



*The Australian Centre for Innovation Limited*

# **Clusters: A Review**

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by

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## ***Executive Summary***

Clusters have become recognised as a potentially effective mechanism for enhancing competitive advantage, and government around the world have sought to develop mechanisms to identify actual and potential clusters and to promote their formation and operation.

There are a variety of types of cluster; the most fundamental distinction is between *trade-driven clusters*, where the emphasis is on trade between the members of the cluster and on collaborating in pre-competitive activities, and *knowledge-driven clusters*, where the benefits are based on access to new knowledge emerging from research organisations, and knowledge held by other firms; on this basis, a typology of clusters has been developed.

Clusters enhance economic performance through increases in the productivity of member organisations, driving the pace and direction of innovation, stimulation of the formation of new businesses, and access to new knowledge and learning.

A variety of approaches have been developed to map clusters, each of which captures only a part of the phenomenon; the most developed are input-output analysis, geographic concentration analysis and case studies; much further development is needed.

There have been many studies of clusters in Australia which identify key factors in the development of clusters, with a particular emphasis on their role in regional development.

Upwards of sixty real and possible clusters have been identified and undoubtedly there are claims for more. However the number of well-established, demonstrably effective clusters is much more limited..

It is evident from the many studies that clusters cannot be artificially 'manufactured'. However conditions can be established which facilitate the formation of clusters and their contribution to economic value.

## **1. Introduction**

This review of the concept and practice of industrial clusters was carried out in the context of the DEST 'Mapping Australia's Science and Innovation System' exercise. The objective of the latter is "to take stock of Australian science, technology and innovation by developing a comprehensive overview in terms of resources, players, linkages and performance."

The requirements of this project were to:

- develop a conceptual analysis of the nature and form of clusters;
- identify the various roles of clusters and the nature of their additionality in industrial performance;
- review Australian studies of clusters with a particular emphasis on assessments of strengths and weaknesses;
- develop a definition of a cluster workable in the context of the project to map Australia's science and innovation system; and
- provide an overview of clusters in Australia, their relative performance, and the factors that emerge as being critical for success.

Interest in the concept of industrial clusters, and attempts to establish them, have grown substantially over the past 5-8 years. A current Google search identified almost 20,000 international documents and more than 5,000 in Australian sites.

The drivers for this growth have been the conditions for achieving national and firm-level competitiveness in the emerging knowledge economy. In particular, the need to access knowledge and learning, to effectively innovate, and to achieve benefits of scale beyond a firm's capacity, places a great pressure on firms to look beyond their own resources by linking with other firms and organisations.

Increasing complexity, costs and risks in innovation are enhancing the value of inter-firm networking and collaboration in order to reduce moral hazard and transaction costs, spurring a multitude of partnerships between firms with complementary assets, in addition to traditional market-mediated relations.<sup>1</sup>

In addition to increased interaction with other firms, there is also a growth in interaction between firms and other organisations involved in the innovation process, such as universities, government research agencies, consultants and technical service providers.

## **2. Historical Development of Cluster and Related Concepts**

Clusters have long been part of the economic landscape, with geographic concentrations of trades and industries apparent long before the Industrial Revolution. Attention was first drawn to the phenomenon by the Cambridge economist Alfred

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<sup>1</sup> OECD, *Boosting Innovation: The Cluster Approach*, Paris, 1999, p.7

Marshall<sup>2</sup> in 1890, who noted the tendency for specialised companies to be concentrated in 'industrial districts'. Schumpeter<sup>3</sup>, in his now highly influential exposition on the role of entrepreneurs and the 'creative forces of destruction' in economic activity, noted the evidence of clustering of innovation activities.

However it was Michael Porter's<sup>4</sup> seminal analysis of the competitive advantage of nations, and why some countries produce, relatively, so many more competitive firms, that brought the concept of industrial clusters to the attention of both analysts and policy-makers. The competitive advantage of firms is presented as resulting from the operation of a 'diamond' of four interacting forces - factor conditions, demand conditions, firm strategy, structure and rivalry, and related and supporting industries. It is the last of these that points toward the remaining importance of location, and an explanation for the well-known success of Silicon Valley in electronics, and Hollywood in the film industry.

Today's economic map of the world is dominated by what I call *clusters* - critical masses, in one place, of unusual competitive success in particular fields. Clusters are a striking feature of virtually every national, regional, state and even metropolitan economy, especially in more economically advanced nations. Clusters are not unique, they are highly typical, and therein lies a paradox: the enduring competitive advantages in a global economy lie increasingly in local things - knowledge, relationships, motivation.<sup>5</sup>

But it is more than just 'local things'; it is a shift from a focus on the performance of the firm, to inter-firm linkages. In the context of the knowledge economy, industry specific knowledge is becoming cumulative and embedded in a particular region or area rather than in a specific firm.<sup>6</sup>

When all the elements of the 'diamond' are working effectively,

Benefits flow forward, backward and horizontally. Aggressive rivalry in one industry tends to spread to others in the cluster, through the exercise of bargaining power, spinoffs and related diversification. Entry from other industries within the cluster spurs upgrading by stimulating diversity in R&D approaches... Interconnections within the cluster lead to new ways of competing and entirely new opportunities.<sup>7</sup>

For the record, Porter's 1990 analysis only incidentally addresses propinquity as a factor in successful clusters.<sup>8</sup>

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<sup>2</sup> Marshall, Alfred, *Principles of Economics*, Macmillan, London, 1920 (8<sup>th</sup> edition)

<sup>3</sup> Schumpeter, J.A., *The Theory of Economic Development*, Harvard University Press, 1934 (translated from 1919 German edition)

<sup>4</sup> Porter, M. E., *The Competitive Advantage of Nations*, Macmillan, London, 1990.

<sup>5</sup> Porter, M. E., 'Clusters and the New Economics of Competition', *Harvard Business Review*, November-December 1998, p.78.

<sup>6</sup> Enright, M. J., 'Regional Clusters and Firm Strategy', in Chandler, A.D., Hagstrom, P., and Solvell, O., eds., *The Dynamic Firm: The Role of Technology, Strategy, Organization, and Regions*, Oxford University Press, 1998, p.322.

<sup>7</sup> Porter, 1990, op cit, ref 4, p. 151.

<sup>8</sup> Marceau, J., 'Clusters, Chains and Complexes', in Dodgson, M. and Rothwell, R., eds., *The Handbook of Industrial Innovation*, Edward Elgar, Aldershot, 1994.

The 'first generation' of clusters largely resulted from the opportunities for economic transactions between firms. The benefits were explained in terms of economies of agglomeration:

Agglomeration economies consist of a local concentration of customers (or downstream firms) sufficient to permit suppliers to achieve economies of scale in production or distribution, great enough for local firms to amass sufficient demand to warrant the provision (usually by or via local governments) of specialised infrastructure, and large enough to realise specialised local division of labour.<sup>9</sup>

A typical first generation cluster consists of a large demanding purchaser, such as a major multinational firm, or a hospital, surrounded by a 'halo' of suppliers.

However, in the context of the knowledge economy, the emphasis of 'second generation' clusters has shifted to learning and knowledge access:

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. As a result, there is an increasing focus on the efficiency and efficacy with which knowledge is generated, diffused and used, and on the dynamics of the related networks of production and innovation.<sup>10</sup>

While there has been a great emphasis on physical co-location, it should be recognised that co-location may assist, but it will not guarantee collaboration. Many of the failures of technology parks and incubators can be traced to assumption that mere propinquity would generate effective interaction, ignoring the need for the players to see commercial value resulting from the interaction.

At the other extreme, advances in telecommunication, particularly the Internet, and global distribution systems, have raised the possibility of virtual clusters. These may take the form of predominantly international clusters based on emerging technologies, or "communities bounded and bonded by values which create an ability to share ideas easily across great distances".<sup>11</sup>

Clusters can be viewed as a subset of networks. These can be considered as an:

Open system of inter-connected firms and institutions with related interests. Networks offer a rich web of channels, many of them informal, and have the advantage of high source credibility: experiences and ideas arising from within the network are much more likely to be believed and acted upon than those emerging from outside.<sup>12</sup>

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<sup>9</sup> Porter, M.E., *On Competition*, Harvard Business Review Book, 1998, p.213.

<sup>10</sup> Roelandt, T., and den Hertog, P., 'Cluster Analysis and Cluster-based Policy Making in OECD Countries, Chapter 1, p.9, in OECD, 1999, op cit, ref 1.

<sup>11</sup> Quoted in Howard, J. H., *Audit and Review of Science, Technology and Innovation Infrastructure in Victoria*, Department of State and Regional Development, Melbourne, 2000, p.34.

<sup>12</sup> Marceau, J., and Dodgson, M., 'Systems of Innovation', Paper No 1, Innovation Summit, Department of Industry, Science and Resources, Canberra, 1999.

Relationships generated by network interaction include social relationships based on trust, market relationships based on contracts, and exchange relationships based on alliances.

However, clusters differ from networking in that those involved are linked in a value chain:

Clusters are an alternative way of organising the value chain. Compared with market transactions among dispersed and random buyers and sellers, the proximity of companies and institutions in one location and the repeated exchanges among them, fosters better coordination and trust... A cluster of independent and informally linked companies and institutions represents a robust organisational form that offers advantages in efficiency, effectiveness and flexibility.<sup>13</sup>

Other less commonly used terms are 'chains of production' in which the economic structure is composed of chains of interlinked companies, and 'complexes', made up of formal and informal networks of cooperation between firms, public sector research organisations, users and regulators.<sup>14</sup>

### **3. Definitions and Characteristics of Clusters**

As the concept of the cluster has become increasingly popular, and used to pursue a wide variety of objectives, so have definitions multiplied. Some emphasise location, some industry sector, and others innovation. Ostensive definitions are commonplace - 'like Silicon Valley', 'like the California wine cluster or the Italian leather fashion cluster', etc. The common theme is that it is the linkages between firms and other organisations that provide the economic value of clusters.

Porter has defined a cluster fairly consistently, over ten years, as: a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities.<sup>15</sup>

To this, various descriptive statements are added. Most recently, these took the following form:

The geographic scope of a cluster can range from a single city or state to a country or even a network of neighbouring countries. Clusters take varying forms depending on their depth and sophistication, but most include end-product or service companies, suppliers of specialised inputs, components, machinery, and services; financial institutions; and firms in related industries. Clusters also often include firms in downstream industries; producers of

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<sup>13</sup> Porter, op cit, ref 5, p. 80.

<sup>14</sup> Marceau, 1994, op cit, ref 8.

<sup>15</sup> Porter, op cit, ref.9, p.199.

complementary products; specialised infrastructure providers, government,... universities and standard-setting agencies.<sup>16</sup>

The lack of operational precision in this definition is reflected in Porter's comment that:

Drawing cluster boundaries is often a matter of degree, and involves a creative process informed by understanding the most important linkages and complementarities across industries and institutions to competition. The strength of these 'spillovers' and their importance to productivity and innovation determine the ultimate boundaries.<sup>17</sup>

An alternative to Porter, but addressing the same issues is that of Rosenfeld<sup>18</sup>:

A geographically bounded concentration of similar, related or complementary businesses, with active channels for business transactions, communications and dialogue, that shares specialised infrastructure, labour markets and services, and face common opportunities and threats.

The OECD has produced a different working definition, placing greater emphasis on the knowledge dimension:

Clusters are characterised as networks of production of strongly interdependent firms, knowledge-producing agents and customers linked to each other in a value-adding production chain.<sup>19</sup>

Moreover it is the synergy resulting from the combination of complementary knowledge from different sources that drives the formation of clusters. The benefits are enhanced innovation arising from interactive learning processes based on knowledge exchange, interaction and cooperation among members of a value chain.

For consultants promoting the formation of clusters, they are nothing more than:

a group of businesses or organisations that can benefit by doing things together.<sup>20</sup>

For those whose business is regional economic development, an industry cluster is:

a regional concentration of competing, complementary and interdependent firms that create the wealth of regions through exports<sup>21</sup>

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<sup>16</sup> Ibid

<sup>17</sup> Ibid, P.202

<sup>18</sup> Rosenfeld, S., *Overachievers: Business Clusters that Work*, Regional Technology Strategies Inc, quoted by Houghton, J., "Issues in Clustering and Clustering Studies", presented to the Australian ICT Industry Cluster Studies Design Workshop, Melbourne, 2000 - <http://www.cfes.com/clusters.htm> (accessed March 2003).

<sup>19</sup> OECD, 1999, op cit, ref1, p.157.

<sup>20</sup> for example, <http://gippsland.com> (accessed March 2003).

<sup>21</sup> <http://business.unisa.edu.au> (accessed March 2003).

for whom membership within the group is an important element of each member firm's individual competitiveness.<sup>22</sup>

There have been a number of attempts to develop typologies of clusters. Marceau has identified:

- 'horizontal clusters' between small and medium-sized firms in an industry sector that both compete and collaborate with each other;
- 'web clusters' between large firms and their core suppliers;
- 'virtual clusters', where physical co-location is not important; and
- 'emerging clusters', where firms have a common resource base or resource needs, but have only emerging relationships in production and innovation.<sup>23</sup>

There is also recognition that clusters may raise interest and be considered at different levels - for example at the national level, industry or inter-industry level and firm level, or geographically, at the metropolitan, producer region and rural level.

What emerges clearly is that there is no single, standard, 'one size fits all' model of clusters. Every country and region has a different set of clusters, shaped by historic background, national characteristics, the strength of the knowledge base, size, connectedness, R&D intensity and share of innovative products.<sup>24</sup>

However, it may be useful to develop a standard typology of clusters, not least to reduce the confusion between the claims of the many proponents for whom cluster status has become an important objective.

The first dimension upon which clusters can be differentiated is whether they are primarily *trade-driven* or *knowledge-driven*. The former are based on enhancing business opportunities within the cluster, either through direct trade, or by pooling resources to compete for export markets.

The latter are based on opportunities for learning from a variety of different knowledge sources. They include clusters which develop around knowledge-producing institutions such as universities and government research agencies, but also inter-linked firms, suppliers and customers, where the primary benefit of the linkage is the sharing of knowledge and learning.

Within *trade-driven* clusters two types can be distinguished: *horizontal* clusters, in which the members, operating in the same end-product market, cooperate in pre-competitive activities such as R&D, collective marketing and purchasing;<sup>25</sup> and *halo* clusters, in which a powerful and demanding purchaser, such as a large multinational or a major public sector organisation (defence department, hospital) attracts and shapes the activities of a variety of suppliers.

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<sup>22</sup> Larcombe, G., 'Australian Clusters', - <http://www.cfses.com/clusters.htm> (accessed March 2003).

<sup>23</sup> Marceau, J., 'The Disappearing Trick: Clusters in the Australian Economy', Chapter 6 in OECD, 1999, op cit, ref 1.

<sup>24</sup> Den Hartog, P., Bergman, E and Charles, D., 'Creating and Sustaining Innovative Clusters', Chapter 22 in OECD, *Innovative Clusters: Drivers of National Innovation Systems*, Paris, 2001.

<sup>25</sup> The OECD would regard these as networks, not clusters - op cit, ref 1, p.12.

Within *knowledge-driven* clusters, it may be useful to distinguish between those that are primarily concerned with knowledge held by firms, versus those drawing knowledge from public sector organisations. However, as the latter are increasingly operating commercially in managing their knowledge assets, this distinction may become increasingly blurred.

Finally, it may be useful to differentiate between *local/regional*, *international* and *virtual* clusters. Adoption of this typology would allow clusters to be categorised according to the following matrix:

**Table 1**

	<b>Geographic Character</b>		
	Local/Regional	International	Virtual
<b>Trade-driven</b> Horizontal Halo			
<b>Knowledge-driven</b> Private Public/private			

Application of this 2x3 or 4x3 matrix would allow clusters to be relatively clearly identified and differentiated, and appropriate measures of output and outcome applied.

#### **4. The Role and Contribution of Clusters**

As noted above in Section 2, clusters have emerged as a powerful new organisational tool for economic competitiveness. Porter emphasises that comparative advantage, while still operating, has much less power under the conditions of global competition. Increasingly it is competitive advantage, based on a superior (in terms of efficiency and effectiveness) use of inputs, that is crucial. However:

The sophistication with which companies compete in a particular location is strongly influenced by the quality of the local business environment.<sup>26</sup>

Clusters affect competition in three broad ways. The first is by increasing the productivity of companies within the cluster.

Being part of a cluster allows companies to operate more productively in sourcing inputs; accessing information, technology and needed institutions; coordinating with related companies; and measuring and motivating improvement.<sup>27</sup>

The productivity improvements are achieved through

- improved access to specialised and experienced employees and a deep, high quality supplier base;

<sup>26</sup> Porter, op cit, ref 5, p.80.

<sup>27</sup> Ibid, p.81.

- improved access to specialised market, technical and competitive information;
- complementarities, in the form of complementary products to meet customer needs, coordination to optimise collective profitability, in marketing, and in the breadth and scale of market which attracts buyers.

The second way in which clusters affect competition is by driving the pace and direction of innovation. The characteristics that enhance productivity can have an even more dramatic effect on innovation. Companies within a cluster have access to better information about changing customer needs, evolving technology, service and marketing concepts. But in addition they support the flexibility to respond rapidly to these changes, through lower cost experimentation.

Reinforcing the other advantages for innovation is the sheer pressure - competitive pressure, peer pressure, constant comparison - that occurs in a cluster. Executives vie with one another to set their companies apart.<sup>28</sup>

The third effect of clusters is through stimulation of the formation of new businesses. This occurs because the cluster itself represents a significant local market, the increased potential to identify new niche business opportunities, and the resources and skills to establish a new enterprise are on hand, including investment capital.

In summary:

A cluster allows each member to benefit *as if* it had a greater scale or *as if* it had joined with others formally, without requiring it to sacrifice its flexibility.<sup>29</sup>

The cluster concept incorporates the important dimensions of modern innovation:

- the importance of increasing returns to knowledge accumulation;
- recognition that this accumulation process is path-dependent, non-linear and shaped by the interplay of market and non-market forces;
- the importance of organisational innovation to design institutions and procedures capable of handling more complex interdependencies;
- the role of trust in avoiding escalation of transaction costs resulting from increased specialisation; and
- the role of cultural and institutional variety in boosting creativity.<sup>30</sup>

The cluster approach can be seen as part of the growing family of innovation systems-based analysis and decision-making. Indeed, OECD studies have suggested that an industrial cluster could usefully be thought of as a "reduced national innovation system" (NIS)<sup>31</sup> in which the essential system elements help stimulate the emergence of specific kinds of innovations in various segments of a national economy. In simple terms, a cluster is a mini-innovation system.

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<sup>28</sup> Ibid, p.83.

<sup>29</sup> Ibid, p.80.

<sup>30</sup> paraphrased from OECD, *Dynamising National Innovation Systems*, Paris, 2002, p.25.

<sup>31</sup> OECD, 2001, op cit, ref. 24, p.8.

In this way, clusters provide the variation and selection environments in which firms, intermediaries and knowledge organisations operate and innovate.

In Australia, with its strong public sector research organisations, there has been a determined policy emphasis over the past ten years to increase effective linkage to economic activity. Significant initiatives have included the Cooperative Research Centres and the ARC Linkage Grants. The former, in particular, have been seen as a mechanism for aligning public and private sector research and technology development interests. In the most recent round of CRC applications, the ability of a CRC to act as a specific catalyst to cluster formation was used as a selection criterion.

Research of the OECD Focus Group on Clusters suggests that advanced technology-based clusters, such as those for ICT, are generally 'boundaryless' and international, whereas more mature clusters typically function at a national or regional scale.<sup>32</sup> However this should not suggest that local clusters could not form in the technology-based areas, appropriately inked to the global industry.

The same group has identified a series of key factors in cluster development. These include:

- supportive framework conditions acting through market-based incentives;
- high levels of interdependency between firms;
- outsourcing to existing or new firms (the key determinant of cluster demography)
- innovation-friendly financial systems, in particular venture capital;
- corporate governance that favours innovation;
- supportive education and training systems;
- market-oriented innovation policy; and
- regional specialisation.<sup>33</sup>

It should be emphasised that clusters are not static. They grow, they evolve, they mature, and, in some cases, they die. Clusters can operate for decades if they are supported by a continuous process of renewal. And like any company, if they become rigidified and inward looking, they can be swept away by change. In particular, technological discontinuities may render a cluster's assets - market knowledge, technical expertise, staff skills, etc irrelevant.

The cluster concept offers a considerable advance on the traditional sector-based analysis of industrial performance. Standard industrial classification systems fail to capture a great deal of the interaction that occurs in clusters, and as such may provide a very misleading picture of industrial performance. New forms of analysis, and data collection, may be necessary.

The nature and role of clusters are also providing a useful framework for developing and applying new forms of governance, moving away from direct intervention towards forms of indirect inducement, facilitating networks and market-induced cluster formation and operation.

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<sup>32</sup> Ibid, p409-410.

<sup>33</sup> Paraphrased from OECD, 2001, op cit, ref24, p.28.

It is also claimed<sup>34</sup> that clusters reveal a mutual dependence and collective responsibility of business, knowledge organisations and government for creating the conditions for productive competition. Fresh thinking on the part of leaders is required, particularly with regard to 'who does what' in the economy. The distinction between public and private investment is becoming increasingly blurred.

In particular:

- Companies, no less than universities, have a stake in education;
- Universities have a stake in the competitiveness of local businesses; and
- Governments can achieve a great deal through information dissemination and intermediary facilitation.

## **5. Mapping Clusters**

A variety of tools have been applied in attempts to map clusters, largely imported from either economics or geography. Each captures a useful slice of cluster activity, but at the same time has severe limitations.

Initially, the major shaper of the choice of technique has been the availability of data. Use of existing national and international data sources for cluster analysis is limited, as the protocols were not designed to capture flow relations between different industries, or to measure dynamic interactions and linkages between industries and firms. However, as the limitations of these tools have emerged, a number of new approaches are in development.

The most commonly used technique is *input-output analysis*, based on measuring trade links between industry groups. Data has been collected and analysed for Australia, Belgium, Finland, Norway, Spain, Switzerland, and USA.<sup>35</sup> However, only in a few countries is the level of disaggregation sufficient to accurately identify cluster operation. In addition, trade data can only identify trade-based clusters, not knowledge-based ones.

A second category is *correspondence analysis* (for example, factor analysis, principal component analysis, multi-dimensional scaling and canonical correlation) which aims to identify groups or categories of firms or industries with similar innovation styles. One example, applied to Germany was based on the development of measures of the innovation intensity, knowledge base and sources of technological opportunities of firms, based on survey data.<sup>36</sup>

A third category, based on *graph analysis* used to develop innovation interaction matrices based on survey, or estimated, data on the flows of major innovations of using and supplying industries.<sup>37</sup> This approach appears promising, but is limited to 'major' innovations.

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<sup>34</sup> Porter, 1998, op cit, ref 9.

<sup>35</sup> See OECD, 1999, op cit, ref 1, Chapters 3, 6, 10 and OECD, 2001, op cit, ref.24, Chapters 12, 13, 16.

<sup>36</sup> OECD, 1999, op cit, ref 1, Chapter 4.

<sup>37</sup> Ibid, Chapter 2.

A fourth category is based on *analysis of geographic concentration and economic activity*.<sup>38</sup>

Finally, and most commonly, are qualitative case studies based on the Porter approach. While qualitative studies can be quite revealing, in descriptive terms, as evidenced by Porter's work, the lack of a quantitative component severely limits the comparability of the analysis.

Clearly, much progress remains to be made.

An interesting case of a national mapping study is provided by Finland.<sup>39</sup> Carried out in 1992, it followed closely Porter's approach, but with local adaptation. Export statistics over time, as a measure of international competitive advantage, were combined with industry knowledge, to identify a number of 'cluster skeletons' the members of which were mapped.

Consultation with experts, followed by a study of every member of the cluster with an emphasis on inter-linkages, led to the identification of ten clusters: forestry (classed as strong), base metals and energy (fairly strong), telecommunications, environment, well-being, transport and chemicals (potential clusters) and construction and foodstuffs (latent or defensive clusters).

An international survey of cluster mapping (Table 2) shows that most OECD nations have embarked on this exercise in one form or another.

**Table 2**

Country	Level of analysis			Mapping technique			
	Micro	Meso	Macro	I/O	Graph	Corresp.	Case
Australia		X				X	X
Austria		X	X			X	X
Belgium	X				X		
Canada		X	X	X			X
Denmark	X	X		X	X		X
Finland	X	X					X
Germany	X	X		X		X	
Italy		X		X			
Mexico		X	X				X
Netherlands		X	X	X			X
Norway		X	X	X			X
Spain		X		X			X
Sweden		X					X
Switzerland	X	X				X	X
UK	X	X					X
USA		X		X			X

<sup>38</sup> For example, OECD, 2001, op cit, ref 24, Chapter 14.

<sup>39</sup> OECD, 1999, op cit, ref 1, Chapter 15.

## 6. International Experience of Clusters

In association with the mapping survey reported above, respondents were asked to identify the clusters that had been identified. Given the varying definitions of clusters, and of techniques for identifying them, considerable caution should be applied to the interpretation of their results. Even with common definitions and methods, the fact that two countries report (or don't report) common clusters may have limited meaning. Moreover, the clusters are largely defined in traditional SIC terms. Nevertheless it is useful to present the data in Table 3. Perhaps the most that can be said is that on first sight, and as might be expected, different countries focus on different industrial clusters.

**Table 3**

Nation	Cluster																					
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
AUS			X				X			X	X	X	X									
AUT									X	X				X		X			X			X
BEL					X								X		X	X						
DK	X				X	X	X			X	X		X	X								
FNL	X	X			X	X	X			X	X		X	X					X			
GER		X			X			X		X			X		X							
NL	X	X	X	X	X	X	X	X	X	X	X											
NOR	X				X		X		X		X											
SP													X									
SWE	X				X		X			X			X	X		X				X	X	
USA	X	X			X		X	X		X			X	X	X						X	X

1-Construction. 2-Chemicals. 3-Commercial services. 4-Non-commercial services. 5-Energy. 6-Health. 7-Agro-food. 8-Media. 9-Paper. 10-Metal-electro. 11-Transport & Communication. 12-Biomedical. 13-ICT. 14-Wood & paper. 15-Biotechnology. 16-Materials. 17-General supplier. 18 Consumer goods/leisure. 19-Environmental. 20-Machinery. 21-Transport. 22-Aerospace.

Cluster strategies have been adopted as a regional economic development approach in the UK.<sup>40</sup> The initiatives are summarised in Table 4.

**Table 4**

Region	Cluster focus	Cluster methodology
Scotland	ICT (electronics, software, multimedia), energy food, textiles, tourism	Focus groups, coordinating policy initiatives along cluster lines
Wales	Automotive, consumer electronics, medical devices and diagnostics, telecommunications equipment	Supply chain initiatives, links to centres of excellence
Northern Ireland	Engineering, food processing, health technologies, software, textiles, tourism and leisure	
North East England	Automotive, food, electronics, business services	Top-down and bottom-up initiatives

<sup>40</sup> OECD, 1999, op cit, ref 1, Chapter 5.

A number of clusters have been established in the provinces of Canada, but particular attention has been directed to the high-technology cluster around Ottawa. The combination of a concentration of public sector research and the headquarters of Nortel have seen a substantial cluster grow over the past 10 years, with a focus on hardware, software and telecommunications. In all there were some 700 product companies in this cluster, and a further 200 firms providing consulting services.

The Ottawa cluster was largely a natural cluster, driven from the bottom under favourable framework conditions. Reinforcement of the growth of the cluster occurred through support of broker-type agencies.

In Spain, cluster initiatives have emerged almost exclusively at the regional level. One prominent example is Catalonia, where clusters have been identified and benchmarked against relevant competitors, study trips organised to introduce cluster managers to best practice elsewhere and appropriate supporting organisations introduced to the cluster.

Denmark has engaged in the mapping and formation of clusters over 15 years. Five clusters were subject to a Porter-type analysis from 1988-90 - agro-food, shipping, biotechnology/medical, 'technical' and mink. This was followed by micro-cluster initiatives in electro-medical instrumentation, furniture and pharmaceuticals. In the late 1990s eight 'resource areas (eg construction, energy, etc) became the focus of cluster development. The approach was to assist in cluster formation based on favourable local conditions.

As shown in Table 3, twelve clusters were identified in the Netherlands<sup>41</sup>, largely through input/output analysis. Further analysis enabled these clusters to be divided into four different types, the success of which depends on different factors. These are:

- Self-creating clusters (metals, electrical engineering, chemicals), largely reliant on their major investments in knowledge generation, and purchase know-how in other non-core technologies;
- Absorptive clusters (construction), heavily reliant on the knowledge base of their suppliers;
- Self-sufficient clusters (agro-food), in which companies absorb knowledge via intermediate deliveries, themselves largely created by public sector research;
- Knowledge intensifying sectors (commercial services), in which companies make use of research and technology to increase the knowledge intensity of their goods and services.

In Austria, the approach has been based on small coordinated schemes to reduce barriers and enhance capabilities through fostering links between research institutions and the private sector, reducing regulatory barriers, and promoting specific clusters.<sup>42</sup>

More recently, the OECD organised a conference to learn from experiences in ICT clusters and in mature clusters.<sup>43</sup>

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<sup>41</sup> Ibid, Chapter 13.

<sup>42</sup> Ibid, Chapter 14.

<sup>43</sup> OECD, 2001, op cit, ref 24.

As already noted ICT clusters have a largely international character from the outset, though they may have a strong local/regional presence. But different circumstances shape the cluster differently in different countries. The Finnish cluster is relatively complete though it relies on foreign sources for its R&D and non-technical knowledge. One consequence is that international ICT firms are increasingly using Finland as a test-bed for new technologies and services.

Ireland, lacking a national ICT champion like Nokia, has moved away from an exogenous development strategy towards one of embedding these firms into a local context and developing more indigenous firms, in order to create an indigenous growth cluster.

Denmark is part of a wider Nordic ITC cluster, in which it has traditionally played a role as an advanced user. In the Netherlands even a major firm like Philips sees itself as part of an international ICT cluster.

In the mature clusters, innovation is more advanced and complex than assumed by some. They often have highly specific innovation styles which need not be less advanced than those in high technology clusters. In clusters such as agro-food and construction, the knowledge base was relatively more application- and process-oriented. The linkages are more likely to be based on organisational and marketing knowledge.

## **7. Australian Studies of Clusters**

The first reference to clustering in an Australian academic paper was by Morkel in 1993,<sup>44</sup> in which he identified the importance of clusters to industrial output in Australia and the importance of developing local competencies to support the development of industry clusters.

However, Marceau may be regarded as the true pioneer of cluster studies in Australia, starting with her 1994 expository chapter in the Handbook of Innovation.<sup>45</sup> This was followed by an analysis of the requirements to establish a knowledge economy in Australia, and of the importance of clusters and knowledge networks to drive it.<sup>46</sup> More recently, she has used national input-output tables to demonstrate the hollowing out of many older industrial clusters.<sup>47</sup> Throughout this period, she led research on clusters in Australia in the areas of toolmaking, motor vehicles, textiles, clothing and footwear, and electronics.<sup>48</sup>

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<sup>44</sup> Morkel, A., 'Industry Clusters and Value-System Strategies for Australia' in Lewis, G., et al, eds, *Australian Strategic Management*, Prentice Hall, Sydney, 1993, pp388-399.

<sup>45</sup> Marceau, 1994, op cit, ref 8.

<sup>46</sup> Marceau, J, Sicklen, D and Manley, K., *The High Road or the Low Road*, Australian Business Foundation, Sydney, 1997.

<sup>47</sup> Marceau, 1999, op cit, ref 23.

<sup>48</sup> Reports can be found at <http://www.uws.edu.au/research/aegis> (accessed March 2003).

The most comprehensive paper on clustering in Australia, with a regional emphasis, is that by Roberts and Enright.<sup>49</sup> This paper introduces the tension between globalisation and localisation of industries and points to the levels of innovative performance in regional clusters. Cluster development initiatives overseas are reviewed, as well as national, State and local government initiatives in Australia. Three short case studies are presented leading to conclusions about lessons for the future. In addition, Roberts has examined the core competencies and risks affecting the competitiveness of industry clusters in the Far North Queensland region, and the food processing industry in Melbourne.<sup>50</sup>

A variety of other studies have been made of clusters in Australia, some by academic researchers and many by consultants. Brief summaries of these are presented below in author alphabetical order.

Brown, a long-time advocate of clusters, drawing on academic research, reported on Australian regional clusters in order to raise awareness of their value in promoting regional economic development.<sup>51</sup> In a presentation to an OECD conference, he described over 70 regional cluster initiatives in Australia.<sup>52</sup>

Davenport has used geographic information systems as an alternative technique to map industry clusters.<sup>53</sup>

Forde has written extensively on the design, development and implementation of industry clusters in South Australia. While this program has not been without its difficulties, it is claimed to have been effective in making people more aware of supply chains and in boosting exports. Costs are estimated at \$2.7 million per annum (over a period of 8 years) and cumulative financial benefits at \$475 million - a handsome twenty-fold return!<sup>54</sup>

Genoff has written extensively on, and managed the development of clusters in South Australia, and most recently on devolution and clusters at the 5<sup>th</sup> Global Conference of the Competitiveness Institute in Cairns.<sup>55</sup>

Henckel has mapped the development of an audiovisual and creative industry cluster in the Northern Rivers region of NSW, largely driven by lifestyle and cultural ambitions, and facilitated by convergent telecommunications.<sup>56</sup>

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<sup>49</sup> Enright, M J, and Roberts, B., 'Regional Clustering in Australia' available at [http://cities.canberra.edu.au/pub\\_papers.html](http://cities.canberra.edu.au/pub_papers.html) (accessed March 2003).

<sup>50</sup> Roberts, B., *Benchmarking the Competitiveness of the Far North Queensland Regional Economy*, Queensland University of Technology, Brisbane, 2000.

<sup>51</sup> Brown, R., 'Industry Clusters in the Australian Context' presented to Australian and New Zealand Regional Science Association, Canberra, 1996.

<sup>52</sup> Brown, R., *Clusters, Innovation and Investment: Building Global Supply Chains in the New Economy*, Australian Project Developments P/L, Canberra, 2000.

<sup>53</sup> Davenport, P., 2000 at <http://www.cfses.com> (accessed March 2003).

<sup>54</sup> Forde, H at <http://business.unisa.edu.au> (accessed March 2003).

<sup>55</sup> Genoff's articles appear in [www.loc-gov-focus.aus.net](http://www.loc-gov-focus.aus.net); the Cairns conference program can be found at <http://www.competitiveness.org> (accessed March 2003).

<sup>56</sup> Henckel, C, Queensland University of Technology, available at <http://www.regionalartsnsw.com.au> (accessed March 2003).

Houghton has examined issues in clustering and cluster studies in the particular case of the ICT industry and the contribution that clusters can make to industry development.<sup>57</sup> Most recently he has been examining, with Thorburn, the emergence of an ICT cluster in Western Sydney.

Howard has applied the cluster concept in an audit of science, technology and innovation infrastructure in Victoria, and identified a number of geographic clusters.<sup>58</sup> Larcombe has characterised clusters according to whether they are based on 'propulsive' industries, OEM led, based on a knowledge-intensive incubator or an SME network. Constraints he identifies on cluster formation in Australia are:

- the historical legacy of State-based economic development;
- the lack of economies of scale;
- the strong domestic market orientation;
- commodity dependence; and
- branch plant relationships with headquarters.<sup>59</sup>

Marceau has also emphasised the constraints imposed on the formation of clusters in Australia by the truncated industrial structure.<sup>60</sup>

Liyanage proposed that collaborative research programs could have a significant effect on the structure of the national innovation system by creating and strengthening networks which can be seen as essential precursors to clusters.<sup>61</sup> This concept has come to fruition in the application of a criterion of clustering potential in the latest round of CRC applications.

Lowe has cautioned about the efficacy of clusters. He notes that an analysis of recent literature on clustering reveals a lack of consensus on the clear causative links between clustering and economic development:

What is clear is that many commentators make the mistake of concentrating on a limited number of factors as being THE main factors affecting economic success. As with all success stories, cluster development is a propitious combination of many forces. The 'right place' is only one element in a complex formulation... Given that 'location' lies at the heart of cluster dynamics, and given that no two locations are identical, descriptions of how clustering occurs in Italy are perhaps of little value in assisting the development of clusters in Bendigo, Ballarat or Birchip.<sup>62</sup>

Marsh has written an extended case study of the Australian wine industry and the role of collaboration and learning in its astounding growth in production, exports and brand image. He traces the shift in business attitudes from an exclusive concern with local competition to a complementary level of industry collaboration on matters which

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<sup>57</sup> Houghton, op cit, ref 18.

<sup>58</sup> Howard, op cit, ref 11.

<sup>59</sup> Larcombe, op cit, ref 22.

<sup>60</sup> Marceau, 1999, op cit, ref 23.

<sup>61</sup> Liyanage, S., 'Breeding Innovation Clusters through Collaborative Research Networks', *Technovation*, **15**(9), 1995, pp553-567.

<sup>62</sup> Lowe, J., and Miller, P., 'Business Clustering: Panacea or Placebo for Regional Australia', available at <http://www.regional.org.au> (accessed March 2003).

are best addressed as a shared concern: in particular quality, international participation, marketing and innovation. The report shows that this is largely a horizontal and non-localised cluster - what might be characterised as a relatively early first generation cluster. Nevertheless, the benefits of even this level of clustering are evidently abundant, in this case.<sup>63</sup>

Martinez-Fernandez has examined the strengths of regional firm and industry networks in the Hunter region of NSW, and on knowledge intensive clusters as a driver for cluster innovation.<sup>64</sup>

In 1992 Mathews examined an unusual private sector cluster - TCG - a networked company dominant in electronics and ICT applications. The company consists of an operating core of 24 companies organised as a cooperative cluster with strong market coherence. Membership is voluntary and rules are minimal. Each company focuses on its core business and outsources all other requirements to other companies in the group.<sup>65</sup>

He has also drawn on his extensive experience in analysing the economic development of Taiwan and Singapore to emphasise that clusters are created and seeded through the attraction of foreign investment as well as encouragement of local firms.<sup>66</sup>

Morris has focussed on the development of ITC and engineering services clusters, mainly in Western Australia.<sup>67</sup>

O'Neill has worked and reported on the development of clusters in South Australia, since the ill-fated MFP.<sup>68</sup>

Scott-Kemmis, leader of a major research project to identify the characteristics of, and analyse the Australian innovation system, is involved in a major analysis of clusters in this context.<sup>69</sup>

Thorburn, a long-time analyst of the biotechnology industry in Australia, has recently examined patterns of biotechnology clusters and government support.<sup>70</sup>

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<sup>63</sup> Marsh, I. and Shaw, B., *Australia's Wine Industry*, 2000, available at <http://www.abfoundation.com.au> (accessed March 2003).

<sup>64</sup> Martinez-Fernandez, C., "The Network Perspective in Regional Regeneration" *Australian Journal of Regional Studies*, 5(3), 1999, pp297-312, <http://www.fbe.unsw.edu.au> (accessed March 2003).and Cairns Conference.

<sup>65</sup> Mathews, J., *TCG: Sustainable Economic Organisation through Networking*, Industrial Relations Research Centre, UNSW, 1992.

<sup>66</sup> Mathews, J., at [http://www.brisinst.org.au/papers/mathews\\_john\\_asia/](http://www.brisinst.org.au/papers/mathews_john_asia/) (accessed March 2003).

<sup>67</sup> Morris, P., <http://www.telesis.com.au> (accessed March 2003) and Cairns Conference.

<sup>68</sup> O'Neill, M., *Towards an Economic Community for the 21<sup>st</sup> Century: The Cluster-based Economic Development Project in Adelaide*, MFP Australia, 1996 and Cairns Conference.

<sup>69</sup> <http://www.ngsm.anu.edu.au> (accessed March 2003).

<sup>70</sup> Thorburn, L., Cairns Conference.

## 8. Clusters in Australia

Many have been involved in the identification of clusters in Australia. Some academics have offered their judgments, consultants interested in the promotion of clusters have broadcast their wares, and local governments keen to promote their region and attract investment have publicised their potential clusters. This makes the compilation of an authoritative list of clusters well beyond the limited resources of this study.

Brown has identified more than 100 clusters in Australia, together with a 'Cluster Scorecard' by which clusters can be assessed against ten key attributes.<sup>71</sup>

Lacking these resources, the author has attempted to develop a substantially complete list of what are, or are claimed to be, clusters, in Australia. Quality control on the list is very limited.

However, based on all the available literature, interviews, and the author's judgment, the clusters have been rated into four categories - 'strong' - \*\*\*\*, 'moderate' - \*\*\*, 'potential' - \*\*, and 'maybe' - \*. The criteria include both strength of interaction, and strength of consequent output. Typically, a strong cluster will have strong horizontal and vertical interactions and produce significantly enhanced outputs such as exports. A moderate cluster will rate less strongly on one or more of these criteria. A potential cluster is one in which cluster advantages have been identified, but are yet to be realised. A 'maybe' cluster is largely a cluster in the eye of the proponents only.

The clusters are further characterised by industry, location, and identifier. (Table 5) The only intentional ordering is by State.

**Table 5**  
**Industrial Clusters in Australia**

	<b>Cluster</b>	<b>Location</b>	<b>Status</b>	<b>Identifier</b>
	<b>NSW</b>			
1	ITC & services	Sydney CBD/Ryde	****	Roberts, Marceau
2	Financial services	Sydney CBD	****	NSW Gov, Marceau
3	Electronics	Sydney CBD	****	TCG, Mathews
4	Film services	Sydney CBD	***	NSW Govt
5	Transport/logistics	Airport corridor	***	Roberts
6	Component manuf'ing	Western Sydney	**	Roberts
7	Toolmaking	Western Sydney	**	Marceau
8	ITC	Western Sydney	**	OWS
9	Legal/accounting	Parramatta	**	Marceau
10	Multimedia/cultural	Northern Rivers	**	Henckel
11	Agribusiness	Hunter	*	IDC-Hunter
12	Building/construction	Hunter	**	IDC-Hunter
13	ICT	Hunter	**	IDC-Hunter
14	Engineering fabrication	Hunter	***	IDC-Hunter

<sup>71</sup> Further information is available, on a commercial basis, from <http://www.capinc.com.au> (accessed March 2003).

15	Equine	Hunter	****	IDC-Hunter
16	Telecommunications	Illawarra	***	IBC, ITC
17	Health	Illawarra	**	IBC
18	Food/horticulture	Riverina	***	Brown, Roberts
19	Natural medicinal/herbs	Northern Rivers	**	NSW Govt, Roberts
20	Tourism	New England	**	Roberts
21	Outdoor recreation	Snowy	*	Roberts
22	Food and fibre	South-east Corner	*	Group of Councils
23	Forestry	South-east Corner	*	Group of Councils
24	Wine	Hunter, Mudgee	***	Marsh
	<b>Victoria</b>			
1	Motor vehicles	Fisherman's Bend	***	Vic Govt
2	Aerospace	Fisherman's Bend	**	Vic Govt
3	ICT	Melbourne CBD	***	Vic Govt
4	Wireless telecomms	Melbourne	***	Vic Govt
5	Creative Content	Melbourne	**	Vic Govt
6	Film services	Docklands	**	Vic Govt
7	Food machinery	North Melbourne	***	Vic Govt
8	Biotechnology	Parkville, Clayton	****	Vic Govt
9	Wine, Jobs, GPs	Gippsland	*	Gippsland Council
10	Dairy	Goulburn-Murray	**	Vic Govt
11	Surf supplies	Torquay	****	Brown
12	Wine	Yarra	***	Marsh
13	Food Processing	Shepparton	***	Brown, Vic Govt
	<b>Queensland</b>			
1	Mining	Central Qld	***	Roberts
2	Tourism	Far North	***	Roberts
3	Tourism	Whitsundays	***	Roberts
4	Film services	Gold Coast	**	Johnston
5	Marine industry	Gold Coast	*	Roberts
6	Food processing	Toowoomba	**	Roberts
7	Magnesium	Gladstone	**	Marceau
8	Biotechnology	Brisbane	***	Qld Govt
9	Music industry	Brisbane	**	QUT
10	Electronics m'fure	Se Qld	**	AEEMA
11	Electronic games	Brisbane	**	Qld Govt
12	e-security	Brisbane	**	Qld Govt
13	Training	Mackay	*	Mackay Consortium
14	Marine/Fishing	Cairns	**	CREDC
	<b>South Australia</b>			
1	Wine	Barossa, etc	****	Marsh
2	Defence	Salisbury	***	SABV
3	Water	Adelaide	***	SABV
4	Horticulture	Virginia	**	Playford Council
5	Spatial Information	Adelaide	***	SABV
	<b>Western Australia</b>			
1	Marine Engineering	Jervoise Bay	***	Brown
2	Wine/ Tourism	Margaret River	***	Roberts
3	Aquaculture	Coastal WA	**	Roberts
4	Mining Services	Perth	**	WA Govt
	<b>Tasmania</b>			
1	Marine industries	Hobart	**	Roberts
2	Gourmet Food	King Island, Tamar	***	Roberts

The data about these various clusters are insufficiently available or reliable to allow a comprehensive classification into the typology described in Table 1. However, examples can be provided of each category, as shown in Table 6:

**Table 6**

	<b>Geographic Character</b>		
	Local/Regional	International	Virtual
<b>Trade-driven</b> Horizontal Halo	Wine TCG, Defence	Financial services Film services	Surf supplies
<b>Knowledge-driven</b> Private Public/private	ITC services Biotechnology, Water	Telecommunications	

There may be emerging virtual, knowledge-driven clusters arising from the activities of the CRCS, or through Australian research engagement in international collaborative projects, including megascience. These have not as yet formed sufficiently for identification as a cluster.

A number of lessons emerge from the experiences associated with developing and operating these clusters.

i) *Co-location does not necessarily produce collaboration.* For example, Marceau identified a large number of firms in the biomedical device industry located in the Hills District of Sydney that served the same hospitals. However there was very limited interaction, and the location decision was associated most strongly with the home addresses of the company founders.

ii) *Many attempts to manufacture clusters fail.* A general review of the many attempts to establish clusters as engines of regional development suggests more than half fail, and as few as 10% are significantly successful.

iii) *Clusters can die.* Thus Brown has shown that an effectively operating cluster in the Latrobe Valley is in steep decline as a result of the wind-down of the operations, and in particular the investment in new knowledge and technology, in the now privatised operators.

The electronics clusters in Australia are facing the same collapse with the dramatic reduction in investment by the multi-national nodes (Ericsson, Nokia, Alcatel, etc) as a result of the IT downturn. AEEMA is responding with a strategy whereby the industry association becomes the driver of cluster formation and operation.<sup>72</sup>

<sup>72</sup> AEEMA, <http://www.aeema.asn.au> (accessed March 2003).

## 9. *Ingredients for Success*

Lowe's analysis is sobering. If the secret of clusters is location, and if every location is different, then no general rules for success can be formulated. The OECD analyses have also pointed out that every cluster is different, and that there is no best model for cluster formation or success.

At the same time, the lure of the extraordinary gains in production, employment, wealth generation and innovation evidently resulting from successful clusters remains.

The various attempts to support cluster formation have been driven by four distinct objectives, though with frequent overlap or confusion of them:

- to improve the national advantage of certain sectors;
- to improve SME competitiveness;
- to improve the attractiveness, economic performance and development of a region; and
- to intensify industry-research collaboration.<sup>73</sup>

Each of these objectives may be entirely appropriate, but their conflation and confusion have severely hindered attempts to assess the basis of success, and of failure. Mapping the contribution of clusters will require a clear delineation of the different objectives that are being pursued.

Not all cluster initiatives are effective, as indicated by the 'Six Secrets of Failure' in establishing regional clusters, apparently the product of bitter experience. The ways to fail are to:

- focus on real estate;
- concentrate on attracting outside investment;
- use political forces to push for the creation of various components of an industry cluster;
- provide government assistance to firms where market failures are identified;
- allow government agencies to plan the development of an industry cluster; and
- keep all information confidential until the proposal has been finalised.<sup>74</sup>

The only effective clusters are 'natural' clusters. But their naturalness only becomes evident in hindsight. And there are a wide variety of factors that contribute to their success or failure. One of their greatest contributions may yet turn out to be in breaking down the traditional assumptions of 'who is responsible for what' in the economy, and breaking the stranglehold of market failure as the sole basis for consideration of government initiative.

In conclusion:

- clusters have become recognised as a potentially effective mechanism for enhancing competitive advantage, and government around the world have

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<sup>73</sup> Boekholt, P., and Thuriaux, B., 'Public Policies to Facilitate Clusters', Chapter 16 in OECD, 1999, op cit, ref 1.

<sup>74</sup> <http://brisbane.apana.org.au> (accessed March 2003).

sought to develop mechanisms to identify actual and potential clusters and to promote their formation and operation;

- there are a variety of types of cluster; the most fundamental distinction is between *trade-driven clusters*, where the emphasis is on trade between the members of the cluster and on collaborating in pre-competitive activities, and *knowledge-driven clusters*, where the benefits are based on access to new knowledge emerging from research organisations, and knowledge held by other firms;
- on this basis, a typology of clusters has been developed;
- clusters enhance economic performance through increases in the productivity of member organisations, driving the pace and direction of innovation, stimulation of the formation of new businesses, and access to new knowledge and learning;
- a variety of approaches have been developed to map clusters, each of which captures only a part of the phenomenon; the most developed are input-output analysis, geographic concentration analysis and case studies; much further development is needed;
- there have been many studies of clusters in Australia, and many real and possible clusters identified;
- clusters cannot be 'manufactured'; however conditions can be established which facilitate the formation of clusters and their contribution to economic value.