

**Cluster Dynamics  
in Theory and Practice  
with Application to Scotland**

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## **Abstract**

The paper reviews the academic and policy literature on clusters and cluster-based development strategies. In particular, it highlights the key issues which will affect cluster development activities in Scotland and how Scottish Enterprise can progress with its current and future cluster action plans. The paper has the following objectives: to examine the theoretical issues surrounding clusters and cluster-based strategies, including different definitions of clusters; to review the spatial levels at which policy-makers attempt to implement cluster strategies; to assess the different approaches and methods of analysing and measuring clusters; to examine the evolution of clusters and how different clusters relate to one another; to highlight issues involving 'cluster governance' and how different countries/regions structure cluster programmes; and to provide some brief conclusions on how SE can take forward its clusters approach.

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## TABLE OF CONTENTS

<b>1. The Theory and Practice of Clusters.....</b>	<b>4</b>
<b>2. Geographical Issues Surrounding Clusters .....</b>	<b>6</b>
<b>3. Measuring and Selecting Clusters .....</b>	<b>8</b>
<b>4. The Evolution of Clusters.....</b>	<b>10</b>
<b>5. Cluster Governance.....</b>	<b>12</b>
<b>6. General Policy Conclusions.....</b>	<b>13</b>
<b>Annex 1: Definitions .....</b>	<b>15</b>
<b>Annex 2: Porter's Diamond .....</b>	<b>16</b>
<b>Annex 3: Cluster Policies by Country .....</b>	<b>17</b>
<b>Annex 4: Cluster Analysis Techniques .....</b>	<b>26</b>
<b>Annex 5: Glossary .....</b>	<b>27</b>
<b>Annex 6: A Typology of Scotland's Pilot Clusters .....</b>	<b>28</b>
<b>References .....</b>	<b>29</b>

## 1. The Theory and Practice of Clusters

This section examines some of the theoretical issues surrounding clusters and cluster-based policies. It is fair to say that there has been a large degree of confusion surrounding the concept of clusters and that clusters or clustering means different things to different people. One of the reasons for this is the fact that there is no real unified theoretical framework for examining clusters. Feser (1998) notes there is no cluster theory *per se*, rather a broad range of theories and ideas that constitute the logic of clusters. Some argue that this situation has had negative policy ramifications: 'sadly, in the rush by various governments to employ clusters, some fundamental issues have been slighted, including appropriate research methods and even the definition of the cluster itself' (Held, 1996, p.249). Held claims that this approach can be harmful.

Part of this problem owes to the fact that there has been a variety of different definitions used when examining clusters<sup>1</sup>. Michael Porter defines clusters as 'concentrations of interconnected companies and institutions in a particular field' (1998, p. 78). Meanwhile, the DTI (1998, p.22) defines clusters as 'a concentration of competing, collaborating and interdependent companies and institutions which are connected by a system of market and non-market links'. Scottish Enterprise (SE) define clusters as 'customers, suppliers, competitors and other supporting institutions such as universities, colleges, research bodies, financial institutions and the utilities' (Scottish Enterprise, 1998).

In practice, clusters are taken to mean a group of business enterprises and non-business organisations for whom membership within the group is an important element of each member firm's individual competitiveness. Binding the cluster together are 'buyer-supplier relationships, or common technologies, common buyers or distribution channels, or common labour pools' (Enright 1997, p. 191). It is also important to note that clusters involve a certain degree of spatial proximity between its actors. Geographical proximity enables face-to-face networking, common labour markets and the diffusion of knowledge, especially 'tacit' knowledge which is difficult to codify.

Although these definitions have a large amount of commonality, not everyone views clusters the same way however. For example, in the UK there is now a widespread acceptance in policy-making circles that clusters are a 'good thing'. From a national perspective, clusters are seen as an effective way of promoting national economic competitiveness across the UK as a whole through a process of regional or local specialisation (DTI, 1998). From a regional or local perspective, clusters are viewed more generically as a *process* for stimulating regional/local economic development. Indeed, for local economic development practitioners clusters have rapidly moved from being an academic *term* used to describe industrial agglomerations to a process of economic development to promote local business competitiveness and enhance growth within local economies. For the purposes of this paper we will concentrate on clusters in the latter sense.

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<sup>1</sup> Adding confusion to this is the fact that related terms, such as industrial districts, value chains and business networks, are sometimes used interchangeably with the term clusters (see Annex 1).

Much of the upsurge of interest in clustering was sparked by the influential work of Michael Porter (1990). It is widely recognised that most cluster studies use Porter's work as a starting point for cluster analysis (Bergman and Feser, 1999). Porter's model of national competitiveness - the so-called 'diamond' - is by now well known and warrants only a brief summary here (see Annex 2 for more details). Although Porter's diamond provides policy-makers with a useful starting point for examining clusters, not all cluster initiatives proceed with this approach when deciding which clusters to focus policy support upon. In fact, according to a study examining cluster initiatives across Europe, the majority of cluster programmes were not preceded by an in-depth regional analysis comparable with Porter's cluster mapping process (Lagendijk, 1999a). Moreover, Lagendijk claims that the general Porterian concept of clusters has been interpreted very differently across regions and translated into practical initiatives according to the specific needs of the local economy. This has been backed up by other cluster researchers<sup>2</sup>. A study by Michael Enright (2000) also found that very few clusters nowadays adopt Porter's approach.

Most observers acknowledge, however, that Porter's work is merely the starting point for the majority of cluster studies whilst tapping into a wider range of more developed ideas to explain the origins of industry clusters, the dynamics of cluster growth and change and advantages to using clusters as a basis for regional policy (Bergman and Feser, 1999). Current thinking on clusters led by Michael Enright suggests that Porter's work should be used as a starting point or a catalyst to undertake cluster development and not as some kind of manual which has to be rigidly followed. From a policy perspective, different clusters are often highly place-specific and public policy towards clusters should be flexible enough to accommodate varying industrial, institutional and political conditions.

According to Feser (1998), there are broadly two different types of cluster policies. First, policy applications that focus specifically on identified clusters called '*cluster-specific strategies*'. Under the cluster-specific policy approach, the objective is to encourage the emergence or development of a distinct identified cluster. The first stage of this policy approach is to map out the cluster and identify its characteristics and nature through SWOT analysis. The primary characteristic of the cluster-specific approach is the comprehensive attempt to nurture a given value-chain through a range of carefully crafted demand-side and supply-side policy interventions. Cluster-specific approaches are mutually reinforcing and may involve economic interventions which are not development strategies per se, but are instead traditional functions of governments (eg. regulation, enforcement, pricing and education).

The second approach is termed '*cluster-informed strategies*'. The principal policy objective from the cluster-informed perspective is the improved implementation of individual development initiatives. This approach to cluster development is less holistic than the cluster-specific approach. No formal cluster mapping exercise is undertaken under this approach, but some cluster-related techniques may be deployed. Cluster-informed strategies often seek to examine specific aspects of a cluster. For example, such an approach might seek to examine parts of a cluster's supply chain (eg. weaknesses in local suppliers) which would then be targeted by business development

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<sup>2</sup> The initial meeting of Euro-Cluster also found this to be the case.

initiatives. Under this approach clusters are primarily viewed as an analytical device to improve the effectiveness of narrower types of policy tools (Feser, 1998).

Annex 3 outlines different approaches taken towards clusters across countries throughout Europe. It is clear from this analysis most countries fall somewhere between these two camps outlined above and significant inter-national (eg. Sweden and Finland) and inter-regional variations (eg. Wales and Scotland) arise in the implementation of cluster-based development strategies across Europe. With the exception of the Netherlands and parts of Scandinavia, we can see that few countries have an explicit overarching national cluster policy (Boekholt and Thuriaux, 1999). Nonetheless, many countries and regions adopt policies which are clearly 'informed' by notions such as clustering and networking (see Annex 3). What is also interesting is that some countries not examined within, such as the Republic of Ireland, who have examined a clusters approach to economic development then opt for a more traditional sectoral approach (see NESO, 1998). These differences clearly reflect the fact that different countries have vastly different political structures and systems for national industrial policy, science and technology and regional development.

## 2. Geographical Issues Surrounding Clusters

This section examines the issues which affect the operation of cluster policies across different spatial and institutional scales. There are a number of general issues concerning the geography and scale of clusters that policy-makers should take into consideration when assessing how cluster policies might need special tailoring to address issues facing their regional economies (OECD, 1997). These include:

- I. **Geography:** A cluster approach should consider such factors as geographic size and proximity to other important regional economies.
- II. **Jurisdiction:** Jurisdictional issues affect assessments of regional economies as many regional economies are composed of multiple jurisdictions (ie. municipal; provincial/state; federal) which possess their own sub-regional economies and public policy regimes<sup>3</sup>.
- III. **Population:** Population size can be significant as it can determine the size of local labour forces and local consumer markets. Additionally the urban/rural split can be a further policy factor in regional economies.
- IV. **Sector Size:** Many industrial sectors (and therefore potential industrial clusters) are not particularly large in many regional economies. As a result, any methodology used to measure or select clusters should be adaptable enough to capture the key aspects and group dynamics of smaller industrial groupings of like companies.

In addition to the factors mentioned above, the most appropriate scale for working with clusters is also determined by other factors. For example, a recent DTI (1999)

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<sup>3</sup> For example, Porter (1998) notes that a strong chemicals cluster in Germany crosses the border into neighbouring Switzerland.

enquiry into the biotechnology sector discovered that perceptions of cluster proximity vary between countries. In the US, clusters tend to be thought of as locations that can be visited within a single business day, and from this perspective the UK as a whole might be viewed as a single cluster. In contrast, the DTI study team felt that in the UK a cluster is more likely to be circumscribed by a much shorter journey (around an hour or so). The geographical size of any given cluster is also determined by labour market issues. In particular, how far staff are prepared to move their place of work without moving house. Given this, clusters are often geographically circumscribed by the perceptions of participants within the cluster, both businesses and workers.

Differences also arise in the width and breadth of clusters which are selected by policy-makers. For example, in Northern Ireland the clusters chosen are very wide ranging. Examples include broad industrial/service clusters such as 'engineering' and 'tradable business services'. According to observers, such wide-ranging clusters are too general to have much coherency for policy support (Enright, 2000). Meanwhile, in Scotland a more narrowly focused approach has been taken with its first wave of clusters. For example, SE has chosen to breakdown the electronics industry into smaller sub or micro-clusters comprising elements of different sectors, eg. semiconductors and opto-electronics rather than information industries/electronics as a whole.

Although clusters tend to be geographically concentrated (see Porter, 1998), determining the most appropriate scale to work with clusters is very important, not least because clusters often cut across international, national, regional and local boundaries. As we can see in Annex 3, there are significant variations in the geographical scale at which countries/regions implement cluster policies. While some countries operate a highly systematic top-down approach to cluster development (eg. the Netherlands), in some other countries cluster policies are implemented by local or regional actors in a very *ad hoc* way (Scandinavia and to a lesser extent the UK). Determining the most appropriate spatial scale for adopting cluster policies is obviously a key issue for policy-makers and will normally be influenced by the political and institutional structure of any given country.

In countries with a large degree of political or economic autonomy, such as Spain and Germany, cluster policies are typically undertaken by local or regional actors. In fact, cluster policies are sometimes most developed in regions which have the largest degree of autonomy (eg. The Basque Country and Catalonia in Spain). The reason for this owes to the well developed economic development infrastructure which is found in highly decentralised countries. For example, in the UK it is probably no coincidence that the regions which have been quickest to embark upon cluster-led economic development are those with the highest levels of political and institutional autonomy. In particular, Scotland has been at the forefront of clusters during the 1990s through the work of Scottish Enterprise.

Cluster development strategies are sometimes devised at the national level but are then implemented locally by a different set of actors. This then creates problems when implementing local cluster policies. How can central agencies ensure that local cluster policies are properly implemented? When this situation occurs it is important that close coordination takes place and appropriate coordination mechanisms are in

place between different economic agencies at various spatial scales<sup>4</sup>. Very little, if any, research has been undertaken to assess how different countries/regions surmount these difficulties. However, it would appear that very close linkages and information flows between different sets of actors will be needed to ensure this works effectively.

### **3. Measuring and Selecting Clusters**

Although numerous methods are used to analyse and measure the size and importance of regional clusters, there is no universally accepted method of cluster assessment and measurement (see Held, 1996). Different countries and regions tend to define clusters in a variety of ad hoc ways, using a wide variety of research techniques and criteria. According to some observers, ad hoc procedures are always questionable for defining and implementing policy (Doeringer and Terkla, 1995). Indeed, there is a large cluster 'tool box' from which clusters can be identified: for example, industry-based input-output relationships, shift-share analysis, location quotients, industry growth forecasts, case studies and predictions about the business potential of particular products and technologies (Rosenfeld, 1995). The variety of different cluster analytical techniques also owes much to the different techniques which are deployed by various economic development bodies and consultancies working in this growing field. Cluster identification methodologies also differ in the use of economic analysis and techniques (see Annex 4 for a summary).

One of the main problems which can hinder cluster analysis is the lack of available regional data, a problem which is particularly acute in Europe. Porter (1998) claims that clusters rarely conform to standard industrial classification systems. This problem means that standard economic analysis may fail to capture many important actors and relationships. Even in the US, which has a relatively disaggregated statistical nomenclature (ie. 8-digit SIC), problems identifying clusters can occur. For example, in Massachusetts more than 400 companies representing at least 39,000 employees, are involved in medical devices in some way yet statistical analysis failed to detect this sizeable cluster. This can sometimes lead to a situation whereby policy-makers and businesses do not recognise their existence owing to overlapping industry categories such as electronic equipment and plastic products. Despite this, representatives from this 'hidden' cluster have now come together to tackle common problems. Some countries, such as Denmark, are currently undergoing a process of re-classifying their statistical classification systems so that clusters are better captured by official data sources.

In addition to these measurement problems, Sternberg (1992) warns against an overly mechanistic approach towards cluster identification because such an approach may fail to recognise rapidly emerging or embryonic clusters which have not yet reached a critical mass and may require support from public policy to maximise its potential<sup>5</sup>.

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<sup>4</sup> As we shall see in section 5, this problem is sometimes complicated when business actors are brought into the process of 'cluster governance'.

<sup>5</sup> A good example of this would be the optoelectronics cluster in Scotland which would not be 'picked up' by conventional cluster measurement techniques. This mini-cluster has substantial growth potential but needs proactive policy support if its potential is to be achieved. Similarly, had Finland relied on retrospective economic data during its cluster analysis during the early 1990s, the



Unlike SE's approach, few countries pay little explicit attention to industry growth forecasts when selecting clusters to focus policy efforts on. However, one of the reasons why the so many regions select so-called 'fashionable' clusters probably owes to the projected growth rates of these industries.

Practitioners generally favour the use of both quantitative and qualitative analysis towards cluster identification and analysis (Held, 1996). This is the approach which the DTI is taking to its current research which is attempting to map industrial clusters across the UK. Following consultation with external experts, the DTI were advised to adopt a 'nested' or 'mixed' methodology when measuring clusters. This approach will make use of various official data sources such as the Inter-Departmental Business register (IDBR) as well as close liaison and interviews with local business leaders, RDAs etc. Such an approach attempts to marry 'hard' quantitative analysis with 'softer' forms of qualitative understanding<sup>6</sup>. Clearly some clusters are more difficult to define than others.

Following the process of cluster analysis and identification, policy-makers are then faced with the difficult decision of deciding which clusters to work with. The process of selecting clusters is one of the most controversial aspects facing economic development practitioners when adopting a cluster-based approach and care must be taken during the selection process so that clusters which do not get given priority by development agencies are not then neglected (Enright, 2000). Lagendijk (1999b) claims that there are two principal routes to cluster selection:

1. The first is the '**top-down**' approach in which a list of clusters is drawn up on the basis of cluster analysis. This approach faces the problem of justifying why certain clusters were included and others were excluded. Enright (2000) claims that policy-makers often find it difficult to resist 'fashionable' clusters (eg. biotechnology, multimedia etc.) even when there is little genuine background in these areas. Even if this temptation is resisted, the process of cluster selection will always be based on certain arbitrary choices. This approach is found in places such as the Basque Country (Lagendijk, 1999b).
2. The second is the '**bottom-up**' approach which sees the initiative being taken by actors within the sector themselves. Bottom-up approaches generally benefit from existing inclinations to undertake joint action and to cooperate. This type of approach involves a process of self-selection and may only suit strong clusters with existing patterns of horizontal/vertical cooperation, ignoring weak clusters with strong development potential. This approach is common in southern European countries such as Spain and Italy, especially the Italian industrial districts.

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telecommunications cluster would not have been included in its list of clusters for policy support (see, Rouvinen and Ylä-Anttila, 1999).

<sup>6</sup> The latter approach is particularly important when deciding which clusters policy-makers should focus upon.

In reality, the majority of clusters selected for policy help and support involve a combination of these two routes<sup>7</sup>. For example, in the state of Arizona local governments offer clusters the opportunity to bid for public funds to undertake clustering initiatives, ensuring that only the clusters with existing cooperation were likely to win funding. Meanwhile, in Scotland a combination of the two approaches also took place owing to the fact that extensive private sector consultation took place prior to launching a clustering approach in each of the four pilot clusters.

#### **4. The Evolution of Clusters**

As many observers have noted, clusters are not a static phenomenon. Once a cluster begins to form, a self-reinforcing cycle promotes growth, especially when local institutions are supportive and local competition is vigorous (Porter, 1998). Vibrant clusters are constantly innovating, changing shape and altering their internal dynamics (Baptista, 1998). In fact, the reconfiguration of any given industry or cluster is often a mark of the level of innovation within its component parts. Indeed, clusters which remain quite stable and do not transform themselves may end up stagnating, especially if they do not upgrade and keep abreast of new technology. There are numerous examples of regions which have been severely hit because a dominant industrial cluster failed to diversify, upgrade or move up the value-chain (shipbuilding in Glasgow being a good example).

Although different clusters have varying trajectories, some seem to develop along a life-cycle model (Swann, 1998). Often the life-cycle of any given cluster owes to new developments in technology and when a new technology or innovation process occurs, new or embryonic clusters emerge. These often arise from research within universities and research bodies. A good example of this in the Scottish context is the emergence of an opto-electronics cluster which is now beginning to grow and develop, primarily from the Scottish research base. Given this cluster is made-up of university researchers and small spin-off companies, this cluster is clearly in the formative stages of its development and will probably not fully develop until well into the next century. In fact, according to Porter (1998), numerous case studies suggest that clusters require a decade or more to develop depth and real competitive advantage.

Clusters which follow the above type of developmental trajectory are often formed by commercialising the existing science base. Using an example for a hypothetical cluster, the life-cycle could be categorised as follows:

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<sup>7</sup> Lagendijk (1999b) claims that a mixture of the two approaches is probably the best method of cluster selection.

1. **Stage 1:** The research base creates the technology which forms the bedrock for the future development of the cluster.
2. **Stage 2:** The research base commercialises the technology either internally through spin-offs or via a third party contractors.
3. **Stage 3:** Companies begin to grow and develop around the technology creating a small cluster of related firms. Employment levels are still quite low.
4. **Stage 4:** Specialist support services and suppliers emerge to service the cluster, adding to the depth and innovative capacity of the cluster as a whole.
5. **Stage 5:** Companies begin to grow and expand their capabilities. Often trade bodies or informal networks grow during this stage.
6. **Stage 6:** Companies begin to reach a degree of maturity and may need to diversify to be able to continue in business. Linkages with universities or other suppliers of technology may be necessary to upgrade.

Not all clusters of industrial activity follow this simple linear developmental path. Often clusters arise as a consequence of convergence between traditional and newer technologies. One of the most widely quoted examples is the convergence of telecommunications and information technology. Some computing and electronics companies start to specialise in the branches of technology required to make this interaction happen (modems, communication cards, digital exchanges etc.). Following this, companies in one industry start to diversify into another. For example, the telecommunications giant Nokia has used its wide-ranging experience in telecoms to move into other forms of ICT which were traditionally seen as outwith its core business. Indeed, the convergence between traditional technologies and new ones can sometimes yield substantial dividends (Swann, 1998).

Just as clusters may have a varying life-cycles or developmental trajectories, there is also the need for public policy towards clusters to adapt over time to the needs of a cluster at any given time. Therefore, policies appropriate to one stage of the cluster life-cycle may not be appropriate to another. Thus, from the hypothetical example quoted above, policy-makers such as Scottish Enterprise will have to ensure that appropriate policies are implemented at any given stage of a cluster's development. For example, the early stages of cluster development require help with the commercialisation process. Often the early phase requires pro-active hand-holding on behalf of public agencies. This can take the form of assistance with market research, testing, prototyping and general marketing. Following this companies within the cluster may require assistance gaining venture or patient capital to aid their expansion. During the later stages, economic development assistance may be confined to attracting specialised foreign investors, improving networking in the cluster and developing 'bridging mechanisms' between industry and the research base.

However, it is important to stress that the needs of clusters will vary and there is no uniform 'tool-kit' which can foster cluster development. Furthermore, appropriate policies will also be required for 'existing' or 'mature' clusters. For example, much of the policy focus for existing clusters, particularly mature clusters such as food and

drink, is geared towards fostering networking and developing better technology-transfer mechanisms. Finally, the need for a customised approach is even more vital for clusters which are built upon foreign investment. These transplant clusters often require a completely different set of policy instruments to aid their development, such as pro-active supplier development, incentives to facilitate new R&D facilities and help to develop the managerial autonomy within branch plants in order to gain secondary investments.

## 5. Cluster Governance

This section highlights some of the issues surrounding 'cluster governance'. According to Michael Enright, a cluster's governance structure refers to 'the relationships among firms in the cluster in terms of the nature of relationship and distribution of power' (2000). Cluster governance typically refers to the structure of the industry and how firms interact with one another. Coordinating mechanisms, on the other hand, refer to the ways that inter-firm relations are organised and how the public sector seeks to influence the development of the cluster. We shall now examine in these two features in turn.

A clusters governance structure is comprised of a variety of different aspects (see Annex 5). For example, the activity base of a cluster involves the number and nature of the activities in the value-added chain that are performed within the region. In *activity-rich clusters*, most or at least many of the critical activities in the value-added chains of the relevant industries are performed locally. *Activity-poor clusters*, on the other hand, involve one or only a few activities in a given industry or set of related industries. Within Scotland, examples of activity-poor clusters would be certain parts of the electronics industry, especially those that are predominantly foreign-owned, which perform little value-added locally. Other elements of cluster governance, such as cluster density and breadth, are outlined in Annex 5.

Applying Enright's framework to Scotland's pilot clusters is a good way of illustrating some of the dynamics of cluster governance. As we can see in Annex 6, Scotland's three pilot clusters are quite different in their structure and overall dynamics. Therefore, SE will have to undertake policy interventions which are suited to each of the cluster's characteristics and needs. Some of the key characteristics are:

1. The biotechnology cluster is composed of a small number (sparse) of firms with a diverse range of activities (broad) with no leading or core firms which are spread across Scotland (dispersed).
2. The semiconductor cluster is characterised by a small number (sparse) of lead firms with a narrow range of activities (narrow), mostly based in Central Scotland (localised).
3. The food and drink cluster comprises of a large number of firms (dense) in a very diverse range of businesses (broad) with no leading firms, spread across all of Scotland (dispersed).

Coordinating mechanisms refer to the role played by different institutions in developing clusters. For example, in some parts of the world clusters are coordinated primarily by private sector. This is the case in many parts of the US and some parts

of Europe. In Arizona, for example, different clusters bid for public funding and are then in charge of making interventions which will benefit the rest of the cluster. This ensures that members within the cluster are pro-active enough to work together to establish mutual goals and objectives. This type of approach ensures industry 'buy-in' but may only be appropriate for clusters which are already well-developed and have good internal linkages. However, in other parts of the world, such as Scotland, economic development agencies may have to take the lead.

According to Enright, characterising clusters along these dimensions allows us to understand their potential and problems in ways which can inform policy. Knowledge of governance structures and coordinating mechanisms can also guide policy towards the most efficient use of scarce resources, especially as clusters, even in the same location, might have very different characteristics. In general, policy-makers should try and help localise, deepen, broaden, activity enrich and/or improve the innovative capacity of clusters. From a policy perspective policies directed towards SMEs will be somewhat ineffective in a cluster, such as semiconductors in Scotland, if core firms are not interested in the programmes operated by SE. Similarly, SE will have to act as the main coordinating mechanism, at least in the short-term, for cluster policy if industry does not take up the challenge.

## **6. General Policy Conclusions**

The clusters approach has emerged as an important analytical tool for governments and economic development agencies seeking policy prescriptions to make their economies and firms more competitive. While the cluster approach has traditionally been used for examining national economies it can also be a useful tool in analysing the dynamics of sub-national or regional economies. However, it is absolutely vital that cluster programmes and actions are properly tailored to the individual needs and requirements of any given cluster and the specific characteristics of any given region. It is important, therefore, to stress that the needs of clusters will vary and there is no uniform 'tool-kit' which can foster cluster development

This paper has highlighted a number of different issues which can help public policy when adopting a cluster's perspective. The most significant of these conclusions for Scottish Enterprise were:

1. There is no overriding cluster theory per se and clusters are generally viewed as an economic development process rather than a definite development theory. Approaches towards developing clusters vary significantly across different countries with some adopting a holistic cluster-specific approach while others adopt a less far-reaching cluster-informed approach. SE should avoid adopting a fixed attitude to 'cluster thinking' and should instead think laterally about the specific needs of Scotland's clusters. Working closely with external organisations (eg. Scottish Executive, SHEFC, Coshep, SFEU, trade bodies) should help to ensure that SE's work on clusters also helps to influence other organisations and policies so that cluster policy becomes fully embedded throughout Scotland.

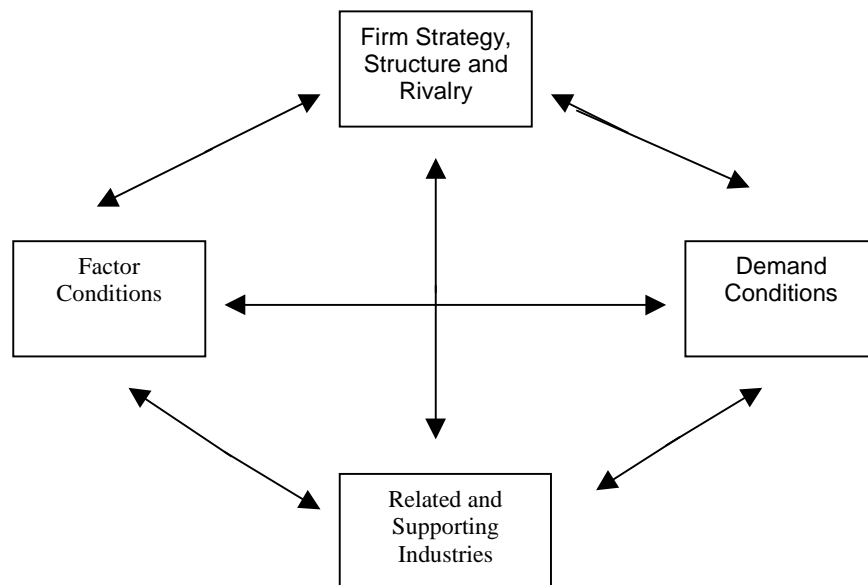
2. Given clusters often transcend different jurisdictions, care must be taken to ensure that close coordination takes place between different actors, especially when cluster strategies are devised at a national level and then implemented at a local level. This is something Scottish Enterprise will have to ensure now that the implementation of the cluster action plans transfers from SE to other parts of the Network. SE could also try and increase the role played by Highlands and Islands Enterprise in the clusters process, especially in clusters which clearly transcend both their jurisdictions (eg. tourism and forestry). This could be undertaken by having representation from HIE's at SE's cluster events and/or inviting HIE's sector teams to become involved in SE's cluster Implementation teams.
3. It is important that cluster methodology is carefully tailored to address the special characteristics of the locale being examined and a mixed approach to cluster measurement seems the most appropriate for bodies such as SE. Therefore, Scottish Enterprise should try and be flexible when assessing which current and future clusters to focus policy support upon. It is also important to recognise that clusters change very rapidly, not least because of the rapidly changing nature of technology, and thus require a constant redefinition and focus. When it comes to selecting which clusters to focus policy support upon, care should be taken to ensure that members of the cluster are actively involved from the beginning in a 'bottom-up' manner. This reinforces the need for extensive discussion and development work with members of clusters prior to devising cluster strategies. It is therefore important that SE do not assume a fixed attitude when defining clusters which may omit potential or emerging clusters.
4. Given clusters have varying life-cycles or developmental trajectories there is a need for public policy towards clusters to adapt over time to the needs of a cluster at any given time. Owing to rate of change within existing clusters, especially high-technology business clusters, policy-makers will have to be able to track and examine cluster dynamics in order to be aware of future technological developments which can positively and negatively affect clusters. One method of undertaking this is to engage in 'foresight exercises' which can help steer the future of existing clusters towards new growth opportunities by improving industry awareness and channelling research resources appropriately (Swann, 1998).
5. Recognising different cluster governance structures and coordinating mechanisms can help to guide policy towards the most efficient use of scarce resources, especially as clusters, even in the same location, might have very different characteristics. By taking the lead on cluster policies, SE is then in a position to establish public-private sector bodies which can then take up the lead for future cluster-related activities.
6. Finally, SE should try and help localise, deepen, broaden, activity enrich and/or improve the innovative capacity of clusters.

## Annex 1: Definitions

<b>Sector (or Industry)</b>	A sector or industry is a group of enterprises that manufacture similar products, as typically defined, for example, under the U.S. Standard Industrial Classification (SIC) system.
<b>Regional industry cluster</b>	A cluster whose elements share a common regional location, where region is defined as a metropolitan area, labour market, or other functional economic unit.
<b>Potential industry cluster</b>	A group of related and supporting businesses and institutions, that, given additional core elements, inter-firm relationships, or critical linking sectors, would obtain some pre-defined critical mass.
<b>Value-chain industry cluster</b>	A value chain cluster is an industry cluster identified as an extended input-output or buyer-supplier chain. It includes final market producers, and first, second and third tier suppliers that directly and indirectly engage in trade. It is comprised of multiple sectors or industries. (see Roelandt and den Hertog 1999).
<b>Business network</b>	‘A group of firms with restricted membership and specific, and often contractual, business objectives likely to result in mutual financial gains. The members of a network choose each other, for a variety of reasons; they agree explicitly to cooperate in some way and to depend on each other to some extent. Networks develop more readily within clusters, particularly where multiple business transactions have created familiarity and built trust (Rosenfeld 1995a, p. 13).’ Ties between firms in networks are typically more formal than in clusters.
<b>Italian industrial district</b>	A highly geographically concentrated group of companies that ‘either work directly or indirectly for the same end market, share values and knowledge so important that they define a cultural environment, and are specifically linked to one another in a complex mix of competition and cooperation between firms, a result of a close intertwining of economic, social, and community relations.
<b>Innovative milieu</b>	Not a group of business or a region, but a complex which is capable of initiating a synergetic process, an organisation, a complex system made up of economic and technological interdependencies, a coherent whole in which a territorial production system, a technical culture, and protagonists are linked.

*Source:* Based on Bergman and Feser (1999)

## Annex 2: Porter's Diamond



Porter traces the competitiveness of firms to four major national factors:

1. *the nature of firm strategy*, structure, and rivalry in the country, including attitudes toward competition, market institutions, the degree of local competition, and other cultural and historical factors affecting how firms do business with each other, their workers, and the government;
2. *factor conditions*, or basic endowments or conditions on which local firms seek to compete (eg. such as supplies of natural resources or technology-related advanced factors);
3. *demand conditions* or the nature of local demand (eg. the existence of local demand for related intermediate goods); and
4. the presence of *related and supporting industries*, including suppliers and successful competitors; both to stimulate cooperation and competitive rivalry.

Source: Porter, 1990



### **Annex 3: Cluster policies by country**

This annex examines the nature of cluster implementation in different parts of the Western Europe. This survey is not meant to be an exhaustive list of cluster policies, rather it is designed to act as an indicative overview of the types of policy approaches towards cluster development in a selection of countries/regions in Western Europe.

#### **Austria (cluster-informed)**

Cluster-based economic development policies are quite common throughout Austria, especially in certain regions with regional industrial specialisms. As with all industrial and regional policies in Austria, cluster policies are part of a system of 'social partnership'. This implies that basic policy principles and the conception of programmes are agreed upon in advance in an informal cooperation between business (Chambers of Commerce), labour (Trade Unions) and the state (federal and Land) (see Todtling and Sedlacek, 1997). However, owing to the high degree of political decentralisation, cluster policies vary markedly across Austria according to regional and local needs. The main actors taking forward cluster development initiatives are regional governments and regional development agencies.

At the national-level, one of the most ambitious plans for translating the cluster idea into new policy is the 'Competence Centre Programme' (see Peneder, 1999). This pilot programme was first initiated in 1997 by the federal government. The primary goal of this programme is to improve interaction between academic research and private industrial R&D through the establishment of collaborative research institutions, called 'competence centres'. Another cluster-informed policy initiative in Austria is the creation of a new type of technical college specialising in a range of activities from information and communication technologies such as engineering skills and tourism management (Peneder, 1999).

One of the most proactive regions undertaking cluster-based policies is Styria. The Styria automobile cluster is probably Austria's best-know regional cluster. Building on high performing local enterprises in motor vehicle technology and gear units, a successful cluster of related companies has developed in this south-eastern province of Austria. The cluster currently has more than 120 companies, as well as a host of research institutes and technical colleges. Styria has used the cluster concept to create a 'brand name' in order to attract foreign direct investment in the automotive supply chain. The cluster concept has also helped to foster cooperation among local suppliers, ranging from transport logistics to the new development of particular automotive components (Peneder, 1999).

#### **Belgium (cluster-informed)**

In Belgium, national cluster policy is still in its infancy, although there are signs that the concept is beginning to be given a higher priority by national and regional government (Roelandt and den Hertog, 1999). Nonetheless, several policy initiatives are strongly informed by cluster approach, such as the support for cross-sectoral technology diffusion, the creation of supplier-producer networks and centres of

excellence around newly emerging technologies. At present, the main actors involved in cluster development in Belgium are regional governments and RDAs. For example, the RDA in the Kempen region is currently implementing the PLATO programme. This aims to increase knowledge transfer between SMEs and large international companies. The Plato programme brings together a group of SMEs from different sectors in thematic sessions with a mentor company from a large firm. A group of some 12 SMEs and two mentors participate in the groups for two years. The emphasis of the programme is to share knowledge on management issues. This initiative has been in operation since 1988 and has been copied by several other European countries. Although not essentially a cluster initiative, this programme teaches firms, especially SMEs, the benefits which can be obtained from working with other firms (Boekholt and Thuriaux, 1999).

### **France (too early to know)**

As mentioned previously France is just beginning to examine the potential of adopting a national approach towards cluster development. The main national body in charge of cluster work is DATAR and they have identified 230 different clusters located across the country. This process has been undertaken in a very centralist fashion and suggests that cluster selection procedures will be very 'top-down'. At the regional level, a number of RDAs are also beginning to examine the merits of adopting a cluster-led approach to economic development. For example, Nord-Pais-du-Calias and the Alsace region are both undertaking some basic exploratory work in this area. However, it is too early to really assess how this will progress.

### **Germany (cluster informed)**

Germany has a long tradition of collaborative research and networking, without having an explicit cluster focus to its economic strategy (Boekholt and Thuriaux, 1999). Indeed, many of its R&D policies are designed to encourage research collaboration. More recently, cluster-oriented policies have been developed by the federal government. For example, in order to promote networking and clustering in the biotechnology sector, the German government launched the 'BioRegio' initiative in 1996<sup>8</sup>. This initiative requires regions to submit ideas for the development of biotechnology on a regional basis and awards financial and other special support to the selected regions. The main criteria for the selection of a region is the existence of collaboration between all the parties concerned (ie. industry, universities and the public sector). The regions selected so far are Munich, Rheinland, Rhein-Neckar-Triangle and Jena.

The BioRegio fund aims to promote the transfer of scientific knowledge in biotechnology from universities to German industry, thus facilitating the commercialisation of biotechnology research into products and processes. In particular, the scheme supports:

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<sup>8</sup> The BioRegio programme is now being considered as a model for other clusters in Germany (eg. transport technologies and logistics).

- Cooperation between research institutions and medical centres in the area of research and testing;
- Help in management issues for start-up biotechnology firms;
- A network to exchange experiences within workshops and conferences; and
- Privileged funding from federal research funds.

As with Austria, Germany's federal system of government means that each Lander has a high degree of autonomy to pursue its economic policies. Various cluster initiatives are, therefore, actively pursued by regions across Germany, most notably in North Rhein Westfalen (NRW), Barvaria and Baden Wurtemberg. NRW, for example, has been very proactive in promoting the development of its new media and telecommunications clusters which is centred around Dusseldorf and Cologne. In particular, industrial policy in NRW has established a so-called media initiative, aiming at both fostering communication and supporting firms and consortia to realise new media projects (Heinze et al, 1998).

### **The Netherlands (cluster-specific)**

The clusters concept is seen as a central goal of economic policy in the Netherlands. The main actor involved in promoting clusters at the national level is the Ministry of Economic Affairs. Given the size of the country clusters are normally viewed on a national level (Wever and Stam, 1999). In 1990, the Ministry commissioned a Dutch 'Porter' study to assess the economic strength of the economy as a whole and a selection of clusters. Since then, mapping and cluster analysis studies have been conducted and supported by the Ministry. In sectors such as telematics and telecommunications, discussion platforms have been organised with industry to discuss common bottlenecks and opportunities for the future. In the Netherlands, clusters are also seen as key element of national technology policy and technological foresight exercises have also been performed for various clusters. Indeed, most of the measures put in place over the last five years either apply to industry in general or are aimed at stimulating the development of technological innovation projects by consortia of industry, research and end-users (Boekholt and Thuriaux, 1999).

In 1997, the Ministry of Economic Affairs published its first White Paper on cluster policy: *Opportunities Through Synergy: The Public Sector and Innovative Clustering in the Market*<sup>9</sup>. The White Paper distinguishes four main roles for the public sector when promoting clusters:

- To create favourable framework conditions for industry and services in general;
- To act as a broker in identifying cluster opportunities by bringing together supply and demand;
- To provide strategic intelligence for industry; and
- To operate as demanding customer in the provision of societal needs.

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<sup>9</sup> For more information check the Ministry for Economic Affairs website @ <http://info.minez.nl/ezenglish/>

The Netherlands also has a number of RDAs who are actively pursuing cluster-based development policies, such as the LIOF (the Regional Development Agency for Limburg). However, the Ministry of Economic Affairs is not fully aware as to the extent and nature of these activities.

## **Scandinavia**

### *Denmark (cluster-specific)*

Denmark has been actively pursuing a clusters approach to industrial development for a number of years using a cluster-specific approach. In particular, Denmark has deployed the concept of 'resource areas' for a number of years. This approach seeks to move away from traditional forms of industrial policy such as support for individual businesses, to a system of fostering networks which will maintain and increase the competitive position of entire industrial clusters. In principal the entire economy was divided up into eight broad resource areas: services, agro/food, construction, environment/energy, transport/communication, medical/health, consumer goods, tourism/leisure and general suppliers.

As in the Netherlands, discussion platforms involving industry associations and the Council for Industrial Development have been organised to discuss common bottlenecks and opportunities for the future. Within each of the areas mentioned above, the Danish Ministry of Business and Industry set up a dialogue with a group of key people from industry, research, business associations and other related organisation. Following this, cluster mapping exercises were performed for the entire economy as a whole. A key to the success of the resource area approach is that it requires the involvement of a number of Ministries in the implementation of dialogue outcomes (Boekholt and Thuriaux, 1999). Five core areas for potential policy were defined:

1. Government regulation
2. Access to knowledge
3. Access to capital
4. Interaction between the public and the private sector
5. Conditions for international competition

### *Sweden (cluster-informed)*

There is little explicit acceptance of a clusters approach to economic development at the national level in Sweden. Although Sweden undertook various cluster mapping exercises, including the original Porter study, these have not, to date, had a significant impact on its industrial or innovation policy (Boekholt and Thuriaux, 1999). However, the Ministry of Industry, Employment and Communications and NUTEK are currently examining the concept once again.

Where a clusters approach is being utilised in Sweden, it is within ‘bottom-up’ regional development strategies. For example, each county in Sweden has just drawn up ‘Regional Growth Agreements’ (RGAs). These new growth agreements are a clear sign of the Swedish government’s desire for greater decentralisation in the regional policy. The growth agreements also reflect a growing desire on behalf of the Swedish government that regional policy becomes more growth-oriented and less concerned with alleviating regional disparities. Adopted in each region across Sweden, the growth agreements aim to achieve improved cooperation and a comprehensive approach between different policy areas and bodies which work with measures promoting growth and employment within regions. The government wants these agreements to foster greater cooperation between different policy areas so that sector-specific central government expenditure maximises regional growth and prosperity.

The growth agreements are drawn up by the local state bodies, in close collaboration with other local partners such as representatives of the local business community, chambers of commerce, municipalities, and county councils. Although the main purpose of the agreements is to get local partners to agree on measures to be taken and on the best way to coordinate state resources at the local level on a bottom-up basis, the government also expects that national agencies (eg. NUTEK) will work together to deliver these agreements. A recent evaluation of the growth agreements found that many were broadly similar in nature and nearly all adopted a clusters approach when undertaking a SWOT analysis of their local economies.

RDAs in Sweden are also implementing cluster-informed policy approaches. One of the most pro-active actors in this respect is the East Sweden Development Agency. The East Sweden region is a very dynamic region with a host of world-class research facilities and a clusters approach is being applied to its inward investment and commercialisation policies.

#### *Finland (cluster-specific)*

In Finland, cluster analysis and cluster-based policies have been applied at both the national and regional levels and the clusters concept is now widely accepted in Finland (Rouvinen and Yla-Anttila, 1999). The main driver promoting the concept has been the national level, Ministry of Trade and Industry. A major national cluster study during the early 1990s was conducted (Advantage Finland). This identified strong clusters (forestry), fairly strong clusters (base metals and energy), potential clusters (telecommunications, environment, well-being, transport and chemicals) and defensive clusters (construction and foodstuffs). Many observers argue that ‘Advantage Finland’ provided a much needed new vision for the economy, reshaping policy-making and practices nation-wide (Steinbock, 1998). In particular, this national cluster study has encouraged regional and local industrial associations and private businesses to take a more proactive role in improving their operating environment (Rouvinen and Yla-Anttila, 1999).

Furthermore, recent government decisions have showed a willingness to increase R&D funding to the sectoral ministries for various cluster programmes. There are

now cluster research programmes for telecommunications, foodstuffs, transportation, environment, forestry and health care. Analysts conclude that the main impact this transformation has had is on Science and Technology policy which has reoriented towards a focus on developing science centres which focus upon Finland's emerging technological clusters (Rouvinen and Yla-Anttila, 1999).

## **UK**

### *England (cluster-informed)*

Previously, the UK showed little interest in cluster-based policies at the national level. However, considerable interest is now being shown in the clusters approach. The Labour government's recent competitiveness White Paper makes explicit reference to the potential role played by clusters in fostering both national and regional competitiveness (DTI, 1998). Presently, the DTI has been the main player examining the potential of clustering in the UK as a whole. Under the supervision of Lord Sainsbury, Minister for Science, the DTI established a working group of policy-makers and academics to examine the UK biotechnology sector and benchmark this against the US biotechnology sector. The research identified ten critical factors that encourage cluster development (see Table 1 below). It also made specific recommendations for developing the UK's biotechnology cluster (see DTI, 1999).

At the regional level in England, cluster initiatives are being implemented on a rather piecemeal basis. Clearly, informal or cluster-informed initiatives are already evident in parts of England (see Table 2). Most notably, Cambridgeshire has been very proactive and dynamic in promoting a cluster approach to developing its local industry, especially in the high-tech areas of software and biotechnology. Many of these initiatives have involved the establishment of new institutions which bring industry, venture capital, researchers and the public sector together. The government-funded 'Eastern Region Biotechnology Initiative', for example, is viewed as being highly successful at promoting networking within the local cluster (Keeble et al, 1999). So far, it has held a conference to promote the region and conducted a survey of the cluster and its needs. This body received assistance under the DTI's Biotechnology Mentoring and Incubator Challenge.

**Table 1: Factors Encouraging Cluster Development**

Strong science base	Leading research organisations: University departments, hospitals/medical schools and charities Critical mass of researchers, World leading scientist(s)
Entrepreneurial culture	Commercial awareness and entrepreneurship in Universities and research institutes, Role models and recognition of entrepreneurs Second generation entrepreneurs
Growing company base	Thriving spin-out and start up companies More mature 'role model' companies
Ability to attract key staff	Critical mass of employment opportunities Image/Reputation as biotechnology cluster Attractive place to live
Premises and infrastructure	Incubators available close to research organisations Premises with wet labs and flexible leasing arrangements Space to expand, Good transport links: Motorways, Rail, International airport
Availability of finance	Venture Capitalists, Business angels
Business support services and large companies	Specialist business, legal, patent, recruitment, property advisors, Large companies in related sectors (healthcare, chemical, agrifood)
Skilled workforce	Skilled workforce, Training courses at all levels
Effective networking	Shared aspiration to be a cluster. Regional trade associations. Shared equipment and infrastructure Frequent collaborations
Supportive policy environment	National and sectoral innovation support policies Proportionate fiscal and regulatory framework Support from RDAs and other economic development agencies, Sympathetic planning authorities

**Table 2: Sector/Cluster Orientation in UK Regions**

<i>Region</i>	<i>Organisation</i>	<i>Cluster focus</i>	<i>Cluster methodology</i>
Scotland	Scottish Enterprise	Food and drink Oil and gas Biotechnology Semiconductors	Focus groups, co-ordinating policy initiatives along cluster lines (eg. skills, technology)
Wales	Welsh Development Agency	Automotive sector, consumer electronic sector, medical devices and diagnostics sector, telecommunications equipment sector	Supply chain initiatives; links to centres of excellence
Northern Ireland	Northern Ireland Growth Challenge	Engineering, food processing, health technologies, software, textiles and apparel, tourism and leisure, tradable services	Supply chain initiatives; creating new industry forums; developing better university-industry linkages.
North East England	Northern Development Company: Real Service Centre	Automotive, off-shore, food, electronics, business services	Varied top-down and bottom-up initiatives, but primarily agency-led

*Source:* Adapted from Legendijk and Charles (1999)

The onset of new RDAs in England will probably see an increase in regional cluster development strategies. In fact, the DTI (1999) recommends that the new English RDAs adopt a similar approach towards cluster development as in Scotland. In particular, the working group advocated that the new RDAs look at improving the environment for cluster growth, for example by addressing skills, planning, supply chain and inward investment issues.

#### *Wales (cluster-informed)*

The Welsh Development Agency (WDA) has not officially embraced the cluster approach to economic development, but some aspects of its sector-based policies are very much akin to a clusters approach (see Table 2). In particular, the WDA has concentrated its policy support on major sectors in the Welsh economy, most notably automotive engineering and electronics and various emerging sectors such as multimedia, medical, food and financial services (see Cooke, 1998; Legendijk and Charles, 1999). The main policy focus of the WDA has been to promote linkages between foreign-owned firms and local suppliers in these sectors. Facilitating technology-transfer between the HEI sector and business sector has also been a major policy area. The WDA has played an important role at facilitating clustering in these



priority sectors by kick-starting the network process and building-up indigenous supply chains, through forums, clubs and partnerships (Huggins, 1997).

#### *Northern Ireland (cluster-informed)*

The main body responsible for economic development in Northern Ireland is the Department of Economic Development. During the mid-1990s, the Department of Economic Development examined a clusters approach to economic development and established Northern Ireland Growth Challenge (NIGC) in 1995. This body is a private-sector led initiative operated by the Northern Ireland wing of the CBI in conjunction with other social partners. It receives funding from the Department of Economic Development and the EU under the special programme for Peace and Reconciliation.

NIGC seeks to work with and develop the following clusters: construction, tourism, food processing, engineering, software, health technologies, textiles and tradeable business services. As noted previously, these very wide cluster areas have been criticised by some (Enright, 2000). The main objectives of this body is to build world-class firms/clusters, create networks of common interest, develop human resources and market Northern Ireland to the world. Its main activities to date have been fostering new networks of companies in these cluster areas. For example, within the engineering cluster it helped to establish a Northern Ireland Aerospace Consortium, which is a group of companies who cooperate to identify and develop new business opportunities world-wide in the aerospace industry.

To date, nearly 200 companies have been associated with NIGC in different cluster activities however, according to some observers within the Department of Economic Development, NIGC has been somewhat disappointing regarding its progress with the implementation of a genuine cluster-based approach in the province.

## Annex 4: Cluster analysis techniques

The following are just some of the techniques which are utilised to measure and assess clusters:

- *Input-output analysis* is used to identify trading relationships between different actors within an economy. It is used to illustrate buyer-supplier relationships within and between clusters. Regional economists use a range of methodologies such as triangularization and factor/principal components analysis for sorting industries into input-output linkages.
- *Graph analysis*, founded in graph theory, is similar to input-output analysis and identifies cliques and other network linkages between firms or industry groups.
- The *location quotient* is the share of jobs that one industrial sector has in a region in proportion to the sector's share of all the jobs in the country or region as a whole. Location quotients exceeding 1.25 are usually taken as initial evidence of a regional specialisation in a given sector.
- *Revealed comparative advantage* measures the country's share of exports from each sector in relation to exports of all manufacturing sectors, and compared to the average in the 13 OECD countries. National clusters are to be found in industries with a high export rate, measured by the OECD's revealed comparative advantage index. For example, if a country has a revealed comparative advantage of more than 8.5 in shipbuilding, the country has 8.5 times high a share of shipbuilding exports as the average OECD country.
- The majority of cluster-related research into regional clusters/production systems often deploys a *case study approach or expert opinion approach*. Regional experts –industry leaders, public officials, and other key decision-makers- are important sources of information about regional economic trends, characteristics, strengths and weaknesses. Industry association reports, newspaper articles and other published documents are also used when undertaking an expert opinion approach. This approach is often utilised using Porter's diamond approach (Roelandt and den Hertog, 1999).

Each measurement technique, on their own, have limitations. Input output analysis is only really useful for identifying clusters which are made up of buyer-supplier value chains which include final market producers and first, second and third tier suppliers that directly and indirectly engage in trade. The same criticisms also apply to graph analysis. Location quotients say little about the inherent characteristics of regional industry clusters. Furthermore, cluster studies that rely solely on location quotients to identify clusters are simply sector studies in disguise because they offer no insight into interdependencies between sectors (Feser, 1998). Revealed comparative advantage is only useful in certain circumstances owing to the fact that data is often only available for national rather than regional economies. Meanwhile, case study analysis provides us with in-depth insight into the mechanisms which have created various clusters and the methods of production used. However, case studies alone cannot provide information about the quantitative importance of regional clusters.

## **Annex 5: Glossary**

**Organic** cluster strategies seek to broaden and deepen a region's existing economic base.

**Transplant** clusters build clusters by attracting inward investment.

**Dense** clusters can be populated by hundreds of firms with total sales reaching hundreds on millions/billions dollars.

**Sparse** clusters do not have the same economic weight, either because they have fewer firms or fewer substantial firms.

**Broad** clusters provide a variety of products in closely related industries.

**Narrow** clusters consist of one of a few industries and their supply chains.

**Deep** clusters contain complete or nearly complete supply chains.

**Latent** clusters have a critical mass of firms in related industries, but have not developed the level of interaction and information flows necessary to fully benefit from co-location.

**Potential** clusters are those that have some of the elements necessary for the development of successful clusters, but where these elements must be deepened in order to benefit from the impact of agglomeration.

**Policy-driven** clusters are those which have developed primarily as a consequence of government policy (eg. through the attraction of FDI).

*Source:* Enright (2000).

## Annex 6: A Typology of Scotland's Pilot Clusters

<i>Cluster Characteristics</i>	<i>Biotechnology</i>	<i>Semiconductors</i>	<i>Food &amp; Drink</i>
Origin of Industrial Base	Organic	Transplant	Organic
Geographic Scope	Dispersed	Localised	Dispersed
Number/size and importance of firms	Sparse	Sparse	Dense
Breadth & Depth	Broad Shallow	Narrow Shallow	Broad Deep
Innovative Capacity	High innovation	Low innovation	Low innovation
Cluster Governance	All ring, No core (Research-led)	All core, No ring (MNE-led)	All ring, No core (SME-led)
Coordinating Mechanisms	Public-Private (BioAlliance)	SE (initially)	SE (initially)
Overall State of Cluster Development	Potential	Policy-driven	Latent

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The special issue on the "Geography of Innovation and Economic Clusters: Evidence from Russia" is held in order to provide insights on the theoretical elaboration and practical implementation of the cluster concept in the regions of the Russian Federation. Multidimensional nature of the phenomenon of economic clustering has led to the need for a transdisciplinary approach in studying the features of spatial distribution of regional economic entities and institutions of the region in the framework of knowledge economy. We actually do not know the number of clusters. There are several methods to select  $k$  that depends on the domain knowledge and rule of thumbs. Elbow method is one of the robust one used to find out the optimal number of clusters. In this method, the sum of distances of observations from their cluster centroids, called Within-Cluster-Sum-of-Squares (WCSS) . This is computed as. "Practice what you preach" seems to have been the leading principle of Theo Roelandt and Pim den Hertog, the co-ordinators of the OECD Focus Group work and the editors of this book. I would like to thank them for having efficiently managed this "cluster" of experts and policy makers and fulfilled the ambitious goals of the Focus Group. Innovation and the upgrading of productive capacity is a dynamic social process that evolves most successfully in a network in which intensive interaction takes place between those "producing" and those "purchasing and using" knowledge. His "cluster theory"™ has become the standard concept in the field, and policy-makers the world over have seized upon Porter's™ cluster model as a tool for promoting national, regional, and local competitiveness, innovation and growth. But the mere popularity of a construct is by no means a guarantee of its profundity. Seductive though the cluster concept is, there is much about it that is problematic, and the rush to employ "cluster ideas"™ has run ahead of many fundamental conceptual, theoretical and empirical questions. Our aim is to deconstruct the cluster concept in order to reveal and highlight... This review will present an overview of the current research on clusters and cluster-based economic development. It is organized in three parts: First, we look at the conceptual foundations of the cluster approach. Clusters are groups of companies and institutions co-located in a specific geographic region and linked by interdependencies in providing a related group of products and/or.