource-intensive industry such as mining, the factor conditions are more dominant and a disadvantageous position in other determinants does not have the same impact as factor conditions.

The diamond model does not directly depict a cluster but it is the particular process that leads to the development of clusters. According to Porter geographical clustering reinforce interactions within the diamond, increasing competitive rivalry and knowledge spillovers thus innovative activity and productivity rise. The conditions suitable for cluster development are based on the determinants of diamond and expression of their systemic character. In each of the nations that Porter studied, he found that the patterns of competitive advantage show extensive clustering. Domestic rivalry and geographic industry concentrations affect the diamond to transform into a system. The systemic nature of the diamond leads to clustering which is vertical and horizontal linkage between industries (Porter, 1990).

O'Connell et.al, cites O'Donell's review about Porter's diamond, summarizes how determinants lead to clustering in Figure.5 (1999).

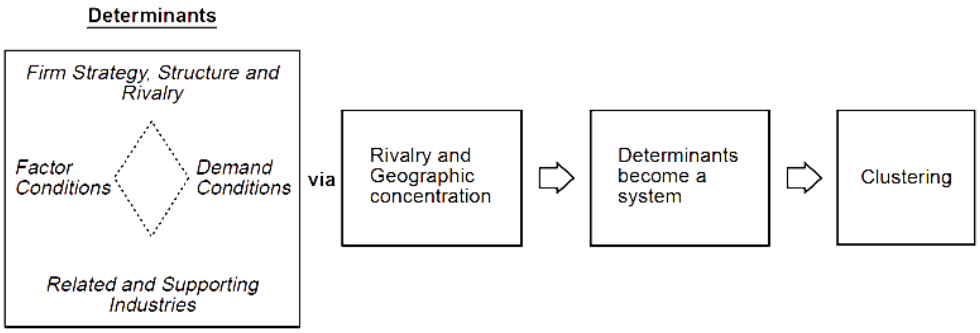

Figure 5 Determinants of Porter's diamond and clustering (source: O'Connell et al., 1999)

2.1.4 Benefits of Clusters

In modern world, competitiveness is based on productivity. Companies can be productive in any industry by using sophisticated methods, advanced technology and unique products and services. And sophistication depends on the quality of the local business environment (Porter, M., 1998, Clusters and the New Economics of Competition, Harvard Business Review). As he put it, "Paradoxically, the enduring competitive advantages in a global economy lie increasingly in local things – knowledge, relationships, and motivations that distant rivals cannot match." (Porter, 1998b).

According to Porter (1998b), clusters affect competition in three ways:

- By increasing *productivity*
- By increasing ability to *innovate*
- By stimulating *new business formation*

In terms of productivity:

Competitiveness is acquired by high productivity and productivity depends on the value of products and services, measured by international markets position and the efficiency of production. In order to reach high productivity, firms need to cooperate with institutions and other firms and increase operational efficiency through knowledge share, spill-overs and synergies. Instead of being isolated, proximity to customers, suppliers, other firms, institutions and research centers facilitate access to public goods, provides better coordination and diffusion of knowledge (World Bank, 2009).

Firms in clusters benefit from ease of reach to variety of inputs like a deep supplier base and pool of specialized and experienced employees. Proximity to suppliers lowers transaction costs, decreases inventory costs due to less lead times, and increases the reach to support services obtained from suppliers through higher levels of communication.

Specialized information is easy to reach within clusters because of the accumulation of technical, financial and rivalry information in clusters via extensive knowledge flow and spill-overs. Personal relationships among firm members facilitate this knowledge flow in clusters.

Complementarities within a cluster increases productivity when products complement each other in meeting customer needs. In California Wine Cluster for example, the wine cluster and tourism cluster complement each other in customer wise. Clustering of vineyards in California attracts tourists to the region besides other tourist attractions of California. Advantages of complementarities for productivity also occur in coordination activities across companies to optimize their collective activity and in increased market reputation due to high reputation of complementary businesses.

Universities, research institutions and public/private sector founded goods in clusters enhances productivity by increasing numbers of training opportunities, infrastructure, quality centers, testing laboratories etc. which serve as collective benefits.

Finally, the rivalry among the firms in clusters is highly motivating and amplifies competitive pressure and results in increased productivity.

In terms of innovation:

Clusters promote innovation by knowledge share among participants of clusters. Availability of close interaction with suppliers and customers, easier exchange of tacit knowledge due to high physical and cognitive proximity and availability of knowledge centers in clusters, facilitates the knowledge flow and feeds innovation. It is not the codified technical knowledge, which can be shared easily in distance, but the tacit knowledge that makes difference in development of new ideas and innovations. Social networks promote the transfer of tacit knowledge.

Clusters also provide environments in which firms can act rapidly for the realization of innovation. In a cluster, a company can source its necessities easier for innovation process, thus respond to customer needs more efficiently.

Competitiveness between the companies triggers innovations. In order to obtain a superior position among the others, companies become more innovation oriented and the success of one company stimulates the others.

In terms of new business development:

In clusters there is a group of existing customers, suppliers and main producers which attracts new entrepreneurs. It is less risky for the new incomers with lower barriers of entry to business, higher human resource, more common assets and higher know-how accumulation. Success of a cluster creates a domino effect and give rise to other related sectors.

2.1.5 Types of Clusters

There are various typologies for clusters. Many studies to classify clusters based on their differences in industry sectors, number and size of the firms as well as inter firm linkages and collaboration have been reported in literature (OECD, 2007).

According to Pavitt's taxonomy of innovating firms as cited in (OECD, 1997) clusters can be classified as:

1. science-based
2. scale-intensive
3. supplier dominated
4. specialized suppliers

(Pavitt, 1984; OECD, 1997)

- For *science-based clusters* working in cooperation with universities and research centers are important to strengthen their own in-house research activities. Firms in this sector develop new products or processes and have a high degree of appropriability from patents, secrecy, and tacit know-how. Examples to such sectors are electronics, pharmaceuticals.
- *Scale-intensive clusters* are characterized by mainly large firms producing basic materials and consumer durables, e.g. automotive sector. The firms in scale-intensive clusters tend to form links with technical institutes and universities, without making much research on their own. The most research focus on process improvement.
- *Supplier dominated clusters* include firms from mostly traditional manufacturing such as services, agriculture, forestry etc., which rely on sources of innovation external to the firm. They tend to import technology mainly in the form of capital goods and intermediary products; their innovative performance depends on their ability to interact with their suppliers and extension services.
- *Specialized supplier clusters*, such as computer hardware and software, specialized machinery production and high-tech instruments, are formed of more specialized firms which produce technology to other firms. They perform research and development, working closely with each other and together with customers.

"Markusen's typology of clusters" is a famous way of classification of clusters into four main types: Marshallian, hub and spoke, satellite platforms and state-anchored clusters (Markusen, 1996).

- *Marshallian clusters* consist of mainly small and medium-sized, locally owned firms that focused on craft-based, high technology or producer services industries. Relatively low scale economies forestalling the rise of large firms are observed in the cluster. Substantial trade transacted between firms often enables long-term contracts and collaboration. Firms

of the cluster are supported by specialized services, labor markets and institutions and they form networks to come over problems. In terms of employees, individuals are committed to the district rather than to the firm. As a result, rate of out- migration is very small while migration occurs into the region as growth permits (Markusen, 1996; OECD, 2007).

- *Hub and spoke clusters* are characterized by one or several large key firms acting as anchors with smaller and less powerful suppliers and related activities spread around them. Hub and spoke clusters can show either a strongly linked form in which smaller firms (spoke) are quite dependent on the large firm (hub) for markets and supplies, or a weaker form in which smaller firms take advantage of activities related to the large firm. While cooperation exists between small and large firms, the relation between competitor firms that enable to spread risks, stabilize markets and share innovations is not observed (Markusen, 1996; OECD, 2007).

- *Satellite platforms* are clusters in which branch facilities of externally based multi plant firms are dominated. In satellite platforms, business structure involves large, externally based firms that make important investment decisions. Intra district trade, networking between the cluster's branch plants and commitments to local suppliers are absent, as a result, spin-off activities are not intense. Scale economies within each facility are moderate to high while rates of turnover tenant are low to moderate (Markusen, 1996; OECD, 2007).

- *State-anchored clusters* represents the fourth form of industrial districts where the business structure consist of a public or non-profit entity (e.g.military base, defense plant, a university, government offices) surrounded by suppliers and service sectors. Substantial intra district

trade is observed mainly among dominant institutions and suppliers. Scale economies are relatively high in public-sector activities whereas turnover of local business is low (Markusen, 1996; OECD, 2007).

The properties of Markusen's typology of industry clusters are summarized in Table.1.

Table 1 Markusen's typology of industry clusters

Cluster Type Growth	Characteristics of Member Firms	Intra-cluster Interdependencies	Prospects for Employment
Marshallian	Small and medium-sized locally owned firms	Substantial interfirm trade and collaboration, strong institutional support	Dependent on synergies and economies provided by cluster
Hub and Spoke	One or several large firms with numerous smaller smaller suppliers and service firms	Cooperation between large firms and smaller suppliers on terms of the large firms	Dependent on growth prospects of large (hub) firms
Satellite Platforms	Medium- and large-sized branch plants	Minimum interfirm trade and networking	Dependent on ability to recruit and retain branch plants
State-anchored	Large public or non-profit entity and related supplying and service firms	Restricted to purchase-sale relationships between public entity and suppliers	Dependent on region's ability to expand political support for public facility.

(source: Barkley&Henry, 2001)

Gordon and McCann (2000) find Markusen's approach as inductive and propose a deductive approach to cluster typology claiming that their approach focuses on processes rather than structures. However, two of these types are close to

Markusen's Marshallian and Hub and Spoke clusters which are *the model of pure agglomeration* and *the industrial complex model*. Different from Markusen's typology, the third type defined by Gordon and McCann (2000) is *the social network model.* Social networks are a form of social capital, in which there exists trust, based on social history, local economic base and personal links among the members. Examples to this model are Italy's Emilia-Romagna (Scott, 1988) and California's Santa Clara County (Larsen and Rogers, 1984; Saxenian, 1994).

2.1.6 Cluster Life Cycle

Since clusters are dynamic formations, they have a definable lifecycle which is as a cyclical process consists of mainly four stages. These stages can be described as emerging, growing, sustaining and declining clusters (DTI, 2005; Menzel&Fornahl, 2007).

Emerging clusters can be defined as the first or early phase of growth (DTI, 2005). Since a new forming cluster is not an actual cluster, it is usually difficult to exactly define the emerging phase. In this phase, the cluster structure is very heterogeneous due to the low number of firms scattered over wide areas. Customer-supplier relations and networks only arise in some parts of the emerging cluster as a result of exchange processes between firms (Menzel&Fornahl, 2007).

Porter (1998b) proposes that there can be many sources leading to the existence of a new cluster. In his study, he explains that historical circumstances, unusual, sophisticated or stringent local demand, prior existence of supplier industries or innovative companies that stimulate the growth of others can be seeds for formation of new clusters.

There are mainly two reasons for the end of this stage. The first reason is that the emerging cluster expands into growing stage if it manages to show innovative activity, have support of local institutions and sustain vigorous competency

between firms. Secondly, the emerging cluster loses its ability to become a functioning one and the stage ends (Porter, 1998b; Menzel&Fornahl, 2007).

Growing clusters are clusters that are perceived as having room for further growth (DTI, 2005). A growing cluster is an indication of a strong increase in employment resulting from the growth of related companies and a high number of new firm formations. The main characteristics of growing clusters are that the boundaries are definable, the existing and incumbent firms are oriented at the centre of the cluster (Menzel&Fornahl, 2007).

In this stage, the cluster signals an opportunity for entrepreneurs, and the individuals with new ideas and relevant skills locate in the area. As a result of emergence of specialized suppliers, accumulation of information and developing of local institutions, cluster broadens to involve related industries (Porter, 1998b).

The growing stage can end due to the adjustment of development of cluster's firms to the development of the rest of respective industry. As a result, the cluster gets stability and enters into sustaining stage (DTI, 2005).

Sustaining clusters are in a kind of equilibrium state in which they exhibit neither extensive growth nor a sharp decrease in the number of firms. One property of this stage is that the competency between firms is exploited by established networks. In addition, new information and knowledge is brought into the cluster by the relations of the firms of the cluster with the outside firms and it enables to keep the networks open (Menzel&Fornahl, 2007).

Two factors play important role for the end of sustaining stage. The first one is that cluster follows life cycle .The second factor is that the cluster enters into a new growth phase as a result of generation of new diversity accompanied by entering of new markets (Menzel&Fornahl, 2007).

Declining clusters are in a stage in which they have reached their peak and begin failing and declining in terms of number of firms or employees due to firm exits, mergers and rationalizations (DTI, 2005; Menzel&Fornahl, 2007). A declining cluster fails to build capabilities in new technologies or relevant supporting firms and institutions, loses the ability to sustain competency between firms and has difficulty to adjust changing environmental conditions (Porter, 1998b; Menzel&Fornahl, 2007).

Three possibilities for the end of this phase can be described. Firstly, the cluster follows the life cycle. Two other possibilities are indications of a new growth phase due to qualitative change of the existing development or structural change towards entirely different fields (Menzel&Fornahl, 2007).

2.1.7 Networks and Clusters

Having studied the clusters; networks, the differences between network structure and clusters and how clusters encompass networks is discussed in this section.

Similar to clusters, networks are defined in several research streams. Although some authors use networks interchangeably with clusters, they refer to different definitions. Before going over the differences between networks and clusters, it is beneficial to define networks. As Pyka and Küppers put it: “Networks are structures that link diverse knowledge producers, suppliers and users located in different organizations in order to facilitate rapid exchange and decision making.” (2002). As cited by Forsman and Solitander (2003) some (Jarillo 1988; Powell, 1990; Thorelli,1986) define networks as an alternative to the market in terms of regulating force and hierarchy, Jarillo’s (1988) strategic network consists a controlling hub firm managing the other firms in the network; while some others’ (Ritter et al., 2002) approach is that one firm cannot control other relationships in the network, rather the firm has to manage their own in the network. Firms have cooperative relationships with other firms in the network in order to benefit the resources of the network (Johanson & Mattson, 1987).

Networks differ from clusters in three broad ways: (Carayannis and Wang, 2008)

- Clusters are formed following the linkages of a value chain whereas networks intersect numerous clusters and different sectors and link several value chains at the same time (OECD, 1999)
- Networks are more flexible in terms of members and activities than clusters. Networks members may change according to altering projects whereas, in clusters there is not frequent change unless fundamental factors such as technology change (Carayannis and Wang, 2008).
- Networks are less sensitive to the number of members and they can reach their ideal density in any number of nodes depending on the technology, managerial capacity and value chain properties (Carayannis and Wang, 2008).

A comparison between networks and clusters is summarized in Table.2.

Table 2 Comparison between Networks and Clusters

In terms of:	***Networks***	***Clusters***
membership	membership based (open or closed depending on the network type)	not required
scale	small, inter-firm	large
basis for agreements	contractual agreements	social values that foster trust and encourage reciprocity
basis of external economies	shared functions and resources	location/proximity
relations	based on cooperation	based on both cooperation and competition
shared goals	common business goals	collective visions

(source: adapted from Rosenfeld, 1997; Rosenfeld, 2001; Cooke, 2002)

The differences between networks and clusters do not mean that they are apart from each other. They are both competitive and complementary working together to accelerate innovation and technology development (Carayannis and Wang, 2008).

Clusters and networks are intertwined. Clusters can include networks and networks can have members from several clusters. The firms in a cluster, linked vertically or horizontally, involve in social relationships or networks which are encouraged by co-location. Porter points out: "a cluster is a form of network that occurs within a geographic location, in which the proximity of firms and institutions ensures certain forms of commonality and increases the frequency and impact of interactions" (1998b). Similarly, OECD (2004) defines clusters as: "networks of production of strongly interdependent firms (including specialized suppliers) linked to each other in a value-adding production chain". Cluster concept is beyond simple horizontal networks where firms operate for the same end-product. Clusters include networks operating cross-sectorally, in which firms are specialized in a part of a value chain and complementary to each other. (OECD, 1999)

As well as local, global network links of clusters are necessary for international competitiveness. Global pipelines, which are global linkages in a *knowledge network*, and local buzz, which is the local information flow through gossips, news and buzz in a cluster, are two essential characteristic of a cluster for knowledge creation, innovation and thus competitiveness (Bathelt et al., 2004). External knowledge is necessary for clusters in terms of fresh ideas. More stable and mature knowledge flow comes through 'network pipelines'. This knowledge is dissipated through local buzz in clusters. Global pipelines encourage local buzz: "[…] The more firms of a cluster engage in the buildup of trans local pipelines, the more information and news about markets and technologies are 'pumped' into internal networks and the more dynamic the buzz from which local actors benefit" (Bathelt et al., 2004). In Figure.6 the structure and dynamics of local buzz and global pipelines are shown.

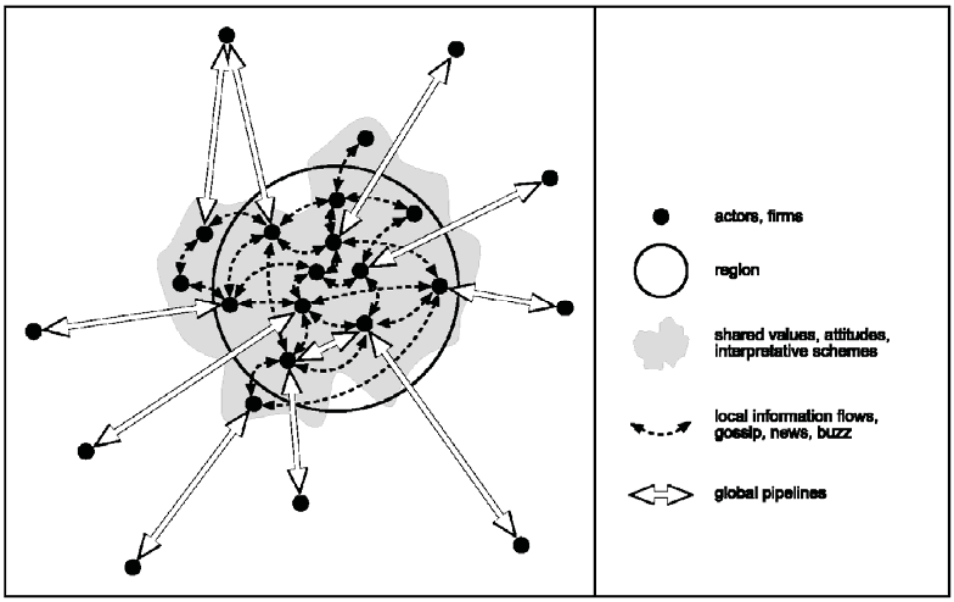

Figure 6 Global Pipelines and Local Buzz acting in a cluster (source: Bathelt et al., 2004)

In summary clusters and networks are inseparable from each other. Clusters perform better, when they encompass internal and external networks. Facilitated knowledge flow through networks, reaching to several technological and financial resources, prevention of lock-in leads to more competitive and innovative clusters.

2.2 Cluster Development and Policies

Governments and policy makers search ways to become or stay competitive and to reach a sustainable development. In a global world, despite the advantages of highly developed communication technologies, the success and competitive advantage of clusters attracts many researchers and policy makers from all over the world. A study revealed that almost all EU countries had at least one cluster program (Furre, 2008). As mentioned by Clar et. al, the surveys, carried out by Eurobarometer and results of which are presented in the analytical report “2006

Innobarometer on cluster's role in facilitating innovation in Europe", show that the companies, which are parts of a cluster, are more innovative and consequently more competitive than the firms outside the clusters (Clar,G. et al., 2008). Concentration of similar and complementary firms in close proximity promotes production of key factors for development in a more economical and competitive way (Innobarometer, 2006).

Barkley and Henry (2005) state that targeting of industrial development programs at specific industry clusters is more beneficial for economic development than unfocused industrialization efforts. Principal benefits stemming from the development of industry clusters are the following (Barkley and Henry, 1997, 2005):

- Clustering strengthens localization economies
- Clustering facilitates industrial reorganization
- Clustering encourages networking among firms
- Clustering results in larger local economic impacts
- Clusters facilitate entrepreneurial activity

It is important to notice that, policy makers or governments cannot build clusters from scratch. Although they play an important role in paving the way for development of clusters and helping for their sustainability, there are conditions necessary to be obtained (Steinle and Schiele, 2002). Once these necessary conditions are satisfied, potential for cluster formation occurs, however clusters don't happen in one night. It takes time, often decades for clusters in order to develop and to progress.

In Porter's diamond, the conditions required for cluster development are shown. Those are the conditions which should be hold to create the suitable environment for cluster formations. However, Porter's study does not identify industries which have higher tendency to cluster. His work is criticized for not being applicable to all industries (Yetton et al., 1992; Penttinen, 1994; C. Steinle and

H. Schiele, 2002). Steinle and Schile argue that Porter's clustering approach is not suitable for industries based on raw material and industries whose products are non-tradable goods, and name conditions to indicate which types of business are more likely to cluster-somewhere. They define necessary and sufficient conditions for how firms cluster; and apart from the suitable environment, what do firms need or what are the conditions they have to satisfy to form a cluster.

In the following paragraphs, those conditions are explained (Steinle and Schiele, 2002):

Necessary conditions are named as divisibility of process and transportability of product. Divisibility of process means dividing production processes in many steps in value chain, so that specialization occurs and by many steps, co-ordination among several firms acting in the same value chain is achived (Brusco, 1982; Jarillo, 1995; Steinle and Schiele, 2002). This is set to be the first necessary condition required to be satisfied to form a cluster. Parcellation of production involves several actors in the production process of the final product. For example, in automotive industry, main automobile manufacturers use several contractors which supply them different sub-parts of the final product. This allows more specialized organizations to be formed and enhances competition and mutual learning. The more the number of processes of one product has to pass to reach its final form and number of actors at each step of the value-chain, the more it is divisible and the more it provides a suitable condition for clustering.

As the second necessary condition Steinle and Schiele consider the transportability of the final product. In a cluster, the final product should be transportable because if not, the location of the producers is defined by the location of the customers. This condition is always satisfied for industrial products and services. Therefore it is unnecessary to mention transportability of the final product as a condition in industrial clusters case.

In addition to the above given necessary conditions, there are three sufficient conditions, which foster clustering. Those conditions are long value-chain, diversity of competencies, importance of network-innovations and volatility of the market.

As a first sufficient condition: long value-chain is connected with divisibility of process. The higher is the divisibility of processes, the longer is the value-chain of the product. Long value-chain provides larger number of firms adding value to the final product and it is preferable for firms to be a part of a cluster to facilitate coordination and co-operation in the value-chain. It enhances specialization and due to higher complementarities, firms are more competitive.

Another sufficient condition for clustering is the diversity of competencies. Higher diversity of competencies in a value chain forces the producer to diversify its production to different firms instead of managing all diverted competencies in-house. When there are several firms producing diverted competencies, clustering facilitates the necessary co-operation to best coordinate complementary competencies.

Innovation networks are important in cluster building. As more complementary firms join to the innovation process and as lesser co-ordination time is available, the efficiency of their co-operation becomes more vital. However, if innovations in an industry are not supported or innovations are not one industry's focus, then co-ordination of firms for innovation do not provide any superior advantage to the firms. The role of innovation in an industry sets the firms need for co-ordination, and higher co-ordination needs are satisfied in clusters. If innovation plays an important role for an industry, clustering is also fostered. Steinle and Schiele (2002) mention in their work about three different types of innovation sources, which are inventor-entrepreneur, large in-house research and network-innovation. In innovations sourced by inventor-entrepreneur, a radically new product often comes out of invention whereas, in large-house research and development, where there are large number of specialist pooled in different

sections of organization, mostly upgrading of existing products and processes is carried out. Apart from the two above, network-innovation is neither a radically new innovation like an inventor-entrepreneur action, nor an upgrading of existing products as in traditional research centers. When different actors, possessing distinct competencies, integrate their skills, a network-innovation occurs usually without purposeful action and absolutely with the assistance of co-operation and tacit knowledge flow among several actors, and it can be both an incremental improvement and creation of a new product. Network-innovation is a good candidate to be widespread in innovation formation.

Steinle and Schiele (2002) name final sufficient condition for clustering as *volatility of market: rewarding flexible adaptation.* Volatile markets are markets having frequently changing demands and requiring quick acting due to these changes. Coordination advantages in a close proximate region turn into competitiveness advantages, due to reduced response times and faster and more accurate coordination among the actors. A system of different firms working in a cluster adapt faster and easier to the fast changing dynamic market than an company including all different processes in itself.

The above mentioned conditions defined by Steinle and Schiele (2002), is helpful for policy makers: firstly by monitoring how far clustering has taken place in development and secondly by helping to select target industries to be supported by policies, as measures for cluster-development.

2.2.1 Cluster policy

Numerous institutions such as European Commission, OECD, World Bank, UNIDO etc. are eager in promoting clusters, and publish books and papers about enhancing innovativeness and competitiveness through clusters. Cluster analysis encourages stakeholders from public and private sector to act jointly on basic public policy issues by developing a shared understanding. This integration is important in starting more extensive processes for economic reform in developing countries. Cluster development policies is attractive to developing

countries in respect to advantages of geographical and activities' proximity, which provide access to specialized labor resources and suppliers, knowledge spill-overs, competition pressure and through linkages in cluster, link to overall economy (World Bank, 2009).

In various policy applications, cluster policies are a part of broader policy initiatives, such as policies for innovation (e.g. National Innovation Systems), SMEs' development and economic development; aiming to reach a higher competitiveness and improved efficiency.

In Boosting Innovation-The Cluster Approach (OECD,1999), Lajendijk and Charles consider cluster policy as an innovative step in regional policy making, not only for the emphasis on networking, but also for combining two levels of economic development, which are business level and structural level. Cluster policies aim to promote inter-firm trading and inter-firm learning in business level of regional economic development and to support the redirection of economic development through rising sectors in the structural level of regional economic development (OECD, 1999).

Boekholt and Thuriaux (1999) define policy activities as:

> Cluster policies comprise the set of policy activities that aim to: stimulate and support the emergence of these networks; strengthen the inter-linkages between the different parts of the networks; and increase the value added of their actions (p. 381).

According to Clar et.al, cluster policy is "process of making and implementing strategic decisions of actors in both the public and private domain with the overall aim to sustain and/or to increase regional economic development." (2008).

Raines (2001) summarizes the cluster policies in Europe and argues that unlike the regional policy developments, the cluster policies' goal is on facilitating

network development rather than individual actors in the network and he argues that instead of pointing the overall local economy, the cluster policy is concerned with promising sectors.

From the above definitions, cluster policies can be defined as a set of activities to provide suitable and necessary conditions to foster networking for clustering or enhance conditions for existing clusters by pointing deficient parts and necessities, which prevents the possession of advantages that a cluster should provide.

In the academic debate, there are opposing views to cluster policy. Some criticize the unclear way that clusters are conceptualized from an academic idea to a policy concept (Martin and Sunley, 2003). Others provide a criticism that the lack of a generally excepted definition for cluster policy prevents the debates on cluster policy (Duranton and Henry, 2008). More fundamental debate is on the necessity and benefits of cluster policy. As mentioned by Sölvell et al. (2009), it is discussed whether the clustering efforts can provide strong impact to reach more competitiveness. Supporters of cluster policy justify the approach with several successful cases which also help the improvement of the cluster policy for higher competitiveness itself (Cortright, 2006; Mills, et al. 2008)

2.2.2 Policy Phases

Hogwood (1987) introduced the idea of "policy life cycle" to describe the evolution of an idea to action, which is given in Figure 7. Raines (2000; 2001) and Benneworth and Charles (OECD, 2001a) used policy life cycle for the phases of a cluster policy life cycle.

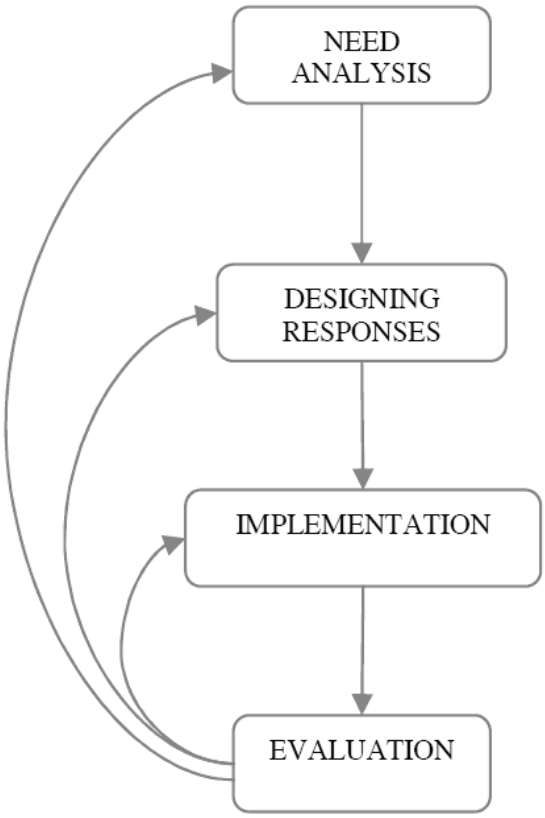

Figure 7 Policy Life Cycle (Source: Adapted from Hogwood 1987 and Raines 2001)

Raines (2000) adapts Hogwood's "policy life cycle" for cluster policies and sets the phases as:

- the *selection and targeting* of clusters in different regions and the methodologies used for identifying the choice of targeted clusters;
- the *strategic interpretation* of the cluster concept in practice, especially how the cluster concept has been interpreted within the wider processes of regional development;
- the *initiation, planning and development* of cluster policies, and how commitment has been secured from the relevant agents in the region;

- the *strategic and operational management* of the cluster concept;
- the arrangements put in place for the *monitoring and evaluating* cluster development programs; and
- the *critical success factors* shaping good practice in these areas.

OECD (2001) names the stages of a cluster policy as:

- *the decision to use a cluster approach* and *determination of the state role*
- *selection and designation of cluster:* based on input/output criteria or promising sectors for national industrial advantage
- *from strategy formulation to programme delivery:* identifying participants, aims and targets, and then planning and delivering actions
- *evaluation and reporting-back stage* where lessons are learned, and the possibilities of subsequent policy phases evaluated. The policy finally re-emerges into the political sphere, where its appropriateness and efficiency *as a policy measure* can be democratically debated, and decisions taken over the future of cluster policies.

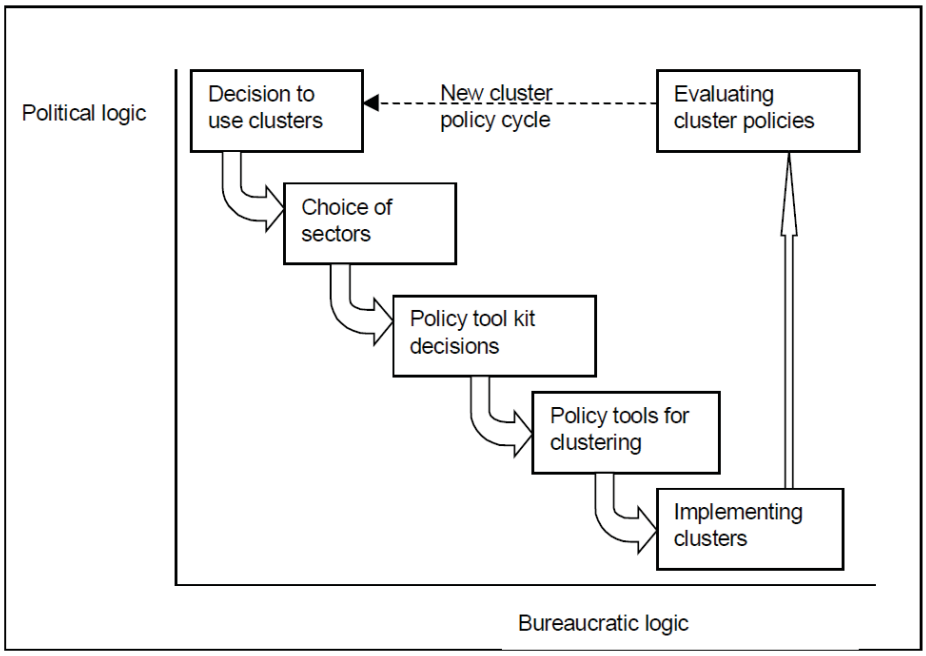

Figure 8 Cluster Policy Life Cycle (source: OECD, 2001a)

Despite different contexts, cluster policies have similar paths. As mentioned above, first the need for a cluster development is identified and studies are carried out for selecting cluster follows the analyzing of the selected cluster. Then policy is developed, setting the targets and tools. Then comes the implementation part, which is the realization of the policy. Finally at the evaluation stage, the policy is evaluated for its effectiveness and efficiency after an appropriate operational period.

Here it is important to distinguish between evaluation of cluster development and evaluation of cluster policy. The last stage of the cluster policy cycle is addressing the evaluation of the policy, whereas this thesis is concerned with the evaluation of cluster development. Obviously, the cluster policy has an important role in the success of the cluster development, but here in this text, evaluation of the cluster policy is not concerned. It is assumed that the cluster policy is sound

and the evaluation of cluster development will be considered independent of the cluster policy.

2.2.3 Cluster Initiatives and Incentives

Governments, state agencies, international organizations such as EU promotes promising cluster initiatives by providing incentives such as tax reduction, financing, investment aids, etc. for regional development.

As Sölvell et al. put it: “Cluster initiatives are organised efforts to increase the growth and competitiveness of clusters within a region, involving cluster firms, government and/or the research community” (2003).

Cluster initiatives are composed of (Sölvell, 2009):

- members composed of actors from private, public and academic organizations
- cluster organization with an office, working as cluster manager/facilitator
- governance of the cluster initiative, key institution for coordination and co-operation among the stakeholders and government, for the implementation of the policy in right manner
- financing of the initiative (local/national/international funding)

As stated by Sölvell (2009), objectives of the cluster initiatives are given below:

- *human resources upgrading* aims to improve the level of specialized labor pool by education, training or attracting skilled people to the region. Initiating related educational departments attracts the student to the region and provides a continuous input for skill pool. The managers are provided by management training programs to improve their management skills. Professional trainings for the sector and technical trainings are provided to the existing technical labor pool.

- *Cluster expansion* aim to increase the number of firms in the cluster by promoting investment in the region or by organizations that offer entrepreneurs a variety of resources, including mentoring, financing advice, technological training, business space, and research facilities.
- *Business development* aims to promote the operation of the firms by offering export promotion.
- *Commercial cooperation* aim to increase the cooperation of firms by encouraging joint purchasing or sharing services to reduce costs.
- *Innovation* is facilitated through cooperation and networking among the firms and also between firms and the universities and research institutes. The government may provide tax incentives for the research and development activities to stimulate innovation.
- *Business environment* objectives target the improvement of the microeconomic conditions of the region by enhancing physical and technical condition, and the legal setting.

2.2.4 Techno-parks as Cluster Initiatives

Techno-parks, as Mytelka and Farinelli (2000) put it "constructed clusters", aimed to provide an intense cooperation between the university and the industry. Techno-park development has been widely supported since 1980s in all over the world (EC Report, 2007). Examples to government-sponsored techno-park initiatives are France's Sofia Antipolis, Taiwan's Hsinchu, and U.K.'s Cambridge (Garnsey and Brookes, 1992).

The reason that techno-parks are so much attractive to many policy makers and scholars after 1970s is mainly the success of Silicon Valley, which was developed spontaneously (Saxenian, 1990). In Silicon Valley, it is not just the high skilled labor quantity, supplier and information that make the region developed and competitive, but a variety of institutions; Stanford University, several trade associations, local business organizations, consulting firms, venture capital firms, that provide collective benefits to firms in lower costs. Moreover,

the strong social networks in the region allow the constant flow of knowledge and labor (Saxenian, 1990). Knowledge flow carries the technical and market information quickly among the customers, suppliers, and competitive firms and triggers the new opportunities and formation of new firms and labor flow carries the tacit knowledge (Saxenian, 1990).

Techno-parks enjoy the matched interaction and cooperation between entrepreneurship and innovation system (Cook, 2007). Inspired by successful technology driven clusters, techno-parks are initiated by governments, regions, universities, high-tech companies, investors/developers (EC Report, 2007).

However, not all the planned techno-parks perform successfully (Malecki, 1991). It is claimed that the Silicon Valley, which serves a master model for most of the techno-parks, cannot be copied to elsewhere, because Silicon Valley was not planned by the government and the local culture changes from place to place (Wang et al., 1998).

2.2.5 Clusters Initiatives In Turkey

Cluster approach in Turkey is relatively a new topic in the policy area. Çağlar (2006) states that cluster policies will have many advantages over the previously conducted policies for regional development. Referring to both Turkish and international experiences, it can be concluded that macro-policies for competitiveness are too broad, whereas micro policies at firm level are mostly less effective and cause waste of sources. On the other hand, cluster policies are in between the macro and micro level policies and their benefits can be counted as such (Çağlar, 2006):

- Organizing industry policies and activities in those policies,
- Remodeling the roles of government, public and private institutions, non-governmental organizations and universities for a more competitive industry,
- Favoring the communication between government and business world,

- Assembling firms with different sizes,
- Focusing on opportunities alongside the problems.

Before cluster approach is widespread all over the world, the popular policy for regional development was Organized Industrial Districts (OSB) for Turkey. Since 1962, approximately 250 OSBs have been established nationwide (Çağlar, 2006). OSBs provide the firms the necessary infrastructure and facilitate the legal issues with the public institutions, besides their original goal of organized industrialization. However, OSBs are different from clusters in ways that the clusters are composed of firms following the linkages of one value chain, whereas in OSBs the firms might be parts of different value chains and they may not be working complementarily.

The cluster initiatives have speed up with projects financed by European Commission; however, the earlier initiatives for clusters are conducted by a non-governmental organization: Competitive Advantage of Turkey (CAT). CAT – later named as URAK ("*Uluslararası Rekabet Araştırma Kurumu"*-International Competitiveness Research Foundation)– has initiated several cluster studies in Turkey, the examples of which are Sultanahmet Tourism Cluster Development Project and Competitiveness and Cluster Analysis of OSTİM OSB.

In the scope of *"Development of a Clustering Policy for Turkey"* Project, a strategy providing guidance on how to support business clusters is aimed to be developed that will constitute the core of this policy. The necessary institutional capacity for implementing this strategy and improving the competitive capacity of the national economy is also targeted. The Project was carried out by the Undersecretariat for Foreign Trade between March 2007 - March 2009 and was financed by the European Commission.

The pilot clusters initiated in the scope of this project are listed below:

- İzmir Organic Food Cluster
- Ankara Software Cluster

- Konya Automotive Parts and Components Cluster
- Eskişehir Bilecik Kütahya Ceramic Cluster
- Muğla Yacth Building Cluster
- Denizli Uşak Home Textile Cluster
- Manisa Electric Electronic Cluster
- Ankara Machinery Cluster
- Marmara Automotive Cluster
- Mersin Processed Food Cluster

Another popular study on clusters in Turkey is done by Özlem Öz. Öz (2004), in her "Clusters and Competitive Advantage: The Turkish Experience", investigates the linkage between geographic clustering and international experiences by examining four cases from Turkey. Those are the furniture cluster in Ankara, the towel and bathrobe cluster in Denizli, the carpet cluster in Gaziantep and the leather clothing cluster in İstanbul. However, these cases are closer to traditional regional agglomerations than today's more technology driven clusters. Counting these examples as promising clusters holding the necessary conditions for competitiveness would not be very accurate.

Despite the increasing popularity of cluster approach, its appropriateness for Turkey and Turkish industry still needs further study. Although clusters stimulate competitiveness, it is not a panacea for all regions and nations. Çağlar (2006) argues that the cluster policy tools, which are successful in countries with limited scope of sectors, might not provide the same results in Turkey where the industry scope is wider. Therefore, it is important to develop the cluster policy according the structure and constraints of the region.

CHAPTER 3

LITERATURE REVIEW ON MEASURING PERFORMANCE OF INDUSTRIAL CLUSTERS

"measure what can be measured, and
make measurable what cannot be measured"
Galileo Galilei

Tracking the performance of a cluster in time is important for evaluating the influences of cluster measures and for the comparison of performance overtime. Policy makers want to have the information about whether the cluster is successful and at what extent, and whether it reached the conceived goals or not. This will help the policy maker to identify whether the interventions, incentives, promotions and financing are beneficial for the desired purposes and whether they are used properly. Furthermore, identifying the weaknesses of clusters is important for more interventions to improve clustering development policies (DTI, 2005).

Despite there are numerous studies about clusters, their benefits and development policies, there is still a lack of studies on the evaluation and monitoring of cluster development. This may be because, cluster development is relatively a new topic and there is not much analysis on results and cluster performance.

In the literature relating to evaluation of clusters, some (Turok, 1990; Diez, 2001; Davis et al., 2006) focus on evaluating the cluster policy considering evaluation as a phase of policy life cycle, which is mentioned in section 2.2.2., while some others' focus is to evaluate the performance of the cluster initiative and program itself (Sölvell, 2009). Evaluating policy, for instance, is concerned with the success of the policy. The aim is to find out whether the policy is to the point, or whether it is set appropriately, and the result of the evaluation gives

feedback to the policy construction itself. Evaluating cluster initiatives, like the policy evaluation, is concerned with the success of the initiative. The success of lobbying government for infrastructure or improving FDI incentives in clusters can be named as measures for a success of an initiative.

Albeit the focus of the measurement differs, the difficulty to define the measures does not differ for evaluation of either cluster policy, cluster initiative or the cluster itself. The difficulty arises from the system characteristic of the cluster and the presence of loops of continuous interactions among the actors in the cluster. Apart from the measures related to economic performance or other measures which can be measured by quantitative indicators, cluster's performance also depends on the qualitative indicators such as the level of collaboration and social capital. Qualitative indicators are more difficult to measure than the quantitative ones since they depend on more subjective data and collecting qualitative data requires performing surveys, interviews or similar methods and depends on the skills of the interviewer.

Table.3 summarizes the challenges of evaluating clusters

Table 3 Evaluation Challenges of Clusters

Cluster Characteristics	**Evaluation challenges**
Clusters involve complex interactive processes	No clear causal relationships
Objectives frequently include knowledge creation, learning, capacity building	Intangible results, difficult to observe and measure
Clusters are systems of vertical and horizontal linkages	Results occur in different subsystems and on different levels
Clusters are rooted in a local context and embedded in socio-economic conditions	The cultural, political, and economic context must be taken into consideration

Table 3 (continued)

Cluster are dynamic	Evaluation requires an adaptive process
Clusters engage active regional participants in bottom-up approaches	Evaluation requires active participation of different actors involved

(Source: adapted from Diez, 2001)

As mentioned above, in the academic literature, there is not a broad study in specifically measuring performance of clusters. According to Fitzgerald et al. (1991), there are two basic types of performance measures in any organization. Those, which are related to results and those, which are related to determinants of the results. In the following paragraphs the various approaches for measuring performance of clusters are discussed.

Carpinetti, Galdamez and Gerolamo have carried a study on a measurement system for the performance of clusters based on the concepts of Balanced Scorecard model (2008). They draw a conceptual framework based on four perspectives of performance. Those are economic and social results, firms' performance, collective efficiency and social capital. In scope of economic and social results, measures related to local gross product, workforce, occupation etc. are considered, whereas in scope of firms' performance, individual firms' performance measures related to growth and competitiveness in terms of financial and non-financial performance indicators are investigated. In order to measure the cluster's performance in terms of collective efficiency and social capital, indicators related to cooperation among cluster members and trust are used. Carpinetti et al. define four dimensions of measuring cluster performance and detail the indicators based on specific cases. In this way, theory is also tested and refined.

Another theoretical approach for performance measurement of clusters is introduced by Davis et al. (2006). They provide a model for cluster measurement including the evaluation of both cluster conditions and cluster performance. Criticizing Porter's diamond for being too overlooking to capabilities of firms in the cluster and lacking measures of outcomes, Davis et al. claim to go beyond Porter's work and form their own framework for clusters in Canadian context (2006). This framework includes current conditions and current performance. The current conditions are similar to Porter's diamond, which are defined as factors, supporting organizations and competitive environment; however they contribute to Porter's framework with "current performance indicators". Those indicators are based on three main parts; significance, interaction and dynamism. The indicators proposed for these three parts are given in the Table.4.

Table 4 Cluster's Current Performance Indicators

Current Performance	**Significance**	Critical Mass	number of cluster firms
			number of spin-offs
			size of cluster firms
		Responsibility	firm structure
			firm responsibilities
		Reach	export orientation
	Interaction	Identity	internal awareness
			external recognition
		Linkages	local involvement
			internal linkages
	Dynamism	Innovation	R&D spending
			relative innovativeness
			new product revenue
		Growth	number of new firms
			firm growth

(Source: Davis et al, 2006)

The focus of the study is not measuring performance solely, but to provide a framework for clusters covering both the current conditions and current performance. So the indicators for current performance are of secondary importance, still it drives a framework for current performance.

Based on practical approaches, the studies presented in the scope of "Promoting Cluster Excellence" seminar, organized by the European Commission, can be referred since the examples cover cases from different parts of the world. In the scope of measuring cluster performance, cluster organization quality and the ways for better use of excellent clusters are debated among participants from several countries. Emily Wise, Vincent Susplugas and Lars-Gunnar Larsson are three of the participants of this seminar and their presentations can shed light for measuring performance of clusters.

Emily Wise (Research Fellow at the Research Policy Institute (RPI), Lund University, Sweden) mentions about the cluster performance indicators used in Japan. Industrial Cluster Project, which is carried out by Japanese Ministry of Economy, Trade and Industry (METI), supports the development of regional competitive industries with a focus on SMEs (Köcker and Rosted, 2010). As a part of the analytical framework, the performances of clusters are evaluated. The data are collected through surveys, direct interviews and analysis of statistical data and the indicators used in the evaluation are based on:

- existence of cluster core,
- level of collaboration,
- level of R&D and Innovation activities,
- level of business creation,
- economic effects,
- perception, use and degree of satisfaction with different types of support services

which are collected through survey assessment. Moreover, statistical data related to employment, sales and profit are investigated. The evaluation of the results is enriched with other informational inputs relating to cluster's conditions (Köcker and Rosted, 2010). However, this study does not specify the indicators but only provide information about the general titles for performance measures.

Vincent Susplugas (Office manager in charge of the cluster policy at the Ministry of Economy and Finance in France) mentions the evaluation of French "Pôles de Compétitivité"- competitiveness cluster program. This evaluation relies on the following elements under five main dimensions (Köcker and Rosted, 2010). Those measures are given in Table.5.

Table 5 The performance measurement indicators derived for French "Pôles de Compétitivité"

Research and technology activity	• Annual expenditures and employees involved in the projects selected by the cluster, coming from enterprises and public research organisms. • Number of projects selected, number of patents • Involvement of actors, exportations and national position • Ability to involve enterprises in the cluster • Exportation • Position of the cluster in the national economy regarding its main field of activity
Employment evolution	• Growth of the added value of clusters' SME members compared to other SMEs of the same size and activity • Global evolution of employment, especially SME • Evolution of the employment in the five main topics of the cluster

Table 5 (continued)

Quality of the cluster's strategy and its implementation	• Economic strategy : relevance of targeted markets • Scientific strategy : scientific roadmap's quality • International strategy : inter-clustering and technological partnership • Competences strategy: developing new trainings, collective skills management tools
Animation and governance	• Quality of the action program • Private involvement to finance the cluster's governance • Expenditure repartition in the different activities
Outcomes	• R&D projects • Infrastructures development • Skills' development • Partnerships • International development • SMEs' development

As a last participant Lars-Gunnar Larsson define the indicators of performance, used in Vinnvaxt Program (Sweden) which are based on national data sets and information received from initiatives. He divides the performance indicators in two main basis; growth indicators and R&D indicators but also emphasize the importance of soft indicators to measure trust, social capital, formation of innovation networks and co-operations.

Likewise Larsson, DTI (2005) stresses the importance of the networks and collaboration for clusters and defines the critical success factors of a cluster as: networks and partnership; strong skill base; innovation and R&D capacity.

The various studies carried out so far, cover the measurement of cluster performance in different subtitles but most of them cover the similar context. The indicators can be summed under the subdivisions of significance, interaction and dynamism (Davis et al, 2006); or networks and partnership, strong skill base, innovation and R&D (DTI, 2005).

The literature of cluster performance measurement does not provide detailed information about the indicators, instead provides the major framework of measurement, i.e. the sub areas that should be taken into consideration while evaluating a cluster's performance. In the following chapter, the literature for measuring individual measures of clusters will be investigated with a cluster perspective.

In the previous paragraphs, the literature is reviewed to investigate the appropriate indicators for measuring cluster performance. The studies carried out to put a framework for cluster performance measurement as a whole, generally cover more or less the same context with differing subdivisions. Most researchers reviewed in this text, include the cooperation, existence of networks and social capital as measures of performance in addition to the economic indicators. However, most of the authors avoid giving a single recipe consisting of specific indicators. The general approach is to define the indicators for each case specifically.

CHAPTER 4

DESIGN OF A MODEL FOR PERFORMANCE MEASUREMENT OF CLUSTERS

In this chapter, the performance measurement framework is constituted and a set of performance measurement indicators is formed. The basic idea behind the model is to measure cluster outputs, which create competitiveness, in order to measure the performance of a cluster.

As mentioned in section 2.1.4, according to Porter, clusters affect competition in three broad ways; by increasing productivity, driving innovation and stimulating new business formations. Set out here, the indicators to measure the performance of productivity, innovation and new business formation will be taken as the success indicators for clusters. Innovation, together with productivity, is the key driver of economic growth. Moreover, the proximity facilitates knowledge sharing and spill-overs, but this can most easily be achieved in high levels of social capital. The level of social capital and co-operation are the key features in a successful cluster. It constitutes the basis for the success. Without cooperation, knowledge flow and networks; the firms in a cluster form just a group, agglomerated in a region, working in isolation. Co-operation paves the way for economic performance and cost reduction. Costs can be reduced if the firm can reach new knowledge and technology from other firms in the cluster instead of producing in house. Co-operation facilitates mutual learning which is essential for improving productivity, and enables the share of R&D costs and risk (OECD, 1999).

The cluster concept is multi-faceted and it is meager to look at the economic indicators only to measure the performance: “building knowledge networks,

learning mechanisms and social capital is a necessary complementary asset to the economic factors traditionally thought to influence economic development" (Morgan & Nauwelaers, 1999). In formation of the model, the indicators for the co-operation, networking and social capital will be investigated as well as the indicators for productivity, innovativeness and new business formation.

Based on the logic described above, first the framework of the performance measurement model is constituted and given in Figure.9.

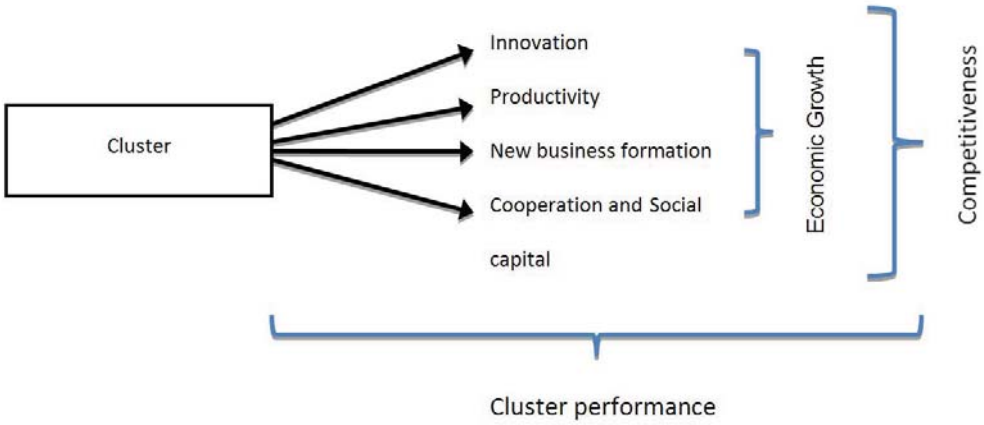

Figure 9 Model Framework

The performance for a cluster can be defined as a sum of performances of determinants of the model, namely productivity, innovation, new business formation and social capital. From this point of view, the literatures on each determinant of performance are reviewed separately. The aim of the review is to find more specific studies on indicators of respective determinants.

As mentioned in the previous chapter, it is difficult to set a general performance measurement model enabling to measure each cluster in every region. Even if a

general model can be set up, such models are too loose, far from giving precise results for an individual cluster under study. If a too detailed set is developed, then it will be unsuitable for most of the clusters. In order to avoid this problem, the model will be moderately detailed having indicators to be selected economical and social conditions of the country.

4.1 Measuring Productivity and Selecting Related Indicators

Clusters promote productivity due to their several advantages as mentioned in section 2.1.4. According to a study done by Madsen, Smith and Dilling-Hansen over Danish industrial clusters, the productivity advances significantly for firms belonging to clusters when compared to their counterparts located separately outside industrial agglomerations (2003).

Productivity in simple terms is the ratio of output to input. Increase in productivity either implies an increase at the level of outputs relative to the inputs or a decrease at the level of inputs relative to the outputs. There is a close linkage between productivity and efficiency. Productivity is taken as an important index to measure a firm's efficiency in converting inputs into outputs (Chen and Liaw, 2006). If a firm is efficient, it means it operates on the productivity frontier, where the productivity frontier is the sum of all existing best practices at any given time or the maximum value that a company can create at a given cost, using the best available technologies, skills, management techniques, and purchased inputs (Porter, 1996; Rogers, 1998). Therefore, rise in efficiency implies rise in productivity (Rogers, 1998).

Although the definition of productivity is rather simple, the measurement of productivity encompasses problems, which are the presence of multiple inputs and outputs, uncertainty for modeling the production process (Rogers, 1998); defining units of measurement, evaluating qualitative changes and getting reliable data for inputs and outputs properly (BFC, 2006).

There is a debate on the measurement methods for productivity. However, there are number of varying productivity measures, which are used commonly. The measures of productivity can be broadly divided into two main categories. Single or partial factor productivity measures are related to a particular output and a single input, such as labor or capital. Partial productivity measures are criticized for misinterpreting the level of integrated productivity and misdirecting the improvement efforts (Chen and Liaw, 2006). Whereas, Multi Factor Productivity (MFP) or Total Factor Productivity (TFP) measures are based on the ratio of a particular output to a group of inputs or total inputs used. Productivity measures can also be divided into two groups in terms of output. The output can be based on a particular measure of gross output or on a value-added concept that attempts to capture the movement of output (OECD, 2001b). The usage of the measures depends on the purpose and availability of data.

According to OECD Productivity Manual (2001b), in nation level major productivity measures are given in Table.6.

Table 6 Major Productivity Measures

Type of output measure	**Type of input measure**			
	Labor	**Capital**	**Capital and labor**	**Capital, labor and intermediate inputs**
Gross output	Labor productivity (based on gross output)	Capital productivity (based on gross output)	Capital-labour MFP (based on gross output)	KLEMS multifactor productivity
Value added	Labor productivity (based on value added)	Capital productivity (based on value added)	Capital productivity (based on value added)	-
	Single factor productivity measures		**Multifactor productivity (MFP) measures**	

At national level, the most frequently traced productivity statictic is value-added based labor productivity (OECD, 2001b). It is easy to measure, and also shows the level of living standards, measured as per capita income. However, it is a partial measure and does not reflect the productivity wholly. Labor productivity reflects how efficiently labor is combined with other factors of production, how many of these other inputs are available per worker and how rapidly embodied and disembodied technical change proceed.

Capital productivity, likewise labor productivity, is another type of single factor productivity measure. Changes in capital productivity show the degree to which output growth can be achieved with lower welfare costs in the form of foregone consumption. It is also easy to measure but has some limitations as other single productivity measurements.

On the other hand, MFP measurement helps to separate the contributions of labor, capital, intermediate inputs and technology effects. Among the MFP measures, KLEMS-MFP is the most suitable to reflect the technical changes by industry since it considers the intermediate inputs in production separately. But the major disadvantage is that it needs considerable amount of data, particularly input-output data based on time periods and consistent with national accounts.

In terms of output, gross output based MFP measures can be used as an index of disembodied technical change. But it is important to highlight two points that not all technical change turns into MFP and MFP growth is not necessarily caused by technological change. Moreover, gross output based MFP does not provide much knowledge about the relative importance of a firm for productivity growth of parent sector. On the contrary, the value-added based MFP growth in a parent sector is the weighted average of value-added based MFP growth in individual firms. But value-added based output does not present the true output.

Productivity can be measured at firm, industry or nation basis. Simple addition of inputs and outputs of firms in a cluster does not give the correct results for the

cluster's productivity results, since the outputs of some firms are inputs for some others. The double counting arising from intermediate inputs should be eliminated. In order to have a more detailed analysis, collecting firm based data and then analyzing it in order to eliminate double counting gives more insights about the productivity of cluster. However, the firm based productivity measurement requires the knowledge of production functions of each individual firm and also detailed periodical data collection. Production function is a function, which defines the process that inputs turn into outputs. The production function is a measure of production performance and productivity measures are derived from production function and quantity measures of inputs and outputs.

The output is produced by primary inputs (labor and capital) and intermediate inputs. This function can be presented as:

$$Q = H(A, K, L, M); \quad (1)$$

where Q is gross output, L is labor, K is capital, M is intermediate inputs and A is the parameter of technical change (OECD, 2001b). Technical change can be presented as a shift which affects all factors:

$$Q = H(A, K, L, M) = A \bullet F(K, L, M) \quad (2)$$

Production function can be polynomial, logarithmic, exponential etc. depending on the production processes. Assuming a natural logarithmic function for production function, the rate of change of variable A, which can be depicted as MFP growth, is calculated as the rate of change of output minus the rates of change of inputs:

$$\frac{d\ln A}{dt} = \frac{d\ln Q}{dt} - s_L * \frac{d\ln L}{dt} - s_K * \frac{d\ln K}{dt} - s_M * \frac{d\ln M}{dt}; \quad (3)$$

where s_L, s_K, s_M are weights of each rate of change of inputs corresponding to revenue share of each factor in total gross output and which sum up to 1. From the above equation, one can find the MFP growth which is a measure for technology change. However, one should be careful that MFP is measured

residually and this residual captures not only the efficiency change, technical change and economies of scale but also the changes in capacity utilizations, learning curve effects and measurement errors. It is challenging to disentangle all these effects.

Productivity increase in clusters depends on several reasons. Coordination and cooperation between producers and suppliers, ease of reach to inputs, lower lead times eliminate supply chain losses in clusters and decrease the input costs for production. Moreover, the trainings performed in clusters and knowledge sharing among people lead to higher quality labor force and decrease the labor input per unit output. Individual investment of firms also diminishes due to common investments in the cluster such as common prototyping facilities and R&D centers in the cluster. On the other hand, output increases due to more efficient production rising from knowledge flow in producers, customers, and suppliers linkages; usage of common production centers to eliminate losses in the production line arising from prototype trials; and also it increases due to process improvements and innovations when firms in clusters are inspired and learn from other cooperating firms in the cluster. Therefore, for a cluster performance, in terms of productivity measurement, measuring technology change by *MFP growth* is essential. Furthermore, the *rate of change in input materials costs productivity*, *rate of change of labor productivity* and *rate of change of capital productivity* are measures to measure cluster performance for productivity. Those measures are selected to be based on gross output at firm level instead of aggregate level, in order to have a more detailed analysis on productivity measurement. The data collection should be based on each firm's inputs and outputs, but while obtaining cluster level productivity, attention should be paid in order not to double count the intermediate inputs.

4.2 Measuring Innovation and Selecting Related Indicators

Another outcome of clusters is increased innovation. Before mentioning how to measure innovation, it is useful to introduce definitions given in the literature. As

Nordfors simply puts; innovation is invention plus introduction (Nordfors, 2009). According to Cooper and Kleinschmidt, innovation is commercializing an invention successfully, leading to a sustainable market niche or introducing new products or processes (1993). Some argues that innovation is destructive and introduces a discontinuity in the existing realm (Carayannis, 1994; Carayannis et al. 2003). Creative destruction, which is popularized with Schumpeter's *Capitalism, Socialism and Democracy* (1987), is destructing the existing routines with innovations which lead to economic growth in capitalist economy.

As quoted in Carayannis and Provance (2008), Carayannis and Gonzalez, (2003), define innovation as:

> Innovation in its broader socio-technical, economic and political context, can also substantially, impact, shape, and evolve ways and means people live their lives, businesses form, compete, succeed and fail, and nations prosper or decline.

However, innovation does not have to create a strong effect each time. According to many taxonomies for innovation, innovations can be characterized as incremental or radical (Henderson and Clark, 1990), evolutionary or revolutionary (Utterback, 1996) and can be divided as product innovation or process innovation (Utterback, 1996). Baruk summarizes the common properties of innovations as (1997):

(1) innovation brings a profitable change into existing state;

(2) this change must have a practical application, and it must be new to given community;

(3) only the first application counts;

(4) changes can be on products, processes and organization;

(5) definite technical, economic and social advantages are expected as a result;

(6) profitable economic effects are important to drive technical progress.

The literature on measuring the innovation is diverse. The most trivial indicator about the innovation is number of patents. Also the R&D expenditures are considered to be an indicator to the level of innovativeness. Although these indicators cannot be disregarded, they are insufficient to measure the innovativeness alone most of the time (Carayannis and Provance, 2008).

Before going into the literature of measuring innovation, it is beneficial to define the measurement stages of innovation. For example R&D expenditures are the input for innovation, whereas the number patents are the outputs. Outputs of innovation can be defined as the short-term results of innovation, on the other hand, the more long-term results like the economic growth the innovation results are the outcomes of the innovation. Carayannis and Provance (2008) illustrate these stages in their "Cascaded Innovation Management Architecture" which is given in Figure.10.

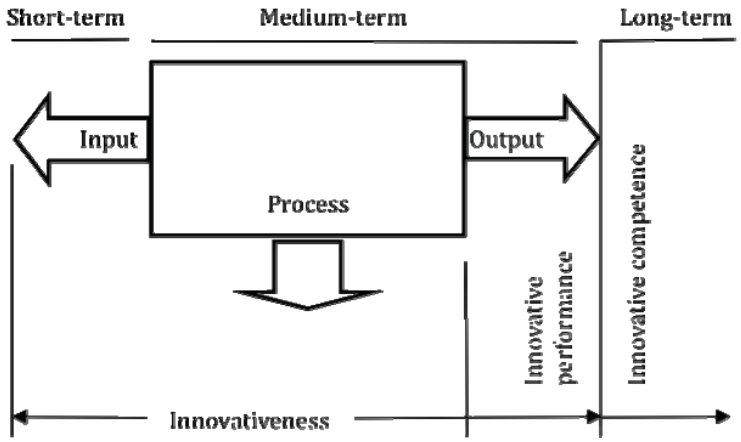

Figure 10 "Cascaded Innovation Management Architechtiure" (source: Carayannis and Provence, 2008)

Input measures for innovation are usually related to the capital resources or human resources (Carayannis and Provance, 2008; Carayannis and Alexander, 1999). The most commonly used indicators for innovation are related to output of innovation which are for instance, patent citations, number of innovations, (Flor and Oltra, 2004), new product announcements (Hagedoorn and Cloodt, 2003), sales shares of new products (Hollestein, 1996).

Measures related to R&D are usually the main measures for innovation in the literature. Examples to those measures are; expenses on R&D compared to GDP, R&D as a % of the labor force, patent applications, "technological effort (innovation expenditures/turnover)" (Bacaria et al.,2004). Walker et al. criticize this with the following reasoning: first R&D activity does not give an indication to the output of innovation, it only indicates the level of input to the innovation development, and carrying out a high level of R&D activity does not guarantee to have high innovation as an output (2002). Second, number of patents does not guarantee innovativeness either, it shows the level of creativity and inventiveness, moreover, the innovations might not always be patented (2002). As mentioned in Carayannis and Provance (2008), Kleinknecht (1987) has a similar view that small firms usually do not have an R&D budget although they may perform R&D. Therefore, R&D expenditures are also sensitive to firm size. Santarelli and Piergiovanni (1996) argue that not all innovations are patented and not all patents become innovations, the number of patents varies widely among the different cultures and across firms with different sizes. While in some cultures/nation, there is a higher tendency to patent each and every small development, while in others the tendency is lower.

Furthermore, measuring only R&D does not cover measuring innovation wholly. Many studies have only one indicator to measure the innovativeness (e.g. in Evangelista et al., 1998; Feeny and Rogers, 2003; as cited in Carayannis and Provance, 2008). Coombs et al. (2007) criticize this such that single measurement is deficient in showing the economic and qualitative effects. Therefore, in addition to R&D measures, economic and social measures are also

important. Measures related to economic benefits of innovations can be named as; sales share of new products (Hollenstein, 1996), new product profit in a year per R&D spending in that year (McGrath and Romeri, 1994), licenses granted to other firms (Hollenstein, 2003). Moreover, social impacts of innovation can be measured. Those are benefits to customers such as lower prices and time savings.

Cooper and Kleinschmidt (1995) define a set of indicators for successful innovation other than the R&D measures. Those are success rate, percent sales, profitability relative to spending, technical success rating, sales impact, profit impact, success in meeting sales objectives, success in meeting profit objectives, profitability relative to competitors and overall success relative to competitors.

Carayannis and Provance (2008), after a review of literature and empirical exploration, state that a set of indicators covering indicators of input, process and output provides a better understanding for the innovation performance.

In terms of clusters performance, it is more suitable to trace the outputs of innovation, in other words the realization level of innovation efforts. As discussed above, the mostly used indicators to measure innovativeness are the ones related to R&D activities and number of patents. However, the level of R&D expenditures is an input to innovation process, which does not guarantee innovativeness, and number of patents does not directly indicate the level of innovativeness, instead it shows the level of inventiveness and creativity. Furthermore, the tendency to patent each invention varies cultural and country wise. Although increasing in the recent years, the number of patents is still low in Turkey, when compared to worldwide (World Patent Report, 2008). Therefore, instead of choosing number of patents and R&D expenditures as measures for clusters' performance, new product announcement rates (Hagedoorn and Cloodt, 2003), sales shares of new products (Hollestein, 1996) and new product profit per R&D spending are more suitable, since they are directly related with the innovation outputs and outcomes. Moreover, effects of

new product announcement in meeting sales and profit objectives can be counted for success of innovation.

4.3 Measuring New Business Formations and Selecting Related Indicators

The clusters are a magnet for new investments and entrepreneurs, because of the advantages such as proximity to customers, suppliers and infrastructure. Moreover, existence of supporting institutions, such as universities, R&D centers, common prototyping facilities etc. attracts new comers avoiding large amounts of initial investment. Therefore, the level of employment and number of new firms are expected to be increased in a successful cluster.

New business formation is highly associated with entrepreneurial activity, which is stated as "enterprising human action in pursuit of the generation of value through the creation or expansion of economic activity, by identifying and exploiting new products, processes or markets.", (OECD, 2009). Since entrepreneurship is a multi-faceted concept which shows itself in many ways, it is difficult to agree on a unique definition. Most of the definitions are based on theoretical concepts and lack of empirical measurement. Although specific empirical data such as self-employment or number of small firms exists, this data does not give us a full understanding of entrepreneurship.

OECD initiated the Entrepreneurship Indicators Programme (EIP) in 2006 to achieve international comparable data on entrepreneurship and its determinants. EIP delivers different indicators of entrepreneurial performance; which are:

- Employer enterprise birth rates (manufacturing and services by industry, by size class)
- Employer enterprise death rates (manufacturing and services, by industry, by size class)
- One- and two-year survival rates (manufacturing and services)
- Share of one- and two-year-old employer enterprises in the population (manufacturing and services)

- Share of high-growth firms (employment)
- Share of high-growth firms (turnover)
- Share of gazelles (employment)
- Share of gazelles (turnover)
- Employment creation by enterprise births
- Employment destruction by enterprise deaths.

Among these, the prior attention is usually given to the creation of firms with non-zero employees, the number of high-growth firms, and the number of gazelles.

US Bureau of Census has introduced a new administrative data product- the Business Demography Statistics (BDS)- to have a better understanding of business dynamics in US (Haltiwanger et.al, 2008). Similar to the ones in OECD report, these data products include measures of deaths and births of establishments and firms, job creation and destruction by firm size, age and industrial sector.

Furthermore, new business formation leads to employment growth, economic growth and poverty reduction consequently (Arauzo-Carod et al., 2008; OECD, 2009; Fritsch and Schroeter, 2010).

From the above review of literature, the rate of change of number of new firm formations and rate of change of employment growth rate can used to measure the level of attractiveness of the cluster and the level of new business formations. Those are statistics easy to measure cluster wide, but may also encounter problems when there is unregistered employment, which is difficult to trace.

4.4 Measuring Social Capital and Selecting Related Indicators

Social capital, differently from productivity and innovation, is both an input to and output of clusters. Formation of social capital is triggered by the clustering

of firms, though it can also be a facilitator to cluster development in a region. Networks of trust and cooperation can facilitate higher realization of human potential and importance of social networks and trust for stimulating collective efforts has gain attention in the economic literature (OECD, 2001c).

As introduced by Putnam (1993):

> By analogy with notions of physical capital and human capital –tools and training that enhance individual productivity – "social capital" refers to "features of social organization, such as networks, norms, and trust, that facilitate coordination and cooperation for mutual benefit.

Social capital stocks like trust, norms and networks facilitate the collaboration among the actors in a cluster, and more collaboration builds more social capital in the region (Putnam, 1993). Therefore, it can be concluded that social capital is an input to the cluster development, i.e. it enhances the linkages and facilitates the flow in the cluster, but it can also be an output with trust building through collaborations in the cluster. As Putnam puts it: "networks of civic engagement embody past success at collaboration, which can serve as a cultural template for future collaboration" (1993).

Putnam and a group of researchers (Loury, 1987; Coleman, 1990; Woolcock, 1998) take social capital as a collective good, which has results affecting the overall group. Another group of researchers take social capital as a pool of resources, besides or instead of the personal ones, for the individuals in social networks, to ease to reach individual goals (Burt, 1992; Flap, 2004; van der Gaag, 2005). However, for the evaluation of clusters, collective social capital is more meaningful instead of individual gains from social capital, therefore, the measures related to the individual social capital is excluded in this thesis.

Before going into the measurement of social capital, it is beneficial to identify the basic forms of social capital. According to Woolcock (1999), social bonds, bridges and linkages are three facets of social capital. Bonding is the relationship

among the families and ethnic groups; bridging social capital is formed among distant friends and colleagues; whereas linking social capital is the relations across the different social layers. Bonding among the members of a group needs bridging ties in order to avoid the pursuit of narrow interests (OECD, 2001c).

Trust is the key point for many norms, understandings and values, which support cooperation (OECD, 2001c). As Putnam puts it: "trust lubricates social life" (1993). It is beneficial to separate trust and trustworthy. Trustworthiness results from factors such as networks, shared values and norms.

Measurement of social capital still has conceptual difficulties since the norms, trust and networks are seen as both the causes and consequences of social capital (OECD, 2001c; van der Gaag, 2005). In the literature, single measure is chosen frequently (Borgatti et al., 1998). However, this is an underestimated approach since social capital is a multidimensional concept (van der Gaag, 2005).

Putnam (2000), in his analysis of social capital in USA, used social capital measures as: intensity of involvement in community and organizational life; public engagement (e.g. voting); community and volunteering; informal sociability; and reported levels of inter-personal trust. Yet, he concluded that trust is in correlation with other measures and can be a proxy for social capital measurement. For a cluster, firm based trust can be measured with level of joint project and mutual agreements among firms in cluster. If there is high degree of trust level among firms in cluster, then the tendency to have joint projects, such as common product development, will be higher.

Another perspective to measure the social capital is to measure the tie strength (Granovetter, 1973). The related measures are frequency of contact, relationship duration, contact duration and the number of transactions. These measures can be utile for measuring the relations and tie among the cluster members, especially for the ties in vertical dimension.

To sum up, social capital is a complex concept to measure. Still, the social capital in clusters can be measured with the level of firm-based trust and tie strength among cluster members. The indicators suitable to measure level of firm-based trust in a cluster can be named as: rate of change of the percentage of capital investment of firms in joint projects to investment capacity of firm, rate of change of number of procurement agreements among firms in cluster and rate of change of amount of common investments in cluster. In terms of tie strength among group members, the selected indicators rate of change of the percentage of capital investment of firms in joint projects to investment capacity of firm, rate of change of number of procurement agreements among firms in cluster and rate of change of amount of common investments in cluster. Those indicators can be further improved since there is no one single definition for measurement of social capital.

4.5 Indicators Set Composition

The literature has been reviewed separately for productivity, innovation, new business formation and social capital measurement and measures used in literature vary depending on the purposes. Taking into consideration of cluster structure and cluster needs, the indicators are selected and the below list is constituted to measure performance of clusters in themselves over time.

Productivity Measures:

- rate of change of labor productivity
- rate of change of capital productivity
- rate of change of material input productivity
- rate of change of MFP growth

Innovation Measures:

- rate of change of new product announcements

- rate of change of sales shares of new products
- rate of change of new product profit in a year per R&D spending in that year

New Business Formation Measure:

- rate of change of formation of new firms in clusters
- rate of change of growth of employment in cluster / increase in number of employees in clusters

Social Capital Measures:

- rate of change of level of firm-based trust
    - rate of change of the percentage of capital investment of firms in joint projects to investment capacity of firm
    - rate of change of number of procurement agreements among firms in cluster
    - rate of change of amount of common investments in cluster
- tie strength among group members
    - rate of change of frequency of contact
    - rate of change of relationship and contact duration
    - rate of change of the number of transactions

The importance of each determinant of the model depends on industry type or sector in which the cluster takes part. For example, for a science-based cluster, such as an electronics cluster, the innovation measures such as the new product announcements and sales shares of new products are more convenient indicators to measure the performance of the cluster, whereas for a scale-intensive cluster, such as an automotive cluster, productivity measures, like the increase in productivity and efficiency can have more weight than new product announcement. Therefore, the indicators should be weighted according to cluster conditions. Figure.11 represents the hierarchy of the indicators and weights.

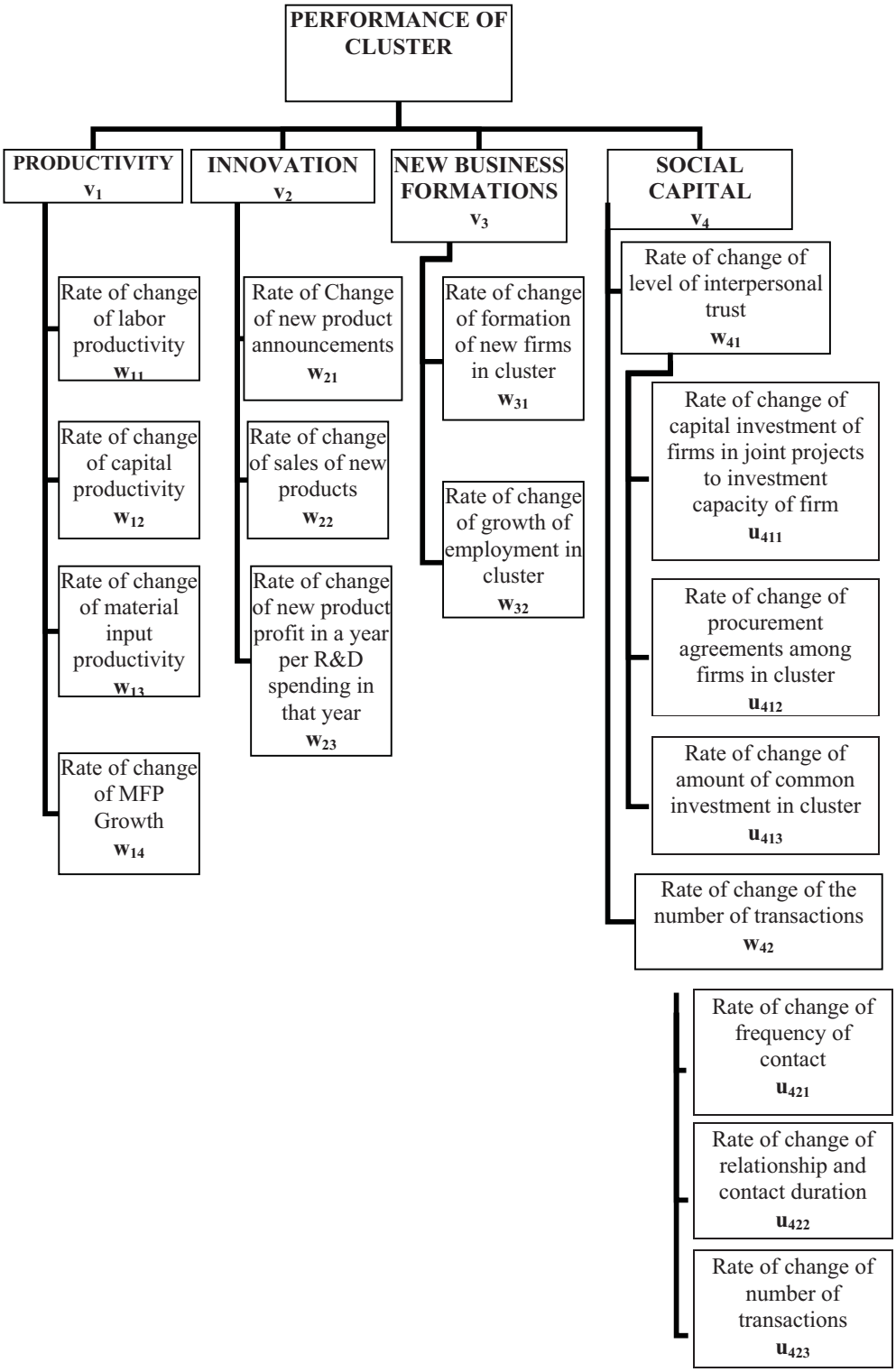

Figure 11 Hierarchy of indicators in cluster performance measurement

v_i= weight of each determinant *i*;

w_{ij}= weight of each indicator *j* under determinant *i;*

u_{ijk}= weight of each sub-indicator *k* under indicator *j* under determinant *i;*

$\sum u_{ijk}=w_{ij}$ for *j*=1,.. n & *k*=1, ... m; where n is the number of indicators for each of the determinant *i* and m is the number of each sub-indicator under indicator *j* under determinant *i;*

$\sum w_{ij}=v_i$ for *i*=1,2,3,4 & *j*=1, ... n; where n is the number of indicators for each of the determinant *i;*

$\sum v_i = 1$ for *i*=1,2,3,4.

Without disregarding the fact that the weights of the indicators are cluster-specific, a Delphi test is carried out among the participants from industry, government and universities, in order to have an initial assumption for the weight distribution of indicators to test the model on cluster cases. The participant list is given in Appendix-A . Participants are asked to give a weight to each of the indicator between 0-10, where "0" for indicators considered having no importance in measuring cluster performance and "10" for the indicators considered having the highest importance in measuring cluster performance. The Delphi test is repeated for three times and it is stopped when the standard deviation of each indicator is below 1,00. The results of the Delphi Test are given in Appendix-B.

Although the test was sent to a group of 30 experts, the return rate from participants was less than 50%. Moreover, the outputs from the test did not give satisfactory results to fill the weights of each indicator. The weights of each indicator stayed close to each other and did not make a significant distinction among the indicators. Therefore, the results are not used as weights of the indicators. Even though the Delphi Test is a practical test which can be made

without too much time consumption, gathering data from experts is difficult due to time allocations of participants. Moreover, lack of finished and evaluated cluster examples in Turkey can be a drawback for obtaining more discriminative weights for the indicators.

4.6 Performance Measurement Guide Chart

In previous sections, first a framework is developed and then the indicators, under this framework, are assembled to form a set of indicators for performance measurement of a cluster. In this section, a scorecard for performance measurement of a cluster is prepared.

Table 7 Scorecard for Performance Measurement of a Cluster

	Perspective	**Indicator**	**Weight**	**Score**	**Weighted Score**
	Productivity				$\mathbf{P_{w1}}(t)$
I_{11}		*rate of change of labor productivity*	W_{11}	$P_{11}(t)$	$P_{w11}(t)$
I_{12}		*rate of change of capital productivity*	W_{12}	$P_{12}(t)$	$P_{w12}(t)$
I_{13}		*rate of change of material input productivity*	W_{13}	$P_{13}(t)$	$P_{w13}(t)$
I_{14}		*rate of change of MFP growth*	W_{14}	$P_{14}(t)$	$P_{w14}(t)$
	Innovation				$\mathbf{P_{w2}}(t)$
I_{21}		*rate of change of new product announcements*	W_{21}	$P_{21}(t)$	$P_{w11}(t)$
I_{22}		*rate of change of sales shares of new products*	W_{22}	$P_{22}(t)$	$P_{w12}(t)$
I_{23}		*rate of change of new product profit in a year per R&D spending in that year*	W_{23}	$P_{23}(t)$	$P_{w13}(t)$
	New Business Formations				$\mathbf{P_{w3}}(t)$
I_{31}		*rate of change of formation of new firms in clusters*	W_{31}	$P_{31}(t)$	$P_{w31}(t)$
I_{32}		*rate of change of growth of employment in cluster / increase in number of employees in clusters*	W_{32}	$P_{32}(t)$	$P_{w32}(t)$

Table 7 ***(continued)***

	Social Capital				**$P_{w4}(t)$**
I_{41}		***rate of change of level of firm-based trust:***	W_{41}		$P_{w41}(t)$
I_{411}		*rate of change of the percentage of capital investment of firms in joint projects to investment capacity of firm*	u_{411}	$P_{411}(t)$	$P_{w411}(t)$
I_{412}		*rate of change of number of procurement agreements among firms in cluster*	u_{412}	$P_{412}(t)$	$P_{w412}(t)$
I_{413}		*rate of change of amount of common investments in cluster*	u_{413}	$P_{413}(t)$	$P_{w413}(t)$
I_{42}		***tie strength among group members:***	W_{42}		$P_{w42}(t)$
I_{421}		*rate of change of frequency of contact*	u_{421}	$P_{421}(t)$	$P_{w421}(t)$
I_{422}		*rate of change of relationship and contact duration*	u_{422}	$P_{422}(t)$	$P_{w422}(t)$
I_{423}		*rate of change of the number of transactions*	u_{423}	$P_{423}(t)$	$P_{w423}(t)$

In Table.7, the w_{ij}'s are representing the weights of each indicator under determinant *i,* which are the constants of performance equation. $P_{ij}(t)$'s and $P_{ijk}(t)$'s are performance of each indicator and sub-indicator measured at time *t*, which is the variable of performance equation. $P_{wij}(t)$'s are weighted performance score of each indicator. P_{wi}'s indicate the performance of each determinant *i.* The total performance equation of a cluster is defined as:

$$P(t) = \sum_{i=1}^{4} P_{wi}(t);$$ is the total performance of the cluster,

where *i* corresponds to 1 for *Productivity*
2 for *Innovation*
3 for *New Business Formations*
4 for *Social Capital*

$$P_{wi}(t) = \sum_{j=1}^{n} P_{wij}(t);$$ where n corresponds to number of indicators for each determinant.

$P_{wij}(t) = \sum_{k=1}^{m} P_{wijk}(t)$; where m corresponds to number of sub-indicators (if exists) for each indicator

The above equations denote that the total performance of a cluster is equal to the sum of weighted performaces of each determinant.

In order to find $P_{ij}(t)$'s for each indicator, it is necessary to define the corresponding metrics. In Table.8 the metrics are described for each indicator. Each of the indicator is measured per "measuring period", a proper period to observe the changes in the outputs.

Table 8 Exlanation and Metrics for Indicators

	INDICATOR	**EXPLANATION**
I_{11}	***labor productivity***	Total production output /total man-hour (product/man-hour)
I_{12}	***capital productivity***	Total production output /total machine hour (product/machine hour)
I_{13}	***material input productivity***	Total production output/input material unit (product/unit)
I_{14}	***MFP growth***	Total production output /total cost of combined inputs (product/TL)
I_{21}	***new product announcements***	Number of new products (units of product)
I_{22}	***sales shares of new products***	Sales amount /number of new products (TL/unit)
I_{23}	***new product profit in a year per R&D spending in that year***	Total monetary amount of profit corresponding to new products / total monetary amount of R&D (TL/TL)
I_{31}	***formation of new firms in clusters***	Total number of new firms (each)
I_{32}	***growth of employment in cluster / increase in number of employees in clusters***	Total number of employees (each)
I_{41}	***level of firm-based trust:***	
I_{411}	*the percentage of capital investment of firms in joint projects to investment capacity of firm*	Amount of capital investment in joint projects/Amount of investment capacity of firms (TL/TL)
I_{412}	*number of procurement agreements among firms in cluster*	Total number of procurement agreements among firms in clusters per year (each)
I_{413}	*amount of common investments in cluster*	Amount of common investments per year (TL/year)

Table 8 (*continued*)

	INDICATOR	EXPLANATION
I_{42}	***tie strength among group members:***	
I_{421}	*frequency of contact*	Number of contacts per month
I_{422}	*relationship and contact duration*	Number of months or years in contact duration
I_{423}	*the number of transactions*	Number of transactions per month in cluster (each/month)

In order to trace the performances, the data should be collected periodically. This period can be defined according to dynamics of clusters but generally one year is suitable to trace the data. At T_0, when the data collection starts there will be no performance measurement since the indicators are based on rate of change in time. This will allow tracing the performance of the cluster in itself.

CHAPTER 5

IMPLEMENTATION AND IMPROVEMENT

5.1 Implementation and Improvement Guideline

In this section the implementation steps of the designed performance measurement model is discussed.

Step-1 Necessary Modifications

Although the performance measurement model is designed for clusters and includes the suitable indicators to measure the performance comprehensively, it is not static and may need some modifications and additions of further indicators depending on the conditions of cluster. The decision maker may want to focus on one of the determinants of the framework more than the others and in order to see more detailed results; additional indicators can be added to observe the cluster performance in different aspects.

At this stage after defining indicators, metrics and period of measurements should be reviewed for the modified/additional indicators and necessary amendment should be done.

Step-2 Estimation of Weights

As discussed previously, the weights of the indicators depend on the sectoral position and conditions of cluster. Therefore, weights should be defined case specific. The accurate results can be achieved after detailed analysis of similar clusters in the same sector and distinguishing the effects of each indicator on the

competitiveness of these clusters. Still, competitiveness is a complex issue and depends on diverge factors. This results in effortful analysis.

On the other hand, the weights can also be collected from experts in the field. Like the given example in section 4.5, a Delphi Test is an appropriate method to assign a weight at each indicator. The participants, who can be chosen from the cluster members, public institutions related with cluster concept, etc., are asked to assign weights to each indicator and test will be repeated until the participants compromise on weights. The larger the group of participants, the more correct the results are.

Based on hierarchy of the determinants of the model and the related indicators, the proper way is to start with weighting the determinants of the model. As discussed previously, the importance of each determinant in the overall performance of the cluster changes according to cluster type. Therefore, firstly u_i's will be determined. Then, secondly under each determinant *i,* the weight of each indicator w'_{ij} will be determined. w'_{ij}'s denote the relative weight of the indicators *"ij"* to determinant *i*, whereas the weights shown in Figure.11 are absolute weights. One can also express it as: $w_{ij} = w'_{ij}.v_i$. Thirdly, the sub-indicators' weights will be determined. Similar to w'_{ij}'s, u'_{ijk}'s are relative weights to indicator "ij" and $u_{ijk} = u'_{ijk}.w_{ij}$.

At the end of this step, one will obtain weight of each indicator in consistent with the weight summation formulas given in section 4.5.

Step-3 Evaluation of Each Indicator

Based on the indicators in the model, the data should be collected periodically. This period depends on the preferences of the decision maker. However, in order not to lose track of performance, the necessary data should be collect at least annually.

The data collection can be done centrally, and each firm should be asked to trace the necessary data in-house. The essential processes should be adopted for data collection at firm base. In section 4.6, the description of each metric for indicators are given. Those data should be collected from each firm and synthesized in cluster wide.

The data is supposed to be collected in time intervals and the metrics are based on rate of change. This shows the variation of each indicator in time.

Step-4 Obtaining Performance of Cluster

The total performance of the cluster can be obtained by using scorecard given in section 4.6. This scorecard enables to acquire the weighted performance of each indicator and the sum of each individual performance of indicators will give us the total performance of the cluster.

The total score of the cluster at time *t* gives the performance of cluster in period (*t-1*) to *t* since the indicators are defined as rate of change in time. This enables the decision maker track the performance of cluster in time. The performance of cluster at time *t,* P(t), is also comparable with P(t-1) and enables one to compare the variations in performance.

Tracking the performance of cluster in time, may further be developed in order to observe the relative performance of the cluster. This can be done either by comparing cluster firms with other firms which do not take part in a cluster or comparing the cluster with other similar clusters located in the country or abroad. The former one enables to observe the effects of clustering either positive or negative. For example, while comparing two firms, one of which belongs to a cluster and the other does not, if the performance of two firms are similar or close to each other, then one may conclude that the effects of clustering do not make a significant difference and this result will lead to review the conditions of cluster and take necessary improving actions. In comparison with a non-clustered firm, the expected outcome is to observe better performance for firms in the

cluster. On the other hand, comparison with other similar clusters will help to observe the success of clusters among others. Yet, the differences may result from the current economical conditions of the parent country.It can be concluded that the performance comparison is beneficial for clusters to observe its real place among others however; the difficulty rise in obtaining the matching performance data of the compared side. Therefore, although comparison gives more insights about the performance of cluster, the data collection will raise problems.

5.2 A Premature Attempt to Measure the Performance of Two Cluster Cases in Turkey

In this section, it is aimed to measure the performances of two clusters from Turkey. However, necessary data required for the performance measurement of clusters are not traceable currently. This prevents to obtain scores for each of the indicators. Perforce, the evaluation of the performance of clusters could be done under four determinants of the model and a scoring could not be performed. Therefore, the expectation of the reader should not be encountering the application of the designed model to selected two clusters, since this section is only a premature attempt and contains observations and counsels about the current conditions of the clusters.

However, when a performance measurement system is adopted in clusters, periodical data collection is necessary to measure the performance. This collection can be done by regular surveys, which can be carried out by the cluster management and for some of the measures related to sales, exported sales, profits and productivity, regularly collected company data will be useful. The interviewee list is given in Appendix-C and the interview formed for performance measurement is given in Appendix-D.

In the scope of the evaluation, two cases are selected. The first one is İstanbul Fashion and Textile Cluster (FTC), and the second one is Eskişehir-Bilecik-

Kütahya Ceramics cluster (EBKCC). One of them is already formed and the development project is completed, which is FTC; and the other is newly formed but still has the structure a cluster requires, which is EBKCC.

The following sections deal with the structure of the said clusters and the evaluation of their performances.

5.2.1 Analysis of İstanbul Fashion and Textile Cluster

Textile and clothing sector plays an important role in Turkish manufacturing industry. In terms of employment, production and export, it is in the first place in manufacturing industry (Öngüt, 2007). When the distribution of this sector around Turkey is considered, İstanbul region is in the first place in exporting textile and clothing products and in number of firms (DPT, 2007(a); Öngüt, 2007). Since the portion of this sector is considerable, the developments in this sector will affect the overall economy. Therefore, the sustainability of competitiveness is highly important.

In order to increase the international competitiveness of SMEs in textile and clothing sector, İstanbul Fashion and Textile Cluster (FTC) project was initiated in 2005. The project, which is financed by European Union, started at January 2005 and ended at February 2008. The beneficiary of the project is İstanbul Textile and Apparel Exporters' Association (İTKİB) and SMEs represented by İTKİB. The objective of the project is to increase the international competitiveness by increasing networking among SMEs at local, national and European levels and strengthen public and private support structures for SMEs in this sector (Web-1).

The project has been implemented in two phases, which are "technical assistance for institution building" and "investment support". In the scope of institution building: fashion institute - İMA (İstanbul Fashion Academy), textile R&D center - İTA (İstanbul Textile and Apparel Research and Development Center) and consultancy center - İDM (İstanbul Textile and Apparel Consultancy Center)

are established. The coordination agency is established under İTKİB and named as İTKİB Destek Inc.. These organizations are aimed to work together to integrate the knowledge, technology and qualified workforces of each organization.

İTA and İDM is located in İstanbul Tekstilpark. These two organizations are established to develop and support the innovation capacity of firms in the sector. The equipment in İTA was selected according to the needs of the companies in the textile and clothing sector. The infrastructure of the center is very well prepared with each detail; including facilities varying from technological test and prototyping machines to incubation units for new starters of the sector. However, currently, İDM is not functioning and there is no operation going on in İTA. Due to lack of financial sources, İTA has minimized the number of its employees. In order to raise the awareness of the companies for İTA and thus increase the incomes, İTA plans to deliver technology related services such as consulting, technical training and information services. However, at this stage the interaction between firms and İTA is rare and needs to be improved.

On the other hand, İMA seems to be a more successful outcome of FTC project. It provides undergraduate and graduate programmes besides the short term courses in order to train people working in that sector and educate designers. Furthermore, trainings for companies, consultancy and knowledge-sharing projects are carried out. It has a big library, focused on fashion with over 3.000 books. The location is also attractive for people interested in fashion. In the scope of the project the aim of İMA is set to close the gap between designers and producers. But its access to each SME or each SME's access to İMA is still open to debate. Individually, it serves the sector as a source of designers and fashion management but the effects of İMA on FTC are not easy to analyze and up to now the impacts are not traced.

The planned projects in the scope of FTC development programme have aimed to stimulate and enhance the cooperation among the cluster members, develop

R&D capabilities, support innovation and increase productivity, however not all these projects can be realized. The cluster needs to be improved to sustain the organizations successfully.

In the context given above, and in light of the interviews, the overall evaluation is given in the following paragraphs.

Semi-structured interviews have been performed with the interviewees. The interview consist of questions in order to understand the level of productivity, innovativeness, new business formations, social capital and cooperation (the four main determinant of the model) among the actors in the cluster consisting of the indicators set in the model. However, the required data by the set indicators are not traceable. Therefore, instead of analyzing results of each indicator, the evaluation will be done on four main determinants of the model, based on observations made and data acquisition obtained from the interviewees.

In terms of innovation; the related indicators in the model are “new product announcements”, “sale shares of new products” and “new product profit in a year per R&D spending in that year”. The data for the innovation capacity for the whole cluster is not collected. According to observations, and based on interviews, there exist research and development activities on textile in coordination with universities and it is stated that the level of cooperation between these actors is high. There are mutual projects going on between the university and industry. However, the said innovativeness is limited with number of big firms. The cluster has many SMEs, which produce for some other brands or without any design creation. The diffusion of innovations needs to be obtained and innovativeness needs to be widespread. This can be achieved by raising awareness in the importance of innovativeness and its overall effects in becoming worldwide competitive and companies can be encouraged to create new designs and develop new products by trainings in İTA and İMA.

In terms of productivity; the related indicators in the model are “labor productivity”, “capital productivity”, “ material input productivity” and “ MFP growth”. For the cluster, these measures are not collected periodically. In order to increase productivity, there have been trainings on the recycling of waste water and the efficient usage of energy. These are precautions to decrease the inputs to the system to increase productivity. However, the prototyping facilities in İTA are not used by the firms in the cluster. In order to eliminate the time loss in the production line while new product trials are performed, these facilities should be used by the firms in the cluster. This will increase the amount of output and thus the productivity. This can be achieved again by attracting firms to İTA’s capabilities. Moreover, the usage of new technologies in production should be diffused among the SMEs to increase the productivity. The usage of new technologies can include both the usage of more efficient equipments and the adoption of new methods to eliminate the losses in production. These can be achieved by cluster coordination center by trainings, sectoral meetings etc. and be achieved via knowledge sharing and coordination between the firms.

Increase in cooperation and social capital will also increase the knowledge share among the firms and between the firms and other actors in the cluster. Level of social capital is the hardest to measure in the indicator set and there is no data collection in terms of social capital in the FTC cluster. The related indicators are collected under “level of firm-based trust” and “tie strength among group members”. These data can be measured by regular surveys among the actors. In the cluster, the level of trust is low due to doubts about protecting designs and new applications. Still, the level of cooperations is moderate. The vertical relationships are stronger and more long-lasting than horizontal relationships. The value chain is short when compared to other manufacturing industries so the firms have horizontal relations rather than vertical ones in the sector.

In the scope of “Turquality” project, there are some big textile and clothing firms producing for an upper brand - Turquality. İTKİB provides international market data, based on surveys on customer preferences in those countries and customer

opinions about Turkish brands; and shares this data with the companies. Such data analysis supports the firms exporting textile and clothing products.

In terms of new business formations; the real numbers vary highly from the recorded ones. Small firms have off the books employees and the numbers change frequently. This prevents the data collection for real employment numbers. However, it can be observed that İstanbul region is advantageous in terms of Porter's diamond's factor and demand conditions. It is close to all means of transportation, the infrastructure is adequate and demand is high in the region. These two conditions are attracting new businesses. But it is hard to distinguish that these effects are either arise from the attractiveness of the cluster itself or the charm of İstanbul which has been the magnet of the region in terms of trade and industry since centuries.

To sum up, the performance of the cluster could not be scored since the set indicators are not measured for the cluster. However, the general evaluation has been made according to interviews. The views are discussed in the previous paragraphs and some possible developments are mentioned. The targets in the project are set appropriately to increase the level of innovations and cooperation between the firms, R&D center and university but the realization is less than the expected. So, the level of cooperation, technology sharing, and the diffusion of innovations need to be improved.

5.2.2 Analysis of Eskişehir-Bilecik-Kütahya Ceramics Cluster

Turkish ceramics production got industrialized in 1950's and today Turkey is one of the foremost producers in the world. The ceramics industry is divided in tiles and sanitary wares subgroups and with the common contribution of these two subgroups, Turkey is in 9th position in the world and 3rd in Europe in terms of production capacities and 4th biggest exporter in ceramic tiles in the world. Turkey comes first in production and exports of sanitary wares in Europe (DPT, 2007b; DPT, 2007c; Web-2). The sanitary ware sector has 300 million USD

amounts of production and 150 million USD amounts of exports; and tile sector has 1 billion USD amounts of production and 400 million USD amounts of exports (DPT, 2007b; DPT, 2007c). But most importantly, the local content in both sectors is in considerable amounts so the added value for Turkey is high. With these results, ceramics sector is Turkey's one of the high competitive sectors.

Due to the necessity of high initial investments, the main producers in the sector are large firms. In Eskişehir-Bilecik-Kütahya triangle, the 44% of total number of firms are located (DPT, 2007b; DPT, 2007c). The examples of which are Eczacıbaşı, Kütahya Ceramics, Seranit, Yurtbay etc.

Eskişehir – Bilecik – Kütahya (EBK) Ceramics clusters is one of the clusters, for which a roadmap was prepared in the scope of EU funded "Development of a Clustering Policy for Turkey" project. EBK Ceramics cluster was analyzed using Porter's diamond in this roadmap reports. According to this analysis, availability of raw materials, proximity to transportation crossroads, and availability of educated labor force from four universities located in the region, are advantageous factor conditions of the region (Web-2). Moreover, Ceramics Research Center (SAM) was established in 1998 in Eskişehir in order to meet the research, technology development and innovation requirements of ceramics sector in increasing competition in the world market. This center is a bridge between university and industry, and performs project based R&D activities, provides consultancy and testing services. It is one of the most important actors in the cluster. There are mutual projects, innovation projects and dual projects going on in this center presently (www.seramikarastirma.com.tr).

The Eskişehir – Bilecik – Kütahya Cluster Association is formally founded in May, 2010 as the cluster coordination center. The aim of the association is to raise awareness among firms for the benefits of cluster approach, and therefore achieve the economic growth in the whole sector and attract foreign investors to the region. The vision of the cluster is to "be focused on customer satisfaction,

environmentally-friendly, innovative, energy efficient and global leader in this sector" (Erkılıç, 2010).

The cluster activities aimed to be performed are: establishment of a common prototype/trial production center and a warehouse, formation of a common web based portal, joint lobbying activities for overall cluster benefits, worldwide promotion of the cluster, supply chain improvement and joint purchasing of raw materials.

In the context given above, and in light of the interviews, the overall evaluation is given in the following paragraphs.

Semi-structured interviews have been performed with the interviewees. The interview consist of questions in order to understand the level of productivity, innovativeness, new business formations, social capital and cooperation (the four main determinants of the model) among the actors in the cluster consisting of the indicators set in the model. EBK Cluster Association is fairly new and the data regarding the cluster outputs have not been traced up to now.

In terms of productivity, the data is not traced cluster-wide. Ceramics production is based on high energy consumption, so savings in energy will increase productivity. The effects of clustering in productivity rise will be observed, after joint activities and projects are performed. Currently, the firms in the cluster do not have collective purchasing of input materials, common transportation or logistics center but these are projects that are planned to be realized. Another plan is to establish a common production center, so that firms will be able to produce prototypes without changing their production set-ups. This will increase the productivity while eliminating losses in the production and increasing output. The ceramics machinery is mostly imported but there are also some local producers, and these producers will be stimulated to relocate in the cluster region. This will decrease the input and maintenance costs and turn out as a productivity rise. Currently the level of joint activities in the cluster is not so

high but the targeted projects are promising to increase the productivity. EBK Ceramics cluster need some more time to realize those projects and apply to all its actors.

In terms of innovation, the presence of SAM in Eskişehir is highly motivating in research and development activities. SAM has 43 collaborators from ceramics industry and those firms are not limited with the firms in EBK region. SAM has an expert pool of 40 researchers who respond to the needs of the industry. The joint projects performed with industry increases the level of innovativeness of the firms in the region. The number of new products, sales shares of new products and new product profit in a year per R&D spending in that year are not traced for cluster-wide. However, Eczacıbaşı, for example, keeps these kinds of records in its company database. A data-base can be developed to collect all the data regarding the innovation level of the cluster. Moreover, in the scope of Industrial PhD Programme implemented by Eskişehir Anadolu University with the supports of DPT, the university-industry collaboration level has increased and reached to high levels.

In terms of new business formations, main production in ceramics industry requires high investments and this keeps away the small entrepreneurs. Moreover, most of the firms have integrated facilities and the vertical integration high in these firms. This prevents the development of supporting industries. But the producers in the cluster want the related and supporting industries to be developed and use subcontractors in their productions. Furthermore, the attraction of the cluster is desired to be increased for foreign capital investments to the region.

In terms of social capital, the actors in the cluster are open to cooperation. Most of the producers are also a collaborator of SAM, so SAM is the bonding actor and the trust level has been developed mostly by means of this center. The EBK Cluster Association also constitutes a medium for actors in the cluster and act mutually.

To sum up, EBK Ceramics cluster includes the actors from universities, research center and producers in its structure, but still needs some further actions and developments to increase the joint actions, in-house R&D; support supply-chain activities and improve missing infrastructure parts, such as common production center and a logistical base. Still, it is promising, if they can perform the targeted plans and project. Due to lack of data covering the cluster activities, the performance of the cluster could not be scored, but only a general evaluation is done based on interviews.

CHAPTER 6

CONCLUSION

The aim of this thesis was to design a performance measurement system for clusters in Turkey. Clusters are agglomerations, but more than that, agglomerations with interactions, knowledge flow, spill-overs, innovations and higher productivity. The competitive structure of clusters took researchers attention and they are analyzed to be formulized. However, although there are myriads of definitions in the literature, there is no *one* definition that defines the clusters wholly.

In today's world, the competition is no longer based on price. Sustainable competitiveness is reached by innovativeness and higher productivity. Seeking ways to become more competitive via innovations and productivity, clusters become a solution for governments and policy makers. From China to Brazil, United States to Sweden, the policies for development or improvement of clusters are going on. Government incentives are given; cluster projects are founded to become more competitive.

On the other hand, it is important to see the results and analyze the current performance of a cluster in order to detect the deficient parts, to take necessary actions and develop strategies accordingly. Here, a need to measure the performance of a cluster rises. However, there is not much research on measuring performance of clusters in the literature. Additionally, cluster concept is a complex subject. It is difficult to prepare general recipes to fit to all. There can always be special cases that the formulas do not match. Keeping this in mind, this thesis aimed to provide a method for performance measurement of clusters, based on literature survey and the success stories examined in the

literature. It is not the aim to provide a panacea to cover all the cases. This study is rather a guide to develop more case specific measurement methods, depending on the structure and conditions of each case.

Before developing the model, an extensive literature survey has been covered over cluster concept, its definitions, fundamantals, benefits, phases, similarities with other structures such as networks, techno parks; related policies and initiatives in order to fully draw the context of cluster concept and understand its structure and dynamics. This survey, which is covered in Chapter 2, formed the base of the model.

In theory development, the Porter's diamond is taken as a reference. Porter in his work defines the benefits of the clusters as innovation, productivity and new business formations. This study is taken as a basis to the model and with the addition of social capital, the framework for performance measurement is constructed. The details of the model are given in Chapter 4. After determining the determinants of the model, namely innovation, productivity, social capital and new business formations; the indicators to measure those components are selected based on indicators collected from literature. Consequently the metrics are defined and a scoreboard is prepared. The selected indicators under four determinants do not have equal weights and the weight of each indicator differs according to characteristics of clusters such as the sector type, regional characteristics, etc. The corresponding weights should be defined for each cluster case.

On the other hand, in order to measure a system's performance, system data should be collected regularly. Due to ease of access to all actors in the cluster, cluster coordination centers are good candidates for tracing performance measurement data periodically. In two cases mentioned in this thesis, namely İstanbul Fashion and Textile Cluster (FTC) and Eskişehir – Bilecik – Kütahya (EBK) Ceramics Cluster, the required data to measure the performance of the cluster was absent. Therefore, these two clusters are evaluated based on

interview results under four determinants of the model and the clusters could not be scored.

The current stage of EBK Ceramics Cluster is like FTC's initial stage when the FTC project was started, but as a plus EBK Ceramics Cluster has an R&D institution, SAM, whereas the R&D center for FTC has been established afterwards, in the scope of the project and could not be managed to operate presently. Nevertheless, it would be misleading to compare the two, since they are at different stages. As a last word for FTC; it can be concluded that; governance is very important in the success of clusters despite the amount of investment. There is a need to take some actions to activate the research center and make the firms use that capacity. As a general evaluation for EBK Ceramics Cluster, the university-industry-R&D center collaboration seems promising but more joint activities should be done among the actors; and related and supporting industries should be obtained in the region. Still, the fact that the establishment of the cluster coordination center is an initiative of private sector in the region, is a proof of the interest of the industry to clustering approach.

This thesis has used the examples of FTC and EBK Ceramics Cluster, but these two are not the only two cases in Turkey. As mentioned in section 2.2.5, cluster initiatives are increasing in varying industries in Turkey and this advances the importance of the thesis due to increasing necessity for measuring performance of clusters.

The cluster awareness is rising in Turkey and several actions are taken by public institutions like Ministry of Industry and Trade under national development programmes. The outputs of the applications of the designed model on clusters in Turkey will give rise to profound inputs to cluster policy studies in national level.

The application of the model is not limited with clusters only. It model can also be used for techno parks since they are also some sort of clusters.

In further development, more case specific or industry specific models can be generated for performance measurement of clusters. This study aimed to develop a general formulization for performance measurement. Yet, the further studies can be performed in order to obtain more specific evaluation criteria for clusters. This thesis constitutes a basis in further development. It should be additionally noted that the regulations regarding the legal status of clusters in Turkey should be cleared to improve the clustering concept.

To sum up, in order to reach higher competitiveness levels, sustain this competitiveness and race against world leaders in industrial level, the success criteria should be traced in several aspects. This can be achieved by continous performance measurement and analysis of the outcomes. This thesis is a step to draw the outline of performance measurement and proposes a solution which is aimed to be beneficial for further studies.

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APPENDIX A

LIST OF PEOPLE WHOM THE DELPHI TEST IS SENT

The below list includes the experts whom the Delphi Test is sent via e-mail. The respondents to the test are not denoted in the list.

Table 9 List People Whom the Delphi Test is Sent

	Participant	**Details**
1	Ahmet Ulgenerk	Danışman
2	Cemal Bayazıt	ITKIB Gen.Sekr. Yrd.
3	Erbil Cihangir	ITKIB Egitim Koord.
4	Hikmet Tanriverdi	IHKIB Baskani (Ist.)
5	Dr. Nilay ALÜFTEKİN	Çankaya Üniversitesi İİBF İşletme Bolu¨mu¨
6	Prof. Dr. Öznur YÜKSEL	Çankaya Üniversitesi İİBF İşletme Bolu¨mu¨
7	Yrd.Doç.Dr. Ayşegu¨l TAŞ	Çankaya Üniversitesi İİBF İşletme Bolu¨mu¨
8	Yrd.Doç.Dr. Gu¨lşen ÇAKAR	Gazi Üniversitesi, Ankara MYO
9	Emrah Sazak	Dis Ticaret Musteşarlığı
10	Metin Durgut	ODTÜ Endüstri Mühendisliği
11	Doc.Dr.Erkan Erdil	ODTU STPS Baskani
12	Meral Sayin	Çankaya Üniversitesi Girişimcilik Merkezi Yöneticisi
13	Tibet Seyhan	Piri Group
14	Selcuk Tanatar	Piri Group
15	Prof. Dr. Levent Kandiller	Çankaya Üniversitesi Mühendislik Fakültesi Dekanı
16	Yrd. Doç. Ferda Can Cetinkaya	Çankaya Üniversitesi Endüstri Mühendisliği
17	Orhan Aydin	OSTIM Baskanı
18	Necip Ozbey	ODTÜ Teknokent
19	Melih Bulu	URAK Genel Koordinatörü
20	Prof.Dr.Mehmet Akalin	Marmara Universitesi
21	Murat Gursoy	UNDP Ankara
22	Filiz Morova	İzmir Kalkınma Ajansı
23	Suna Yaşar	İzmir Kalkınma Ajansı
24	Sezai Goksu	Prof.Dr.Sezai Goksu, Dokuz Eylul Universitesi Sehir ve Bolge Planlama Bol.
25	Özer Karakayacı	Yıldız Teknik Üniversitesi Sehir ve Bölge Planlama Bolu¨mu¨, Arastırma Görevlisi
26	Doc. Dr. Hakkı Eraslan	Proje Koordinatoru¨, Iconomy Group - Vezir Araştırma ve Danışmanlık Ltd.
27	Prof.Dr.Fatih Botsali	Konya Teknokent Muduru
28	Prof.Dr.Ayda Eraydin	ODTU Mimarlik Fak. Sehir ve Bolge Planlama Bol.
29	Prof.Dr.Melih Pinarcioglu	ODTU Mimarlik Fak. Sehir ve Bolge Planlama Bol. Dekan Yrd.
30	Prof.Dr.Ercan Tezer	OSD Otomotiv Sanayicileri Dernegi Genel Sekreteri

APPENDIX B

DELPHI TEST RESULTS

Table 10 Delphi Test Results

		1st round mean	1st round standard deviation	2nd round mean	2nd round standard deviation	3rd round mean	3rd round standard deviation
1	*rate of change of new product announcements*	7,50	1,787	8,25	1,165	7,67	0,985
2	*rate of change of sales shares of new products*	7,14	1,956	7,88	1,356	7,45	0,934
3	*rate of change of new product profit in a year per R&D spending in that year*	6,57	2,102	6,50	1,604	6,55	0,934
4	*rate of change of labor productivity*	5,50	1,698	5,25	1,035	5,82	0,751
5	*rate of change of capital productivity*	7,79	1,122	7,29	0,951	7,33	0,866
6	*rate of change of material input productivity*	7,50	1,345	7,57	0,976	7,67	0,866
7	*rate of change of MFP growth*	7,29	1,773	7,14	1,215	7,20	0,919
8	*rate of change of formation of new firms in clusterr*	7,14	2,214	7,43	1,618	7,56	0,882
9	*cluster / increase in number of employees in clusters*	6,57	1,828	6,71	1,38	6,70	0,949
10	*level of interpersonal trust*	9,14	1,167	8,86	0,69	8,80	0,632
11	*rate of change of frequency of contact*	8,79	1,528	8,57	1,272	8,60	0,843
12	*rate of change of relationship and contact duration*	8,29	1,590	8,86	1,215	8,55	0,934
13	*rate of change of the number of transactions*	8,08	1,639	8,29	1,113	8,20	0,919

APPENDIX C

INTERVIEWEE LIST

Table 11 Interviewee List for Istanbul Fashion and Textile Cluster

Interviewee	**Organization**
Çetin Duman	İTKİB Destek A.Ş.
Mehmet Gülmez	İTA Director
Funda Köprülü	İMA
Ahmet Ülgenerk	Former Project Coordination Unit Director
Ceren Gökçe	Former Project Asistant
Mustafa Fazlıoğlu	European Union Delegation of Turkey

Table 12 Interviewee List for Eskişehir-Bilecik-Kütahya Ceramics Cluster

Interviewee	**Position**
Tülin Murathanoğlu	General Secretary in EBK Ceramics Cluster Association Eczacıbaşı/ Advisor
Evrim Erkılıç	Eczacıbaşı/ Public Relations

APPENDIX D

INTERVIEW BODY

(the interview is performed in Turkish)

1. Bölgede sektördeki firmalar arasında ticari ilişkilerin yanı sıra ticari olmayan ilişkiler de var mıdır? Bu ilişkilerin kaynakları nelerdir?

- Akrabalık bağları
- Coğrafi yakınlık
- Ortak komünite, topluluk, dernek
- Okul, gidilen eğitimler, sosyal ortam ve eski işyeri gibi ortamlarda kurulan arkadaşlıklar
- Diğer.....

2. Küme içerisindeki firmalar ile ortak faaliyetler nelerdir? Tanımlanabilir/ tecrübe edilmiş işbirliği etkinlikleri var mıdır?

Gözlenebilecek işbirliği çeşitleri:

- Proje işbirliği
- Aynı müşteriye ortak çalışmak/ortak ihale
- Firmanın tedarikçisine bilgi aktarımı/birlikte çalışmaları
- Teknik bilgi paylaşımı
- Pazar bilgisi paylaşımı
- İşçi paylaşımı
- Ortak işgücü eğitimi almak/düzenlemek
- Ortak problemlerin ortak hareketle çözümü
- Devlet kurumlarına talebi ortak dile getirmek
- Finansal destek almak
- Makine parkı, depo, satış noktası paylaşımı
- Birlikte danışmanlık almak
- Birlikte fuarlarda stand açmak
- Ortak ürün geliştirmek
- Ortak üretim hattı geliştirmek
- Ortak marka geliştirmek

- Ortak pazarlama çalışması
- Ortak makine/ekipman satınalma
- Ortak girdi alımı
- Firmalar arası işgücü hareketliliği
- Diğer.....

3. Bölge dışından da işbirliği yaptığınız firmalar, kuruluşlar var mı?

4. Bölge dışından elde ettiğiniz bilgi birikimini bölge içindeki firmalar ile yapılan ortak çalışmalarda paylaştığınız durumlar olur mu?

5. Sektörünüzle ilgili üye olduğunuz topluluklar, sanayi ve ticaret odaları, vb. kuruluşlar var mı? Bunların hangileri yerel?

6. Beraber çalıştığınız alt yüklenicileriniz/tedarikçilerinizin yüzde kaçı yerel üreticilerden oluşmakta?

7. Beraber çalıştığınız alt yüklenicileriniz/tedarikçileriniz ile ortalama çalışma vadeniz ne kadardır?

- 0-2 yıl
- 2-5 yıl
- 5-10 yıl
- 10 yıl ve üzeri

8. Şuanda çalışmakta olduğunuz tedarikçileri değiştirmeyi düşünür müsünüz? Neden?

- daha az güven
- daha maliyet etkin çözümler
- daha yeni teknolojiler
- isterlerin tam olarak karşılanamaması
- diğer...

9. Bölgede, sektördeki firmaların işbirliğine yaklaşımı olumlu mudur? Cironuzun tahmini yüzde kaçını işbirliklerinden elde edilen pay oluşturur? Tecrübeler? Firmalar gerektiğinde ortak hareket edebiliyorlar mı?

10. Firmalar arası mevcut işbirliği ilişkisinin kaynağını ne olarak görüyorsunuz? (fiziksel yakınlık, teknolojik paylaşım gibi)

11. Firmalar arası işbirliğinin gelişmesini teşvik edecek bir yapı bölgede mevcut mudur? (kooperatif-dernek-birlik-merkez-kurum) Bu yapının etkinliği ve tecrübeleri ile ilgili bilgi veriniz.

12. Kuruluşunuzun bölgedeki firmalar arası ilişkilerin geliştirilmesine ve işbirliğine yönelik bir teşviki/katkısı/etkinliği olmuş mudur?

- Bu anlamda tanımlanmış görevlerin varlığı
- İşbirliği teşvik edici projeler
- Kuruluş bir işbirliği platformu sağlamaktadır (mı?)
- İşbirliğine dolaylı yoldan etki eden yayınların varlığı
- Bilgi alışverişinde aracılık yapmak
- Firmalara bilgi (teknik/pazar/yenilik/sektörde yeni gelişmeler…) aktarmak

13. Firmalar arası iletişim ve işbirliğine imkan verecek iletişim etkinlikleri (periyodik ya da değil) olmakta mıdır? Kim tarafından düzenlenmektedir?

- Sektör toplantıları
- Seminerler
- Buluşmalar
- Eğitimler
- Teknik olmayan sosyal aktiviteler
- Diğer….

14. Bölgede geliştirdiği yenilikleri diğer firmalar ile paylaşıp, sektöre öncülük eden firmalar var mıdır? Siz o firmalardan biri misiniz?

15. İşbirliğine temel oluşturan güveni nasıl tanımlıyorsunuz?

16. Firma içinde yer alan güvenin, küme içindeki diğer firmalar arasında da oluştuğunu düşünüyor musunuz? Firmalar arasındaki genel güven ortamına 1-10 arasında bir not vermeniz gerekse kaç verirdiniz?

17. Firmalar ile üniversite/üniversiteler, araştırma kurumları arasındaki ilişkiler ne sıklıktadır? Bu ilişkiler karşılıklı eğitim, seminer vb. aktiviteler düzenlenmekte midir? Bu ilişkilerden elde edilen kazanımların size daha rekabetçi bir konum sağlıyor mu?

18. Yeni bir bilgiye ulaşmak istediğinizde yararlandığınız kaynaklar nelerdir?

19. Firma olarak ürün veya süreçlerinizi geliştiriyor musunuz?

20. Yeni bir ürün/süreç geliştirirken yararlandığınız kaynaklar nelerdir?

- Firma içi kaynaklar
- Küme içindeki diğer firmalar ile ortak geliştirme
- Küme dışındaki ağlardan firmalar ile ortak geliştirme
- Yurt dışı kaynaklar ile ortak geliştirme
- Yurt dışı kaynaklardan teknoloji transferi
- Üniversite ile işbirliği
- Araştırma-geliştirme kurumları ile işbirliği
- Diğer ...

21. Son 3 yıl için baktığınızda, yıllık yeni ürün miktarınız ne kadardır?

22. Yıllık yeni ürün sayısındaki değişim ne yönde gerçekleşiyor? (azalma, artma) Bu konuda değişimler düzenli izlenmekte midir?

23. Geliştirilen ürün veya süreçleriniz hangi kapsama girer? (pazarda olmayan yeni bir ürün/süreç geliştirilmesi, firma dışında daha önce geliştirilmiş ancak firma içinde mevcut olmayan ürün/süreç geliştirilmesi, var olan ürün/sürecin modernize edilmesi)

24. Yeni geliştirilen ürünlerin satışlarının toplam satışlara oranı nedir? Bu oranın yıllık değişim eğilimi nasıldır? Bu konuda değişimler düzenli izlenmekte midir?

25. Yeni ürünlerden elde edilen karın, yıl içinde harcanan AR-GE harcamalarına oranı nedir? Bu oranın yıllık değişim eğilimi nasıldır? Bu konuda değişimler düzenli izlenmekte midir?

26. AR-GE için belirlenmiş bir bütçe bulunmakta mıdır?

27. Küme içinde yeni kurulan firma sayısının son 3 yıldaki değişimi nasıldır?

28. Küme içinde, istihdam sayısının değişimi nasıldır? Bu konuda değişimler düzenli izlenmekte midir?

29. Firmaların yıllık satış ve kar hedeflerine ulaşma yüzdelerinin yıllara göre değişimi nasıldır?

30. Küme içinde olmak firmaların hammadde, işçilik gibi girdilere ulaşmasını kolaylaştırıyor mu?

31. Küme içinde verimliliği arttırmak amacıyla ne gibi faaliyetler gerçekleştiriliyor?

- **a.** Tedarikçi geliştirme programları
- **b.** Ortak kullanım atölyeleri/depoları
- **c.** Ortak hammadde temini
- **d.** Test analiz laboratuarlarının kurulması
- **e.** Diğer…

32. Küme içindeki firmaların yıllık üretim kapasitesindeki değişim yıllara göre nasıldır?

33. Firmaların son ürünü oluşturmak için girdilerinin toplam miktarındaki değişim nasıldır?