Policy Challenges in Defining and Utilising Cluster Metrics

Tamas Gyulai
DEAK Cooperation Research Non-profit Company, University of Szeged, Dugonics tér 13.6720
Hungary
(Email: tamas.gyulai@inbox.com)

Abstract The paper employs cluster metrics to evaluate the situation of clusters in a selected set of European region. It presents the results of the work of the Innovating Regions of Europe (IRE) subgroup „Regional Clustering and Networking as Innovation Drivers" that was working between 2006-2008.The paper describes the state of the art in cluster development in the different regions and compares their level of maturity. It presents two case studies (one from within Europe and one from outside) and draws up a set of recommendations that should help the policy makers and practioners in the European regions to better utilise clustering and networking as a tool to improve the competitiveness of the European regions. The results of the work can be further expanded in future studies about the role of innovation in cluster development.
Key words regional innovation systems, clusters, industrial networks

1 Introduction

1.1 Background for the Research Work

Industrial clusters are considered to be a key element for driving innovation and thereby for strengthening European competitiveness as stated – among others – by Porter [1] and Rosenfeld [2]. This is reflected in the increasing attention national and regional innovation policy makers pay to developing and implementing cluster policies.

The European Commission is supporting the efforts of the member states and their regions with regards to clusters through different instruments. Prominent examples of such support are the Europe INNOVA initiative and the INNO-Nets of which four are related to clusters.

As stated above one of the sub-groups is dedicated to cluster policies and their implementation at the regional level. Based on expressions of interest 15 IRE member regions were invited to participate in the IRE working group on 'Regional clustering and networking as innovation drivers' (hereafter IRE cluster working group, please refer to Appendix for a list of members). The regions selected include many with solid experiences in the field of cluster policies, as well as some regions that have just started to design and implement cluster policies. The regions represent a good geographical spread and are facing different economic environments which should increase the relevance to other European regions. This paper reports on the outcomes of this initiative.

1.2 The Working Group Objectives and Expected Results

The IRE cluster working group aimed to create a continuous learning process amongst IRE member regions of how cluster initiatives can be stimulated, developed and promoted. A direct outcome of this was increased efficiency and effectiveness of public support to cluster initiatives by improving the integration of both policy makers and practitioners in the process.

Furthermore, the cluster working group contributed to the development of new approaches and tools and to the creation of networks between regions to facilitate exchanges and perhaps joint policy/project implementation.

The operative objectives of the group were to:

(1) To create a network of 15 regions with interest in cluster-based strategies for innovation and economic development.

(2) To deliver a regional cluster policy report based on the experiences of the sub-group members and on the work of the group

(3) To identify and describe successful cluster schemes and strategies and provide recommendations for regional policy making in Europe in this domain.

2 Methodology for Cluster Metrics

Policy makers will want to know whether interventions adopted to improve cluster performance have achieved their intended goals. They will also want to know why interventions have not been successful. This can help to identify whether a particular policy approach is effective, whether it is

efficient and whether it is appropriate. Understanding the different elements of clusters and their respective performance is also an important step in identifying where clusters might be strong or weak and where subsequent intervention might be appropriate.

For this purpose it is necessary to establish a set of metrics that are capable of tracking the performance of a cluster over time and space. Among others these metric should help in answering the following questions:

- Does clustering contribute to boosting the performance of regional economies? (regional effects of clustering)
- Does clustering contribute to growth of enterprises and higher incomes? (effects on companies of clustering)
- Does clustering cause (through increases specialization) influence vulnerability to economic cycles? (stability effects of clustering)

Science, technology and innovation (STI) indicators are tools that are intended to contribute to public reason and the deployment of instrumental rational social action regarding the application of knowledge within the economy.

Ideally a cluster metrics should capture both the effects of the interventions being undertaken and the development of the cluster overall. For the latter it should take into consideration the different aspects of cluster development and seek to understand how each element is developing over time. Clusters are multi-faceted and measurement should recognise this. There is little point in measuring one or two dimensions of a cluster, as this will miss important aspects of performance. In practice those aspects that are cited as the most important in cluster development, such as networks and the development of social capital, are currently not being measured on a regular or consistent basis.

3 Overview of the Situation in the Working Group Regions

Within the cluster working group the members find themselves on very different stages of developing cluster metric models as shown in Table 1.Some are at the stage of describing their cluster or sectors in quantitative terms, some are defining indicators that should (or rather could) be measured and a few have actually developed and implemented metric models. The models should take into account the sectorial nature of clusters as defined by Sternberg [3]. Even in the advanced cases, though, are experiences gained new and should be interpreted carefully.

Table 1 Overview of Clusters and Policies in the Working Group Regions

Cluster Working Group Region	Clusters and policies
Upper Silesia (PL)	Developing sector co-operation between SMEs participation (supporting clusters and co-operation networks) is one of the objectives of The Regional Innovation Strategy of the Slaskie Voivodeship 2003-2013.Prioritised cluster and co-operation networks are Furnitурecluster Aeroplanecluster Automotivecluster Project: CleanCoal Cluster Pilot project: Developing three pilot co-operation networks Pilot project: Network of effective technology commercialization
Region of Western Greece (GR)	In the region three cluster are *under consideration, these are:* ICT (manufacturing, embedded systems), Protection of Environment (new materials) Food technologies (functional products) In addition two networks, Tourism (network of alternative tourist destinations) and Foods (Greek traditional products supporting company) are under consideration
Galicia (ES)	Galician cluster policy is directed towards four main clusters, Automotive, Naval construction, Wood (both saw mills and pulp and carpentries), Audiovisual cluster.
PACA (FR)	The regional cluster programme is delivered under the umbrella of the national Pole de Competitivite programme. The regional cluster are: Solutions Communicantes Sécurisées (SCS) Mer-PACA Optique-Photonique Capénergies Gestion des risques et vulnérabilités des territoires Orphème Européen d'Innovation Fruits et Légumes Parfums, Aromes, Senteurs, Saveurs (PASS)Prod'Innov (Food & Health)

Scotland (UK)	Regional focus is on Life Sciences, Energy, Tourism, Food & Drink, Electronic Mkts, Financial Services At the Scotland wide level these 6 industries have been identified as having high growth potential that could benefit from a specific Industry approach
Veneto (IT)	Cluster policy is managed at Regional level with a specific Law no. 8 of 4 April 2003 (modified with law no. 5/2006). This is a bottom up approach requiring critical mass of the districts (clusters). To be recognized, districts have to present a strategic plan "District Development Agreement" in accordance with current regional legislative and programmatic tools.
East Finland (FI)	The national centres of expertise programme provides an overall framework for regional cluster policy. The regional priorities are, e.g.: HelathBio Well-being Nano/Microsystems/nanotechnology Forest industry future
Tartu Science Park (EE)	A Regional Comprehensive Cluster Strategy as a follow-up of Tartu Regional Innovation Strategy is prepared. Main activities facilitating the development of cluster initiatives in software development, biomedical, wood-forest-furniture and metalworks-machinery clusters
Alentejo (PT)	Regional support to cluster is based on the Regional Program of Innovation, which in turn prioritise those sectors with the highest potential and positive development. The following focus areas have been defined: Tourism Agro-food Alternative Energy Logistics Aeronautics
Aquitaine (FR)	The regional cluster programme is delivered under the umbrella of the national Pole de Competitivite programme. The regional cluster are: Aerospace Valley (Aeronautics, Space, Embedded System) Industrie et Pin Maritime du futur (Forest, Wood, Paper) Route des Lasers (Optics and Lasers) Prod'Innov (Food & Health)
South Great Plain (HU)	Regional cluster support is an integral part of the regional innovation system (co-financed by the Regional Development Council). The regions focus on the following sectors: automotive industry plastics and packaging, printing industries There is also a new initiative addressing the bio-ethanol industry. Services organised by the cluster include e.g. professional engineering, industrial research, product design
Stuttgart (DE)	The region has a wide range of internationally active clusters. Direct regional support is prioritising emerging areas such as fuel cells. Examples of important clusters are: Automotive Telecoms Electrical Software Toolmaking Automation Simulation/VR Med tech Nanosystems Nanomaterials Tech. Textiles Mechatronic Aerospace Logistics

4 Organisation and Composition of Clusters

4.1 From Ad hoc Organisation to Legal Entities and Private Governance

The carriers of cluster initiatives have often been regional intermediary organisations such as

development agencies, industrial associations, research institutes, universities, etc. (See Held [4]). In the past years there has been a development towards the establishment of dedicated institutions with the purpose of managing the cluster initiative. Such institutions can have different legal forms (e.g. associations, foundations, limited companies, etc). A key common characteristic, however, seems to be the *independence* from other stakeholders of regional and national innovation systems - both in terms of legal status and in terms of governance. The drivers for this development may vary but an important aspect is probably the wish of companies to influence the activities of the cluster initiative (in particular as private funding, membership fees, etc become more important as financing sources). A further important reason seems to be a need to position the cluster as an independent organisation for funding purposes. This holds true both for regional/national and international funds.

An interesting case with respect to this is the Upper Austrian "Clusterland" initiative. Since 1998, clusters were gradually developed in important economic branches in Upper Austria: automotive, plastics, eco-energy, furniture & timber construction, food, health technology, and mechatronics. In addition, inter-branch networks have been set-up in the fields of human resources, design & media, logistics and environmental technology. Small & medium sized enterprises are particularly supported in our policy.

All clusters and networks which were directed by Upper Austria's location and innovation agency (TMG) till the end of 2005, are now part of the Clusterland Oberösterreich GmbH. Since January 2006, Clusterland Oberösterreich GmbH is operationally active. Legitimate owners are TMG (Upper Austria's location and innovation agency) with 61%, Upper Austrian Chamber of Commerce, and the Federation of Austrian Industry with each 19,5 %.

A further example is the Italian law on clusters. A legal recognition of Italian industrial clusters ("distretti industriali") dates from 1991.During the last years, particularly with the law 266 of 2005, Italian clusters have been the target of innovative measures, trying to manage the number of private enterprises as a unique entity regarding to tax treatments, administrative burdens and private equity and guarantee schemes. Only a small part of these measures have been implemented, but the approach remains an innovative trend through the Italian cluster policy and the mechanisms and success factors are worthy to be investigated. Interesting possibilities enabled through the law are:

1) Cluster tax concessions: The cluster and the individual companies that belong to a cluster can adopt a "single taxation", upon agreement with the Italian tax agency (binding for at least three years).

2) Cluster administrative procedures: Enterprises belonging to cluster can interact with Public Administrations and Public Bodies through the cluster Authority. E.g. the organisation representing the cluster can sign agreements with the Public Administration allowing companies accessing databases managed by Public Bodies.

3) Cluster bonds: A simplified financial regulation can be applied to the securitisation operations regarding loans granted by a number of banks or financial intermediaries to companies that belong to a cluster.

4.2 R&D Integration and Large Company Involvement

Congruent with the trend of supporting knowledge-intensive and highly competitive clusters the importance of R&D and therefore R&D-institutions and large companies is growing in cluster policy development. In particular there seems to be trends towards linking large companies and R&D-institutions formally to the cluster, e.g. as share holders, as paying members and/or in advisory boards and steering committees.

As an example the clusters of Scotland are supported by advisory boards comprising leading sector experts from industry and academia. The Advisory Board advises Scottish Enterprise with regard to the orientation, steering and evaluation of Cluster policy.

There is also a trend towards policies facilitating the access to R&D funding of clusters. This can, as in the case of the French *"Pole de Competitivite"* initiative, take the form a special subsidy. Each supported cluster has defined a research and development area and within this area additional funding for cluster companies participating in collaborative research projects (at least two companies and one research centre) having received a competitiveness cluster label and financed by the State and its agencies under their competitiveness cluster programmes is available.

5 Examples of Cluster Metrics in Practice

5.1 A Framework for Cluster Metrics. The Case of Canada's National Research Council

The National Research Council (NRC) is the Government of Canada's primary public section

research institution. NRC has launched a number of cluster initiatives intended to make their research institutes and programs drivers of technology clusters. NRC is implementing initiatives in twelve locations across Canada. NRC requires indicators to monitor the progress of its initiatives, to support reporting requirements to the federal government, to assist in program planning and management of current and future initiatives, and to aid in communications with stakeholders within the clusters, the provinces, and the federal government.

Since an underlying conceptual framework is necessary to structure cluster indicators, and as the existing frameworks were found wanting, a new cluster framework has been developed for NRC. The framework, illustrated in Figure 1, has two parts, Current Conditions and Current Performance. Current Conditions consists of three constructs that measure the cluster's supporting organizations (including NRC), the competitive environment of customers and competitors, and the factors in the environment of the cluster that influence all of these actors.

Current Performance consists of three constructs that measure the cluster's significance in terms of a critical mass of core firms, the breadth of responsibilities, and reach of firms; interactions within the cluster and with the rest of the world; and its dynamism in terms of innovativeness and growth. The performance of the cluster as a whole is dependent on the success of the individual firms and moderated by the cluster factors, supporting organizations, and customers and competitors. There is a temporal disconnect between Conditions and Performance in that current conditions impact future performance, and current performance is the result of past conditions.

The framework is operationalized by breaking cluster conditions and cluster performance into a hierarchy of constructs, sub-constructs, and indicators. However, due to the lack of established conventions for cluster indicators and the challenges related to collecting supporting data as outlined above, purpose-specific indicators and data sources are required. These were developed for NRC by drawing on the broad range of characteristics considered important to clustering in the literature, and on the experience of ISRN in studying Canadian clusters. The resulting hierarchy of constructs, sub-contracts, and indicators are shown in the table in the Appendix.

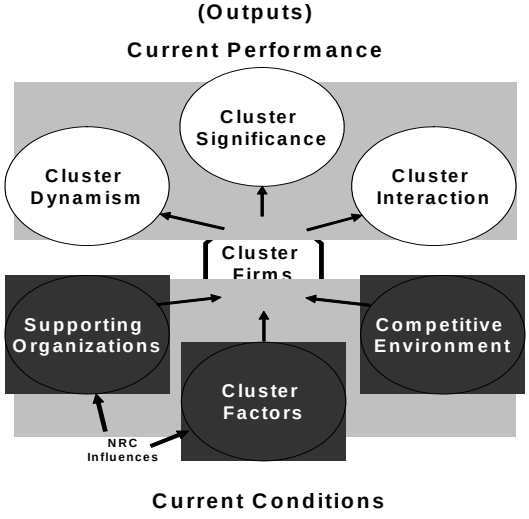

Figure 1 Cluster Metrics Framework

Not all indicators are equally important to the conditions or performance of a cluster, the relative importance is shown in the table. These indicators, by themselves, provide only a partial view of a cluster. Many of the benefits of clustering, such as the creation of local resources of tacit knowledge and social capital, and the promotion of collective learning, are intangible and therefore difficult to quantify. As a result, the cluster analysis process described below includes in-depth interviews and stakeholder meetings in order to more fully understand the state of the cluster.

The cluster measurement process used by NRC includes both the measurement of the quantitative indicators listed above, and methods to gather qualitative information and engage cluster stakeholders. The process has eight components:

(1) Review of documents and the literature concerning the state of the cluster.

(2) Definition of the scope of the cluster.

(3) Identification of stakeholders.

(4) Introductory cluster meeting to explain the process and validate the cluster scope and stakeholder list.

(5) Telephone or face-to-face interviews with key cluster stakeholders to gain qualitative insight into the dynamics of the cluster.

(6) Telephone or web survey of firms to acquire quantitative data on cluster conditions and performance.

(7) Analysis of the data.

(8) Final cluster meeting to communicate and validate the findings.

5.2 How to Capture Soft Indicators? The Case of Stuttgart's Intellectual Capital

The Fellbach (Stuttgart Region) based Virtual Dimension Center (VDC), Center of Competence for virtual reality and collaborative engineering, was founded in December 2002.Its legal form is that of a registered association. VDC is member of the Stuttgart Region's Regional Centres of Competence and Innovation network and as such an element of the region's cluster policy. VDC's facilities offer conference rooms as well as technical equipment for the demonstration of VR technologies that can be used by its members. Center activities include the brokerage of contacts, the organisation of thematic events, joint projects for technology development and application or measures of public relations (e.g. participation in trade fairs, newsletter). At present, VDC has a membership of around 50. The spectrum ranges from hard- and software companies, universities, research institutes and institutions of training and further education as well as users of virtual reality technologies.

The process of drafting an intellectual capital report for the VDC Fellbach took place in the context of the EU-financed project RICARDA (Regional Intellectual Capital Reporting – Application and Development of a Methodology for European Regions). This project focuses on the pilot-application of the method of intellectual capital reporting for regional technology oriented networks. This objective is implemented in four exemplary networks in the regions of Stuttgart (Germany), Styria (Austria), Stockholm (Sweden) and West-Transdanubia (Hungary) where the linkage between clusters and strategic local development is clearly visible. (See also Bosworth et al [5]). VDC is the study case for the Stuttgart Region.

Intellectual capital reports analyse and assess the intellectual capital of organisations. Intellectual capital is commonly considered to have three dimensions:

- Human capital: the knowledge members of an organisation bring with them. It includes peoples' skills , experiences and abilities.
- Structural capital: the opportunities and instruments that serve the exchange and documentation of knowledge (IT, intellectual property, organisational culture, process organisation etc.).
- Relational capital: all resources linked to the external relationships with customers, suppliers and the public. Intellectual capital reports complement conventional financial reporting. They focus on intangible assets – aspects that are of increased importance in times of the service society and knowledge economy.

Within the RICARDA project a basic model for the intellectual capital reporting of regional, technology-oriented networks was developed. It is based on existing methods for intellectual capital reporting on the level of companies and complementary research on existing instruments for the management and evaluation of networks.

Network objectives, the network's intellectual capital and the results of the network are main elements of the basic model. These three elements are closely linked together. The intellectual capital should be focused according to the network's objectives. It contributes – in its three dimensions of human, structural and relational capital – as knowledge resources to the concrete outcomes of the network. Those must be compared with the network's objectives defined beforehand.

A further assumption of the base model is the variability of network objectives in time. Relevant trends in the network's environment need to be considered. Trends in technological development, in the economy as well as political expectations or policy measures influence the network's activities. They might require an adaptation of the network and thus a change or an adjustment of its objectives.

6 Conclusions

Three main conclusions can be drawn from the working group's results on cluster metrics.

6.1 The Identification of Policy Relevant Innovation Cluster Indicators (Metrics) Is Challenging due to a Number of Reasons:

(1) First, they fail to capture basic features of clusters that are essential to understanding the state and performance of a cluster such as supply chain linkages, social capital and knowledge sharing.

(2) Second, many clusters cut across industrial sectors and traditional statistical data are therefore of little use for analysis of emerging areas such as nanotechnology.

(3) Third, available STI statistics are usually aggregated at a regional or national level, it is difficult to identify economic activity that occurs at a sub-regional or cluster level.

6.2 Most Measures and Models Encountered Within and Outside of the Cluster Working Group Focus on the Economic Performance of the Cluster.

Economic performance (also including innovation/R&D-spending) captures the outcomes but can not provide information on the mechanisms behind cluster success or failure. As pointed out forcefully by Philippe Pére, deputy director of Mediterranee Technologies, there are many pitfalls when designing and applying indicators to measure cluster policy impacts. Some key concerns brought up are the inability to grasp the so-called soft-indicators. To these indicators belong in particular:

(1) Governance indicators (Leadership, Human resources, Political science)
(2) Human indicators (Psychology, Motivational studies)
(3) Collective indicators (Computer science, Graph Theory, Game Theory, Economics)
(4) Time indicators (Changes in the cluster environment, economy, technology disruption, etc)
(5) Geo indicators (Economic geography)
(6) Milieu indicators (Diplomacy, Political Science, Sociology)

6.3 Some Common Indicators Seem to Become Standardised

It seems, however, that there are some commonalities in the emerging models for measuring cluster development. E.g. the different dimensions of clusters are often classified under one of four headings:

(1) Networks and partnerships – the extent of social capital.
(2) Innovation and R&D – the extent of innovation and R&D capacity.
(3) Skills – the availability and quality of the workforce within the cluster.
(4) Economy and enterprise – the level of employment, number of firms and their performance and the outcomes.

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