Industry Clusters Studies

Industry clusters: Competitive Advantage
Through Innovation

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C. Martinez
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## Glossary

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<th>Term</th>
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<tr>
<td>Cluster</td>
<td>Geographically bounded concentration of similar related or complementary business with active channels for business transactions, communications and dialogue that share specialised infrastructure, labour markets and services, and are faced with common opportunities and threats. (Rosenfeld, Over Achievers: Business Clusters that Work, Prospects for Regional Development, cited in Williams 1997, 25)</td>
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<tr>
<td>Cluster Leader</td>
<td>One of the cluster members that guides and inspires the rest of the members in the development of the cluster.</td>
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<td>Cluster Map</td>
<td>A representation of the elements, qualities and relations of a cluster.</td>
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<td>Cluster Muster</td>
<td>A formal forum addressed by the leadership team with all the potential members of the cluster where the vision is shared and trust is build.</td>
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<tr>
<td>Coalition Strategy</td>
<td>The action of uniting into a group or organisation the different participants on the economic development of a region.</td>
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<tr>
<td>Collaborative Economics</td>
<td>The process of planning and managing the local economy through a participatory process that incorporates inputs from as many sectors, with a focus on global competition.</td>
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<tr>
<td>Economic Actors</td>
<td>Each of the participants in the economy of the region, being from the public sector, the private sector and non-profit organisations.</td>
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<tr>
<td>Firm</td>
<td>A private company, business or enterprises.</td>
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<tr>
<td><strong>Leaders Forum</strong></td>
<td>A meeting of the potential members of the cluster's leadership team to discuss their roles, their vision for the cluster and strategies for development.</td>
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<tr>
<td><strong>Learning Economy</strong></td>
<td>The Learning economy refers, first of all, to the ICT (information, computer and telecommunication)-related techno-economic paradigm of the post-fordist period. It is through the combination of widespread ICT-technology flexible specialization &amp; innovation as a crucial means of competition in the new techno-economic paradigm, that the learning economy gets firmly established. (Lundwall &amp; Johnson 1994:26)</td>
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<tr>
<td><strong>Network</strong></td>
<td>An organisational or social units connected by a specific type of relationship (Jay 1964).</td>
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<td><strong>Network Analysis</strong></td>
<td>A body of qualitative measures of a network.</td>
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<td><strong>Nodes</strong></td>
<td>Each of the components of a network.</td>
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<td><strong>Physical Supporting Environment</strong></td>
<td>Regional infrastructure that enhances transport, connections and a high standard of living, such as recycling facilities, modern transport systems, and supporting business facilities.</td>
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<tr>
<td><strong>Pole Regional Centres</strong></td>
<td>Localised production agglomerations that form highly developed economic regions.</td>
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<tr>
<td><strong>Regional Network of Economic Development</strong></td>
<td>Pro-competitive alliances of private sector, public sector and non-profit organisations with an interest in the economic development of regions. (Martinez, 1997)</td>
</tr>
<tr>
<td><strong>Social Supporting Environment</strong></td>
<td>Regional facilities at the community level, such as education and research facilities, schools, hotels, cafes, sport facilities and shopping centres that contribute to a high quality of life.</td>
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Acknowledgements

The author is grateful to all those who have provided contributions, comments and guidance on the preparation of the report. This study has been commissioned by the Hunter Regional Development Organisation (HURDO) as part of the industry cluster development project which has been funding by BHP Rod & Bar, Energy Australia, The Industry Development Centre, Newcastle Port Corporation and the Commonwealth Government. I am particularly grateful to Ifor F. Williams from the Cluster Navigators of New Zealand; Professor Bob Fagan and Dr. John Langdale of Macquarie University, Australia; Ben Searle of University of Technology of Sydney; Emiliano Dutch of Cluster Competitiveness, Barcelona; Graham Larcombe, director of National Institute of Economic and Industry Research (NIEIR), Sydney; Peter Murphy of University of New South Wales; and Ramon Sevilla of University of New South Wales.

The author is grateful to Michael Murray (executive officer of HURDO) for his comments, suggestions, and encouragement. Thanks also to professor Tong Wu, Dean of the Faculty of the Built Environment at the University of New South Wales, for his advise and support. Finally, thanks to Bronwyn Hanna of University of New South Wales who proofread the report and whose comments were always helpful.
Foreword

The Hunter Regional Development Organisation (HURDO) was formed in December 1994 under the then federal labor government’s Regional Development Program. HURDO’s mission is to facilitate sustainable development in the Hunter Region through the formulation, implementation and maintenance of a coordinated economic development strategy in collaboration with all sectors of the community.

The challenge for the Hunter Region as we move ever closer to the new millennium is summed up by Rosabeth Moss Kanter, Professor of Business Administration at Harvard University and the author of ‘World Class: Thriving Locally in the Global Economy’ (Simon & Schuster, 1995)

In the future, success will come to those companies, large and small, that can meet global standards and tap into global networks. And it will come to those cities, states, and regions that do the best job of linking the businesses that operate within them to the global economy.

The research undertaken in an effort to develop a regional economic strategy which would achieve this outcome indicated that the concept of industry clustering - the gathering of similar and related firms in a region - warranted further investigation. Regions around the world which had been able to achieve this clustering effect seemed to be sustaining significant success in global markets.

This report was commissioned by HURDO to provide an overview of the international literature on industry clusters and to provide some clear recommendations on appropriate strategies which could implemented within the region to foster existing or potential clusters.

I would like to thank the author, Ms Cristina Martinez for her outstanding effort in preparing this report. I look forward with enthusiasm to working with my colleagues throughout the region in implementing its recommendations.

I would also like to offer my sincere thanks to all those who so generously gave their time to assist Cristina in this endeavour. Your efforts are very much appreciated.

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Author's note

This report stems from a four-month study (March-June 1998).

The study is comprised of a literature review of industry clusters and their contribution to regional development, and has also benefited from discussions with academics, developers and consultants interested in industry clusters.

The central aim of the study was to contribute to a better understanding of key issues on the development of industry clusters. The report was conceived as a compendium of best practice research specifically addressing the following questions:

- In mapping a cluster, what should be the contents?
- How to generate sustainable leadership teams?
- What strategies would stimulate the development of the cluster?
- How to monitor the cluster?

The main contribution of the study is the proposal of new development models for industry clusters based on previous research and experiences.

The views expressed are my own, and not necessarily those of the Hunter Valley Regional Development Organisation. The report is designed to generate further debate on the role of industry clusters in regional development.

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Executive summary

This report advocates the fostering of "clusters" as an effective tool of regional economic development. A cluster may be understood to be an informal association of firms, which are usually in geographical proximity, and which pursue deliberate practices of collaboration and innovation in order to heighten their competitive edge in regional, national and international markets.

The potential value of industry clusters in contemporary economic development lies in the articulation of strategies that foster improvement in the areas of knowledge, technology and innovation. Industry clusters are much more than connecting buyers with suppliers or growth centres. They are about regional representation and competitiveness on the global market. Beyond reporting on clusters that exist, and can be mapped out, this study examines the dynamics of a cluster, what makes it work, advance and be successful.

Perhaps the key characteristic of a cluster is its competitiveness. The exercise of mapping a cluster offers a diagnosis of its competitiveness which allows the identification of strategies for modifying the weak points of the cluster. There are five components that may be analysed to define competitiveness in a cluster: (1) the cluster core firms; (2) the specialist supporting firms; (3) the demand market conditions; (4) the physical supporting environment; and (5) the social supporting environment. A further five factors in the cluster core firms define their potential for operating in the global market: network structure, human factors, knowledge resources, technical infrastructure and capital resources.
Clusters are innovative organisations where leadership is a central issue because of its network structure. A model of sustainable leadership teams should look at four stages. First, key people from the cluster core of firms, identified through the mapping exercise, should be motivated and nominated as future cluster leaders. Second, the proposed leaders have to assimilate their function as catalysts of change in their industry sector and in their community. Third, to manage the cluster, the leaders need specific roles and skills that can be transferred and trained. Finally, planning the next generation of cluster leaders is the key that guarantees a transfer of knowledge and the establishment of a learning system of cluster management.

Innovation has been identified as the driving force of global industrial leaders. To foster innovation, clusters need to explore strategies of 21st century organisation: (1) building knowledge, (2) building network infrastructure, and (3) building global connections. This should be the focus of the cluster core firms' learning process, to develop these components, which produce the synergies which impact on the capacity of firms to create new products and services.

Monitoring the cluster activity contributes to a precise understanding of the dynamics of the cluster and its ability to create quality jobs and business vitality. A regional observatory of industry clusters should be designed, focusing on four core indicators at the cluster level: (1) network evolution; (2) knowledge capital; (3) economic impact; and (4) the level of confidence in the cluster. The observatory will bring rigor and validity to the strategies develops by the cluster leadership team, and it will indicate the extent of its effects.

Further recommendations from this study refer to implementation of the proposed strategies, summarised above, and to rigorous documentation of the process. The implementation of the strategies with regard to existing clusters would require a regional network approach, an alignment of federal and state government, local development agencies and industry partners. The strength of clusters lies in their capacity to generate common understandings of the regional problems as well as a common mobilisation of resources. The documentation of the process would provide lessons to government, developers, consultants and academics concerning the effects of industry clusters on the industry sector and on the regional economy.
This study has five recommendations to government, industry and community leaders:

1. Development of clusters should be supported by a regional network between the public sector, the private sector and non-profit organisations.

2. A leaflet outlining the meaning of clusters and their contribution to the quality of life in the region should be produced as well as the organisation of open workshops, so the whole community will be aware and participate of the economic strategies of the region.

3. A national cluster conference should be held, to facilitate cluster-to-cluster linkages, and region-to-region networks.

4. International linkages between clusters should be developed, allowing further understanding of the dynamics of clusters and creating trade opportunities for the regions.

5. Further research should be promoted as an important part of the learning process of the cluster, and as a guarantee of the rigor on the evaluation of the cluster effects.
Introduction

Achieving success is no longer simply an individual task for individual firms competing to get the best position on the market. Competition and collaboration are now necessary in the difficult task of taking advantage of new information and knowledge. Globalisation of the economy is leading to a new regional order, where regions must be represented in external markets. Success stories of industry clusters represent a method of industrial organisation with precise and replicable rules and dynamics. The opportunity to reproduce such models in other regional scenarios is an issue that has not yet fully explored. However, it could be an effective tool for sustained development and growth, a goal that benefits everyone in the region, generating synergies in all levels of society.

The purpose of this study is to present the dynamics of industry clusters and to indicate factors that contribute to their success. The research investigates the work of both academics and professionals, on four dynamics: the content of cluster maps, the models for sustainable leadership teams, the strategies for stimulating cluster development, and the indicators for monitoring cluster activity. This paper discusses contributions from the literature to these themes and offers models of cluster development and recommendations. It is envisaged that the analysis of these four factors will help professionals, policy makers and academics in developing strategies to enhance industry clusters.

The global economic restructuring is impacting on the way companies work, reshaping their organisations and making their structures more flat and decentralised. The fast
development of new interactive technologies and the World Wide Web is cultivating networking contacts amongst and between inter and intro-enterprises. These contemporary phenomena affect regions, generating industry activity groups that may crystallise in a cluster. Within this context, the literature gives insights on the framework of cluster theory. These insights come not only from academic research, but also from the initiatives taken by professionals, policy makers and government agents. This research investigates the work of academics, developers, consultants and government agents. The methods used include text analysis of the literature on networks and clusters; an e-mail questionnaire investigating key factors of industry clusters, and interviews with experts in cluster studies or regional development.

The paper is divided into seven sections. A brief literature review will be presented first, summarising the main currents of academic research and professional experience in the ongoing discussions around clusters. Section B discusses the content of cluster maps and gives recommendations on mapping a cluster. Section C discusses factors involved in the generation of sustainable leadership teams and presents recommendations. Section D discusses strategies for cluster development. Section E discusses the components necessary for monitoring a cluster and presents a model of monitoring. Finally, section F presents conclusions and recommendations from this research. References are presented at the end of the paper, as section G.

A Defining the cluster environment

Clusters are attracting much interest in different disciplines. Indeed, the concept of the “cluster” is still expanding and being re-defined. It is probably the literatures on regional development and networks which are making the greatest contribution to the definition of clusters. This section will review the main concepts associated with cluster environments and their dynamics.

Clusters, as local industry agglomerations with a strong productive focus, can build knowledge, creating a symbiosis of research and development. This is an important point, because there is so often a discontinuity between these two environments. Biemans states, that “tools, further knowledge and understanding about networks can
only be achieved through true cross-fertilization between theory and practice" (Biemans, 1996, 29).

Asheim links "clusters" with a discussion of the globalisation of the economy and firms' organisational microregulation within a framework of "learning regions". In his analysis, firms respond to the process of globalisation and deregulation of the world economy through global or local networks that constitute a third form of governance as an alternative to markets. Asheim distinguishes between global and local networks,

Global networks are constituted by functionally integrated production systems dominated by large firms (TNCs), and are caused by a change from vertical integration of industrial production in the traditional hierarchical large firms to vertical quasi-integration or disintegration, while the typical local network is a territorial agglomerated, local production system established by SMEs (e.g. the industrial district and other innovative milieus as the ideal type). (Asheim 1996, 3)

The emergence of a flexible post-fordist mode of production imply important changes in the production systems that are reshaping the structural organisation of classical hierarchies (Yeung, 1994). It is in this emerging environment where the globalisation-localisation discussion takes place. At the micro level, local industry networks have attracted a significant amount of research in different disciplines, and they are usually referred to as "clusters". Clusters, as the network concept implies, cross boundaries all the time, including not only firms but also government agencies and community associations. They are thought to be thus influencing new forms of regional governance, reshaping the ways that firms and governments have interacted until now. For the purpose of this research report, the following well know definition of clusters from Rosenfeld will be adopted.

A cluster is a geographically bounded concentration of similar, related or complementary businesses with active channels for business transactions, communications and dialogue that share specialised infrastructure, labour markets and services, and are faced with common opportunities and threats. (Rosenfeld, Over Achievers: Business Clusters that Work, Prospects for Regional Development, cited in Williams 1997, 25)

Recently, Brown (1996) and Murphy et al. (1997) refer to clusters as nothing new. While this is true in essence, the factors impacting their dynamics are a consequence of new

\[^{1}\text{Transnational Corporations}\]
\[^{2}\text{Small and Medium Enterprises}\]
environments and developments, reshaping concepts such as the “growth centres” of past decades. For a literature review with a historical perspective see Murphy et al. (1997).

Scott (1996) argues that at the macro-level, there is a new configuration distribution of the global economy characterised by “pole centres” and “islands of development”. The old top-down approaches, driven by the necessities of the nation-state are not able to explain the emergence of regional centres of the economy (Ohmae, 1995). Regional agents can act as catalysts of growth and development. In both cases (pole regional centres and small localised regions), the driving force of the economy seems to be not in the hands of national leaders, so much as coming from inside the market. When the focus is applied to local markets, it is possible to find multiple interconnections along network structures.

The following diagram serves to locate clusters in the new global framework where networks occupy a central position. Two elements seems to be emphasised in this definition: the globalisation of the world economy and the end of the economic primacy of the nation-state; and a continuing process of innovation driven by new interactive technologies, such as the World Wide Web, virtual networks and electronic commerce.

Figure A1: Role of networks in post-fordism era

<table>
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<th>Post-fordism era</th>
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<td>Globalisation world economy &amp; end of nation-states</td>
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<tr>
<td>Innovation through new interactive technologies</td>
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Global Networks: domination by large firms

Local Networks: Territorial agglomerations: Clusters

Industry clusters: competitive advantage through innovation
Networks are the driving force of the new economic order, reshaping the way society works (Castells 1996). Due to the continual redefinition of boundaries implied by the network definition, it is conceivable that local economies could compete in global markets with their own regulation and leadership. This is the rationale of clusters, an established mode of industrial organisation that now flourishes in a more powerful mode of definition and regulation.

Clusters are discussed extensively by Porter (1990) in his proposed new paradigm for company competitiveness and global strategies. The theory of clusters draws on several fields addressing competitive strategies of firms. Porter draws three critical lessons about global competitiveness through an analysis of the Japanese economy,

...First, what makes nations, states, and cities prosperous and companies competitive is a relentless focus on innovation and upgrading. Second, competitiveness depends on creating and sustaining specialized and unique local advantages. And third, the public and private sectors must work separately and in tandem to encourage clusters to form, grow and diversify. (Porter 1990, 26)

Porter emphasises the role of rivalry in promoting competitiveness in a cluster. However an important article by Granovetter (1985) insists that informal cooperation has a definitive role in contemporary successful business practice; Granovetter in part bases his conclusion on his observation of Japanese business society, where business interlinks are often based in trust and friendship. What he describes as the embeddedness of economic behavior is nowhere mentioned in Porter's work [However he argues that understanding this requires a redefinition of the role of sociology in economic theory]. Granovetter argues that embeddedness is understand to be related to trust, a central factor affecting business inter-links and transactions, and thus a main component of the economy.

Doeringer and Terkla (1995) elaborate Porter's thesis of the "competitive advantage of nations" in relation to industry clusters. Their analysis is based on their case studies in Massachusetts, but is broad enough to be useful to other regions. The authors draw a framework for cluster-based development based on three main rationales for why firms in different industries cluster locally: (1) collaboration economies within production channels; (2) transfers of knowledge through labor market relationships; (3) partnerships with government and unions. (Doeringer and Terkla 1995, 228)
The authors analyse Porter's study of competition between firms in the cluster as an important aspect of the formation of cluster networks. Their conclusions address the issue of development of trust within clusters.

...it is unclear why competition promotes the externality benefits needed for clustering-and, if it does, why it has to be local competition.
In fact, intense vertical rivalry among firms within production channels can be counterproductive to many performance improvements, such as JIT relationships and the opening of niche markets, based on collaborative behavior.
On balance, promoting business rivalry within a region does not seem conducive to cluster-based growth policies. Facilitating cooperative relationships and promoting vertical collaborations that lead to production channel clustering among suppliers and customers appear to be more constructive directions for development policy (Doeringuer and Terka 1995, 235).

Examples in the recent literature (Fulton, 1997; Arthur, 1990; Porter, 1990; Williams, 1997) show successful clusters in North America, Italy, New Zealand and England. There seems to be agreement that clusters are relevant to sectoral business growth, and now attention is being focused on how they can be more successful. Williams identifies four elements associated with good performance by clusters: a core of firm/s, a body of supporting firms, a socially supporting infrastructure and a physical infrastructure. Under these conditions, clusters tend to succeed in making profit and being competitive in global markets. The next questions for research and definition are: how to develop these high performance clusters? What are the determinants of success or failure of clusters?

A report on local cluster development strategies on Adelaide sheds some light on success factors in cluster developments (O'Neil, 1996). The experience of Adelaide provides useful insights into methods of cluster building and development. The figurative aerial view of the report on "The Cluster-Based Economic Development Project in Adelaide", outlines the steps in the identification and initial development of an industry cluster. The goal was articulated to be building a collaborative community.

[The] Ultimate Goal is [a] More Effective, Collaborative Community- The ultimate goal is a collaborative community. Cluster development is a means toward that end, clusters are not an end in themselves. By organising industry cluster working groups and engaging industry leaders in this collaborative process, specific outcomes are achieved that will enhance the competitiveness of the cluster and new relationships are built within the industry, and between industry and government, that help to create a stronger economic community. (O'Neil 1996, 23)
More insights come from the Network Paradigm (Cooke and Morgan, 1993), a new trend in corporate and regional development that refers to regions in the process of restructuring which develop networking between agencies and organizations. Such regions are engaged in a productive learning and adaptation process based on intraorganisational and interorganisational networking. This links to a new theory of regional development intersecting with the concept of "Collaborative Economics" (Henton et al., 1997).

Clusters already provide a framework for local economic development and local export growth. They strengthen the ability of businesses to compete and to attract new enterprises (Martinez, 1997). It is a useful way to extend the region’s strengths around core firms. In the case of industrial restructuring, clustering could be a way of recovering a region’s competitiveness. In addition, clustering brings flexibility to the organisations involved, creating an environment enabling faster responses to the demands of the market. The success of business networks can be linked to dynamic technological and organisational innovation, together with the network characteristics of the local actors and their "milieu" (Bergman et al., 1993). The software technology parks in the south of India, Bangalore, Chennai and Hyderabad are an example of information technology clusters functioning as virtual offices giving support and development to information and communication technology companies in the US.

These emergent industrial dynamics are linked to territorial configurations and to strong innovation in all areas, from the product itself to the organisational management. Peters (1990), in his study "Get innovative or Get Dead", suggests that innovation is the main factor leading to business sustainability. Clusters are innovative environments, starting with their own organisational structure in networks, far from the classical hierarchies. Dupuy and Gilly (1995), in analysing collective learning and territorial dynamics, refer to a system of local innovation in a way that feeds into the current discussion of clusters,

A local innovation system is therefore made up of relations based on cooperation between individual and organizational actors (research centres, firms, institutions, etc.) involved in a productive and cognitive process made possible by territorial proximity. By this we mean proximity not only in the geographical sense of the term (physical distance), but also organizational (complementary in activities) and institutional proximity (social coherence). (Dupuy and Gilly 1995, 1611)
Thus, if innovation is a key aspect of today's economy, clusters are systems where innovation is fostered.

Held (1996) offers a useful study of two clusters in New York concerning information technology and distribution. He concludes,

...cluster intelligence is most useful when (1) a broad definition of clusters is employed to include classic, vertically integrated clusters, as well as horizontal clusters and emerging clusters; and (2) the research methodology integrates quantitative and qualitative approaches, treats the cluster as an integrated whole, and encourages implementation of policy options as an outgrowth of the research process. (Held 1960, 260)

Held puts emphasis on the importance of having a solid base in planning the cluster. His work offers an in-depth analysis, identifying the cluster, analysing its strengths and weaknesses, linking it with the development of policy options, and outlining post-research activities. It is a holistic approach that gives sense to the development process of the cluster's life cycle.

Several authors have advocated ways for government to become involved in cluster development. Brown (1996), describes the efforts of OECD countries.

...all OECD member countries are, in one way or another, grappling with the problem of how central governments can facilitate the development of competitive advantage in regions. The main tools utilised by OECD countries to facilitate these spatial interrelationship appear to fall into five groups:
1. Network building
2. One stop shops
3. Facilitators and Roundtables
4. Infrastructure Planning (in respect both hard and soft infrastructure)

Discussing the Australian context, Brown (1996) refers to five industry clusters,

- North Sydney-Information Technology;
- Goulburn Valley—where food multinationals have substantially expanded their export capability over the last five years;
- Gladstone—a minerals processing cluster which has been consciously promoted by the Queensland Government;
- Bathurst-Orange-Blayney—another food processing cluster exhibiting strong growth characteristics;

Industry clusters: competitive advantage through innovation
- Canberra-the linking of education, information technology and public administration (Brown 1996, 11).

This list could also include the ongoing Industry Cluster Strategy of the Hunter Valley, NSW (HURDO, 1994).

Brown identifies 7 competencies common to most successful regional clusters:

- Workforce education;
- Business creation;
- Technology innovation;
- Global trade;
- Physical infrastructure & planning;
- Taxation & regulation;

Brown also has indicated five themes, which “need to underpin successful cluster-based development: local leadership, strategic planning, partnership, cocktails and facilitative framework” (Brown 1996, 51). These deserve further examination. Brown’s report offers a valuable resource especially for Australian policy makers. The roles of local, State and Federal governments are analysed as key players in industry cluster development, in partnership with private enterprises.

In the international arena, the 1996 Milan conference on Industrial Clusters investigated factors of success and failure of clusters. Quevit suggested reasons for the relative failure of some Marshall Industrial Clusters, which had flourished in the past:

- excessive dependence on a single industrial field,
- insufficient diversification of products,
- difficulty integrating technological innovation, due to excessive dependence on traditional industrial know-how,
- excessive dependence on the constrains of the local and domestic market,
- absence of functional and formalised leadership in relations between entrepreneurs,
- and, finally, no provision of productive services focusing on the non-material. (Quevit 1996, 17)

Quevit also analysed currently successful industrial clusters, which are adapting to the new techno-industrial system. He indicates some of the reasons for the success of these projects,
1. Diversification of products as a function of the global market; different products for different markets.

2. Search for economies of differentiation:
   - search for target markets;
   - good grasp of information on the evolution of the competition;
   - establishment of a system of organising the productive system around shared production services;
   - establishment of structures to support technological innovation;
   - integration in external partnerships in the fields of production and commercialisation;
   - good internal metabolisation of the information on market constraints and technological development;
   - greater formalisation of functional leadership in the organisation of the Industrial Cluster;
   - and, finally, more systematic involvement in an integrated approach to local development in consultation with public authorities. (Quevit 1996, 17)

This section has offered a summary of the recent lively discussions around clusters and industry dynamics. This literature review is not exhaustive, but locates the reader in the main streams of research on this issue. From the latest discussion addressing theory and practice in cluster emergence and evolution, four themes have been extracted as research questions for academics and developers: the content of clusters maps, sustainable leadership teams, strategies to stimulate cluster development and indicators to monitor cluster activity. These four themes will guide the next sections of this study, but also constitute the framework for what is being addressed at this moment in the expansion of the cluster theory. The next sections will identify and offer recommendations concerning these four research & development components of industry clusters.

B The content of cluster maps
The notion that dynamic regions may re-design their economy opens a range of possibilities for encouraging or reproducing economic structures that have been productive in other regions. The “cluster” strategy has been successful in a number of regions such as California’s Silicon Valley (computers), the Route 128 area of Boston (electronics), Minneapolis (medical devices), San Diego (biotechnology), Austin (semiconductors), Seattle/Portland (software) and greater District of Columbia (Internet) (Sabety & Griffin 1996). When a cluster exists, even if only in potential, it can be fostered by facilitating the growth and expansion of the embryo in a flexible and dynamic context. To engineer this scenario, it is useful to define the cluster and its context, and this definition is called “map of the cluster”. Mapping the cluster will make a diagnosis of its potential for development and competitiveness. This section focuses on the content of a cluster map. The components of clusters maps defined by the literature will be presented, and a number of recommendations will be offered and justified.

Mapping a cluster is a tool of diagnosis, a strategy to identify what the strengths are and weaknesses of the cluster, its opportunities and threats. This classical analysis SWOT (Hill & Westbrook 1997; Bamey, 1995; Scheers, 1994; Gray & Karp 1994; Partridge & Perren 1994), commonly applied to the regional economic study could be applied in-depth to the analysis of clusters. Indicators of competitiveness can be developed from a mapping analysis of a cluster. The monitoring system will give insights into the competitive analysis of the cluster, thus modifying the cluster map as it evolves. Research and development should come together, adding value to the development of the cluster.

See below for an overview of the cluster process, which locates the mapping phase within the rationale of the process.

Figure B1: Life cycle of an industry cluster
It is first important to identify the cluster, understood to exist on its own (even if only in potential). Quantitative and qualitative methods can be used to identify clusters (Doeringer 1995). The analysis of “critical proximity points”, such as business working in related activities, helps to identify firms that could be linked in the regional economy. The use of input-output tables helps to identify key regional industries in the production channels of the region. Identifying suppliers to a large industry can be the first step in mapping the boundaries of a potential operative cluster. Niche markets of small and medium enterprise firms may suggest a cluster that might been existing for long time, such as the example of the artisans of south Italy (Best, 1990). Generally, it is the market that determines whether or not a cluster exists, even in a very diffuse form (Searle, forthcoming).

The “Hunter Regional Economic Strategy” (HURDO, 1996) identified 23 potential clusters in the Hunter region. This was recently redefined to a number of 17, through a regional consultation and workshop process. These industry clusters are: agribusiness, building & construction, mining, arts & entertainment, defence, education & training, engineering and fabrication, environmental goods and services, equine, medical research, information technology, marine, metal product manufacturing, tourism, wine, surfing and transport. The process remains dynamic and changes are still taking place.

The identification of these clusters indicates the potential growth poles of the Hunter region, however it can be argued that not all of them will have the same economic effectiveness.

Once a cluster has been identified, the next step is to determine its competitiveness. This process will be explained later in some detail as the focus of this section. A further step is the definition of the operative plan for the cluster, meant to guide its development to a higher level of competitiveness. The final step is the application of a monitoring system that gives feedback concerning the competitive factors identified in the mapping phase.
The next part of this section discusses recent literature, which focuses on the elements that characterise a cluster.

**Components of the cluster map**

Network analysis offers useful insights into the definition of clusters and the process of mapping them. Many writers, including Granovetter (1985), Scott (1995), Lewin (1951), Freeman (1997), Hagen (1997), Mizuchi (1994), Tichy (1980) and Turk (1997), have been addressing how and why network analysis can make a difference to the understanding of any kind of organisational form. Network analysis permits visualisation of the structure of an organisation in terms of communication and transactions between organisations. Analysing a cluster in terms of network analysis will show its structure in terms of the links developed within the cluster and outside the cluster, focusing on the frequency of communication, the density of the network, its level of centrality, equivalence and centralisation. Frequency, density, centrality, equivalence and centralisation are terms used in social network analysis (Scott, 1991). Frequency identifies the level of communication and cooperation between different organisations. Density may be used to measure levels of un-centralized inter-organizational cooperation (Turk, 1977). Centrality is commonly used to identify network leaders (Mizruchi and Galaskiewicz, 1994). Equivalence is used to identify sets of network actors with similar roles in the networks; like economic “clusters” of development communications (Rogers, 1974). Network centralisation measures the degree to which an entire network is oriented around a few central nodes (Scott, 1991).

Another stream of analysis focuses on regional features, useful for strengthening the rationale for the existence of a cluster. Held (1996) presents an analysis of two clusters in the Hudson Valley (US), using four elements: characteristics, analysis, findings and policy options. Characteristics of the cluster are defined by the composition of groups, the regional employment, the type of market (national/international) and the most representative firms. An analysis of the cluster is presented in cluster identification and cluster assessment and uses results from expert interviews to identify the next steps of the cluster. Cluster identification is used to point to the most significant sub-group within the cluster. For instance, in his analysis of a cluster of information technologies, Held found the “factor” of electronics/computers to be the most significant. The cluster assessment was made using an input-output analysis, location quotients, shift-share analysis and a focus group to identify problems. Held also analysed the regional strengths and
weaknesses in terms of human capital, physical capacity and environment. Policy options are the final category of his cluster map.

A summary of Held’s mapping model is presented in Table 1.

Table B1: Held’s mapping model

<table>
<thead>
<tr>
<th>INDUSTRY CLUSTER</th>
<th>Characteristics</th>
<th>Analysis</th>
<th>Findings</th>
<th>Policy Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>Composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional Employment</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Market</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Representative firms</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Analysis

Cluster Identification
- Factor analysis
- Experts interviews

Cluster Assessment
- Input-output analysis
- Location quotients
- Shift-share analysis
- Focus group

Findings

Regional Strengths
Regional Weaknesses

Policy Options

(Held 1996: 225)

Another approach to cluster maps includes a much broader analysis of the physical and social environment as attempt to study the whole scenario where the cluster appears. Brown (1996) suggests ten main elements in the mapping exercise:

1. Internationally capable companies
2. Suppliers/contractors
3. R & D facilities
4. Universities/TAFEs
5. Schools
6. Transport & Communications
7. Health services
8. Housing
9. Networks
10. Leaders (Brown 1996, 30)

Brown (1996) gives an example of a cluster-map in the food industry cluster of Albury-Wodonga. The ten elements identified above are presented in four categories: key
manufacturer exporters; first-order suppliers; second-order suppliers; facilitating agencies & networks; and infrastructure. Although these categories provide information about the cluster, they do not offer a diagnostic indication of the competitiveness of the cluster, which should be the ultimate goal of the mapping exercise.

Sabety (1996) proposes a core of elements worth analysing for their potential to foster cluster development: “competency building skills” of private and public sectors, the resources of government, the regulatory policy, infrastructure investment, and the level of business leadership. Sabety bases his analysis of the cluster on the diamond paradigm of Porter (1990), which determines national and regional competitiveness on four factor conditions: firm structure, firm strategy and rivalry, demand conditions, and related supporting industries. Sabety suggests that the diamond model explains the success of some geographical areas in certain types of economic activity, and he suggests that the following elements must be present in the region for a truly successful cluster to exist:

First, the geographic area must contain advanced and specialized factors of production - highly skilled labor, outstanding research facilities, or unique natural resources are examples. Second, a set of supplier firms providing the highest quality and most cost-effective components and services to the industry must develop. Third, successful clusters in geographic areas must be comprised of numerous individual firms competing with each other to constantly improve products, reduce costs, and sharpen corporate strategies that keep them competing for market leadership. Fourth, a strong global market for the firm’s goods or services and sophisticated and demanding local customers must exist to maintain the pressure for innovation. (Sabety 1996, 4)

These elements could be fostered to develop the competitiveness of an emergent cluster. For instance, they could be applied to the clusters identified in the Hunter region (Hurdo 1996).

Williams (1997) offers an analysis based on four integrated elements of high performance clusters. The first element concerns the core firms of the cluster, the second the supporting firms that act as specialist suppliers, the third the supporting social infrastructure and the fourth the supporting physical infrastructure. Williams has successfully applied this model to the analysis of clusters in New Zealand.

Sabourin and Pinsonneault (1997) analyse clusters in four themes, which rank the competitiveness of the clusters. The model of analysis is presented below;
Figure B2: Sabourin & Pinsonneault mapping model

Highly Qualified Human Resources

Financial Resources

Knowledge Resources

Technological Infrastructure

(Sabourin & Pinsonneault 1997: 172)

This model analyses the cluster as an organisational entity. In their example of Canadian biotechnology clusters, under the theme of Human Resources the authors analysed the average percentage of employees involved in research and development, the average percentage of presidents with a doctorate, and the average annual training allocation per employee in dollars. Under the theme of Technical Infrastructure the authors studied the average number of firms owning a research laboratory, the average number of firms owning production facilities, the average acquisition date of infrastructure, the average area of the research laboratory, the average economic value of the laboratory and the average economic value of production facilities. Under the theme of Knowledge Resources, the authors analysed the average number of patents and the average number of patents leading to commercialisation. Capital Resources were analysed as either external or internal to the cluster.

The value of Sabourin and Pinsonneault's research is that they provide an in-depth method of analysing the core firms at the heart of the cluster as an organisation in itself, where combined resources are understood to benefit the whole cluster. Thus, improvements to the human resources or to the technical infrastructure will improve the competitiveness of the cluster as organisation. Clusters would be ranked as highly competitive clusters or moderately competitive clusters, and different strategies can be designed to improve each of the identified factors.
Recommendations on content of cluster maps

The cluster map is a tool of diagnosis measuring the competitiveness of a cluster. It is an instrument which shows its strong and weak points in order to establish strategies of sustained development. There are five factors that have been identified in this literature review as central to the cluster map: (1) a cluster core of firms; (2) a specialist supporting pool of firms; (3) demand market conditions; (4) a social supporting environment; and (5) a physical supporting environment. Each of these factors should be analysed to identify strengths and barriers to competitiveness growth.

Special attention should be given to the cluster core firms, as the drivers of competitiveness and innovation. There are five factors of competitiveness that have been identified from the literature for the cluster of core firms: (1) the human factor; (2) the network structure; (3) technical infrastructure; (4) knowledge resources; and (5) capital resources.

Figure 3 proposes an integrated model of cluster maps based on the preferred models of Sabety (1996); Porter (1990); Williams (1997); Sabourin & Pinsonneault (1997).

Figure B3: Integrated model of cluster maps
These five "balloons of competitiveness" are interrelated. Each one could have a measure of competitiveness as high, moderate or low, facilitating a visual understanding of the cluster competitiveness and weakness in its life cycle. Following is an analysis of each of the balloons and recommendations about its components.

Cluster Core of Firms

Innovation is the key factor for industry competitiveness today. The cluster has to foster innovation as part of its strategic development. There are five factors impacting on innovation and competitiveness of firm management: the human factor, the technical infrastructure, the network structure, capital resources and knowledge resources.

The human factor analyses the level of specialised education of the human resources of the cluster, which could run from technical education to doctorate levels depending on the type of cluster and the various functions within the firm. Analysing the skills of employees involved in research and development activities will indicate the potential level of innovation and new products. The allocation of training hours per employee amongst the cluster will indicate its knowledge and training renewal. For example, Hewlett-Packard bases its success on its constant development of new products, a serious training schedule for employees, and highly qualified human resources.

The technical infrastructure evaluates the technical stock of the cluster from production facilities to research laboratories and new interactive technology development, including its economic value and age of acquisition. This data will indicate how the
cluster is addressing technological change, a factor associated with innovation and competitiveness. Companies today have to face up to rapid changes in information processes and other technologies.

The network structure will provide a map of the cluster, describing relationship links and drivers' groups. This analysis allows the identification of isolated points within the cluster, but also links with market demand, supporting firms and the social supporting infrastructure. The structure of a cluster is in continuing evolution, developing different shapes as it evolves from earlier stages to mature stages. Thus, the network analysis could be used to shape the evolution of the cluster over time.

Capital resources refer to the financial resources of the cluster, and whether they are external or internal. The financial dependence of the cluster and the capacity to generate financial resources can be analysed. Capital resources give an indication of financial health of the resources of the cluster, which will have implications for investments in technological infrastructure and knowledge training. For instance, external capital resources such as business partnerships and alliances provide firms with a better access to financial resources than if they depend to a greater measure on owner's equity (internal capital resources).

Knowledge resources need to be measured because this is a factor which highly impacts on innovation and competitiveness. They may be measured as patents or as intellectual property. Books, papers, publications, and patents are knowledge resources that the cluster can develop and protect from imitation by competitors. Knowledge resources will be part of the benchmarking of the cluster in the global market.

These five factors of competitiveness offer a holistic analysis of the characteristics of a cluster as an organization of firms with a diffuse shape and independent components, but sharing similar objectives, to innovate and compete.

**Specialist Supporting Firms**

The specialist supporting firms are a set of firms that can act as primary or secondary suppliers of the core firms, and ideally provide the highest quality and most cost-effective components and services.
Strategic alliances should be developed between the cluster and these firms, so that companies will outsource tasks to competitors/suppliers that could do them better than if attempted in-house. Supporting firms could come across from another cluster or from a different economic sector, and such inter-links will strengthen the economic fabric and diversity of the region as well.

**Demand Market Conditions**

The demand market conditions analyses three demand factors: local, national and global. The local market refers to the region itself, and this part of the cluster map will address whether or not there is market scope at the local level and why. The national level will identify the focus market regions or cities and scope for growth. The global demand will show the existing international presence of the cluster, actual trends and opportunities for expansion.

The globalisation of the economy makes markets move very fast. For example, the cluster of industries producing slate in the Bierzo Valley (Spain) is growing rapidly in international markets after centuries of consolidation at the local level. One question which has not yet been answered is why this is happening now? Is it an evolution, a natural process, is it the result of external markets looking for new sources of cheap materials, or is it a result of access to information about prospective markets? In any case it seems clear that an analysis of the demand market conditions will bring to the cluster a broader understanding of present and possible future customers.

**Social Supporting Environment**

The social supporting environment is an important part of the cluster. It also suggests the “social capital” of the community. Educational and research institutions, industry training organisations, professional and trade associations, union programs, business advice agencies, one-stop government agencies, local development agencies, and already established networks are all elements which demonstrate the degree of community services supporting the cluster. Strengthening the social supporting environment will strengthen the competitiveness of the cluster and contribute to a sustained development of the region, towards what has been called the “communities of the 21st..."
century” (Chisholm 1996; Collaborative Economics 1997). These are communities that see the need to maintain a coalition strategy between the key actors of the community as crucial to turn their vision into a reality (Chisholm 1996).

The analysis of the social environment will describe local sources of training or business support, as well as weakness that need to be addressed from a private enterprise or government policy level.

Physical Supporting Environment

Examples of physical supporting elements include research facilities, modern and diverse transport systems, recycling waste disposal, advanced technical communication systems, and supporting business facilities. A poor physical environment will encourage lack of competitiveness in the cluster. Identifying the factors to be improved will lead to government policy options, for instance, encouraging government to invest now in order to generate wealth for the cluster and the region in the long term.

The five sections or balloons presented here integrate information from the literature to diagnose a cluster’s competitiveness. Each balloon informs about opportunities, barriers to growth and points to be developed with the operative plan. A good diagnosis of competitiveness should lead to a healthy and growing cluster, which should benefit the whole region in terms of employment, business enterprises and local investments.

C Generation of sustainable leadership teams
Cluster leaders deal with principles and goals differently from managers of traditional companies. The cluster shape and flexible boundaries require an innovative management style. The new leaders are engaged in a collaborative approach that facilitates learning.

Cluster organisations require leaders with capacity to integrate shared visions of the future and to articulate partnership projects. Cluster leaders are “learning facilitators” involved in continuous complex negotiations. These are innovative skills not often found in hierarchical bureaucratic organisations. As Brown (1987) states "Traditional management training in public or private organisations might be poor preparation for leading programs organised on the network model". (Brown 1987: 466)

The following figure (based in Brown 1987) will help to visualize why cluster leadership is so different from classical management, and thereby it requires specific skills and roles.

Figure C1: Bureaucratic vs Cluster organisation

Cluster organisations are based on vertical relationships with an emphasis on control and distribution of activities. Cluster organisations are based on egalitarian relationships which emphasise cooperation and shared leadership. Leaders emerge from the companies’ part of the cluster, and they are not appointed, but generated.

The literature on sustainable leadership teams has not produced a number of models that can be contrasted. Even business schools do not yet have a focus on models of leadership for cluster organisations. Lipnack & Stamps (1993) present the “teamnet principles”, five basic principles that characterise successful network-teams,
• A unifying purpose. Without a mission, reason, or objective that is clearly articulated and communicated to all people involved, a group begins to slide into degeneration.

• Independent members. A teamnet benefits from the independence of its individual members. When independence ceases, you no longer have a boundary crossing teamnet, but a hierarchy or a merger.

• Voluntary links. The links consists of visible communication links, like telephone, fax, computer networks and video conferencing, and the less visible voluntary personal relationships.

• Multiple leaders. Leadership of a teamnet may change overtime, caused by the multiple roles, skills, and knowledge required to address the complex problems taken on by the group.

• Interactive levels. The existence of multiple levels strengthens a network but it is also a potential source of many problems and conflicts. (Lipnack & Stamps, cited on Biemans 1996:35)

These five principles could be used to address some of the management issues in designing a sustained model of leadership for the cluster, but it does not give a full explanation of all the “components” of cluster leadership. The literature shows an agreement about such components, not yet articulated in a model. The components are: (1) motivating the key people; (2) having leaders as catalysts; (3) network management; and (4) developing the next generation of leaders. To generate internal leaders that will develop the cluster requires specific actions such as energising and catalysing the emergence of leaders, and identifying the roles and skills needed by a cluster management team. These are the components of a leadership team, and they are the keys to a strategic search for the leaders.

This section will review each one of these components, and present specific recommendations on a leadership model for industry clusters.
Components of cluster leadership

Motivating the key people is probably the most difficult task for "cluster facilitators", usually regional developers, local development consultants or civic entrepreneurs (Henton 1997). Chisholm (1997) proposes that a facilitator should be able to answer the following questions before getting the right people involved,

"What knowledge, skills and resources are required to deal with the broad problem? What organisation or individuals can provide the needed skills, resources, and credibility and legitimacy?" (Chisholm 1997:460)

To answer these questions required a good understanding of the cluster core firms, which can be done by mapping the cluster, as described in the previous section.

Clusters are based on voluntary membership of the organisations identified through the mapping exercise. This voluntary membership has two aspects: a "passive role" and an "active role". The passive role requires attendance of members to meetings, and cooperation when information is required. The active role requires thinking strategically about the cluster development, and spending an average of 2-3 hours per week managing cluster activities or projects. Thereby, while passive members are not difficult to involve, seeking leaders for the active role will require a different approach. Williams (1998) describes this strategy as "catering for the heart of future leaders". This is the first step for building a sustainable leadership team.

The facilitator or promoter of the cluster has to spend some time in the community visiting the organisations involved and talking with possible leaders. It is important at this stage to involve the chief executive officer (CEO) of each company, because they have the capacity to make decisions about the degree of involvement of their company in the establishment of the cluster. "Catering for the heart" of the CEOs means first, to be aware of their actual needs and feelings as leaders of an organisation; and second to share the vision for the future of the region and of his/her company. It is in this communication exercise that the potential benefits of the cluster development should energise them as active leaders. Finally, it is this energy that will produce the engagement of both leaders and passive members of the cluster.
As an added value, the benefits generated from the cluster are not only in terms of regional development and company competitiveness, but also in terms of "network capital" (Sabety 1996; Williams, 1998). CEOs will have developed an extensive network of personal relationships over the years at the leadership level. It is an important source of knowledge and informal ties, often decisive in business transactions (Granovetter, 1985).

The strategic leaders serve as "the catalyst" of the cluster, thus as agents causing change. The support of senior leaders in business and government is needed to provide advice, endorsement, connections and resources. "Expertise is required to ensure the process proceeds efficiently towards tangible outcomes". (O’Neill 1996:15)

Leaders as agents of change suggest a much more dynamic position than that of classical organizational managers. It requires energy and clarity about the goals of the cluster. Once the leaders perceived themselves as agents of change, the process of involving other members will proceed. This requires the organisation of a leaders’ focus group on cluster vision and goals. Chisholm (1997) recommends not to include more than 10-12 persons, the key formal and informal leaders, in the early stage of the cluster. There is a process here of "let the leaders emerge and do", where these key people will engage in the cluster development with their own assumptions and strategies.

Clusters promote competitiveness outside the region and in the international market. To be successful in hyper-competitive business, companies must cope with rapid changes on the market place. Companies have to accelerate their learning processes and apply their knowledge rapidly (Hansen-Bauer & Snow 1996). Cluster leaders should, thereby, focus on transferring knowledge and facilitating learning.

Senge (1990) proposed that leaders of learning organisations be responsible for "building organisations where people are continually expanding their capabilities to shape their future—that is, leaders are responsible for learning" (Senge 1990:9). The new roles of the leaders involve being designers, teachers and stewards. Senge offers an excellent example of what is required:

Imagine that your organization is an ocean liner and that you are "the leader". What is your role? I have asked this question of groups of managers many times. The most common answer, not surprisingly, is "the captain". Others say, "the navigator, setting the direction". Still others say, "the helmsman, actually controlling the direction", or, "the engineer down there stoking the fire, providing
energy", or, "The social director, making sure everybody's enrolled, involved, and communicating". While these are legitimate leadership roles, there is another, which, in many ways, eclipses them all in importance. Yet rarely does anyone mention it. The neglected leadership role is the designer of the ship. No one has a more sweeping influence than the designer. What good does it do for the captain to say, "turn starboard 30 degrees", when the designer has built a rudder that will only turn to port, or which takes six hours to turn to starboard? It's fruitless to be the leader in an organisation that is poorly designed". (Senge 1990:10)

The role of "teacher" encompasses being the facilitator of learning, designing specific "learning vehicles" such as conferences, forums and workshops. By definition, a rapidly changing reality requires focus on current issues, thus the leader is also acting as a facilitator of changing mental models of people in the organisations, him/herself included. A fluent circulation of information and knowledge amongst the cluster participants will achieve this.

The role of "steward" is about commitment to the goals of the organisations and commitment to the people involved, as a natural attitude. Muth and Donaldson (1998) study of stewardship theory and the structure of company boards found that directors with many network connections tend to benefit their boards. High frequency connections in network relationships are a factor associated with performance, also pointed out by Kirman (1997).

Senge's (1990) description of the skills needed in these new roles includes the ability to build a shared vision, the ability to challenge prevailing mental models and the ability to foster systemic patterns of thinking. "Building shared vision" is about encouraging and communicating the vision for the cluster in a positive way, and distinguishing it from negative visions. One of the risks of cluster development is to focus on possible negative factors which might impact on the cluster (Williams 1998). "Surfacing and testing mental models" is about seeing leaps of abstraction and balancing inquiry with advocacy. It is also about recognising and defusing defensive routines that could act as barriers to development. "Fostering more systemic patterns of thinking" is about seeing interrelationships and processes as part of a large system. It is about focusing on areas of high leverage and avoiding symptomatic solutions. So, what is important is not to produce strategies, but to promote strategic thinking.
Snow, Miles and Coleman (1992) emphasise three roles as especially important to the success of network organisations: Architect, Lead Operator and Caretaker. The "Architect" has the overall vision of the process. The "Lead Operator" formally connects firms together into an operating network. The "Caretaker" develops a sense of community among the members of the network, and identifies what helps the network learn. The three roles are relevant to clusters, where leadership itself is shared between several members of the cluster.

Henton et al. (1997) refers to leaders as central to the process of building economic communities because they link community and economic clusters of specialisation. They call these new leaders "civic entrepreneurs", playing up to eight different roles through the four stages of building new economic communities. The following table indicates the roles assumed by civic entrepreneurs in each of the stages.

Table C1: Intensive roles played by civic entrepreneurs at each stage of building economic community

<table>
<thead>
<tr>
<th>Roles played by civic entrepreneurs</th>
<th>Stage 1 Initiate</th>
<th>Stage 2 Incubate</th>
<th>Stage 3 Implement</th>
<th>Stage 4 Improve and renew</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1 The Motivator</td>
<td>★★★★☆</td>
<td>★★★★★</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
</tr>
<tr>
<td>#2 The Networker</td>
<td>★★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
</tr>
<tr>
<td>#3 The Teacher</td>
<td>★★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
</tr>
<tr>
<td>#4 The Convener</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
</tr>
<tr>
<td>#5 The Integrator</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
</tr>
<tr>
<td>#6 The Driver</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
</tr>
<tr>
<td>#7 The Mentor</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
</tr>
<tr>
<td>#8 The Agitator</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
</tr>
</tbody>
</table>

(Henton et al. 1997:75)

These roles and skills suggest a new framework for managing clusters, and the key words are learning, knowledge, facilitating and strategic thinking. All of them develop from classical management as a response to rapidly changing markets, technology, and regional development frameworks.

The complexity of roles and skills required by these new leaders make it difficult to find the right people to manage the cluster. For this reason, and also because leadership of clusters tends to be short lived, as a voluntary activity fostering innovation, it is important to focus from the beginning on the next generation of leaders (Williams 1998). Connecting the old leaders with the new ones is the way to best address innovation and
knowledge transfer. In the words of Williams (1998), "Leaders come and go, the cluster remains".

It can be assumed that leaders will remain two to three years, linked to projects and activities. Knowing that leaders emerge, it is also a task of the actual leaders to facilitate the process of emergence of the next ones and even to do some active searching for them. This is part of the innovative "attitude" in cluster leadership. Classical leadership is associated more with holding on to power and less with passing on knowledge. The new leadership is associated with "generosity" in understanding that the goals of the cluster are more important than any individual having a central position in the cluster organisation.

**Recommendations on sustainable leadership teams**

In the above section, components of cluster leadership were identified from the literature. Figure 2 presents a model of sustainable leadership teams based in those components.

Figure C2: Model of sustainable leadership teams

![Diagram of sustainable leadership teams]

**Motivating the Key People**

The facilitator/s of the cluster have to identify the key people in the cluster and motivate them to get involved in the cluster development. Identifying the key people can be done through the cluster map, by analysing the network connections and their level of "centrality". This means that the map of the cluster will show several focuses of connections, which should be indicative of possible leaders. The level of centrality reflects companies engaged in strong collaborative links. These are the key companies in the cluster; and the CEOs of these companies are probably involved in networking movements already. While leaders may emerge across the process of generating a
leadership team, this measure of centralization of the cluster is a starting point for suggesting possible leaders with rich network capital.

The facilitator needs to motivate these key people, to pass on to them the energy and optimism that the facilitator has about the benefits of the cluster. This step involves a process of modeling the leaders, where the facilitator transmits "the vision" to the new leaders. The facilitator/s of the cluster must be experts in local development and excellent communicators. As experts they need to know the impacts and benefits of cluster development on the core of firms and on the region as a whole, which constitutes the strategic vision of the cluster. There are three steps facilitators should follow to generate possible leaders.

(1) Go to the community and spend time talking with the key people, getting a sense of the needs and problems experienced by the core cluster firms. The cluster-map document will give the facilitator good information about the situation of the core firms, and this will be appreciated by the CEOs. The role of the facilitator here is very active, developing trust amongst the business community as a neutral "broker". Trust and neutrality are important values when proposing a new business idea. The facilitator is starting the process of modeling new leaders using one of the goals of the cluster: developing links of collaboration.

(2) Analyse what the common needs and hopes of these key companies are and their possible leaders. Then, develop a strategy of communicating how the cluster will match these needs and hopes.

(3) Organise a "leaders' forum" where the CEOs of the companies at the heart of the cluster can discuss and analyse the advantages of getting involved in the cluster leadership. The facilitator will present the cluster strategy and how it addresses the actual situation of the core of firms. It is a function of the facilitator to develop awareness through the leaders' forum of the importance of leadership as an innovative process that will bring sustainability to the cluster.

The leaders' forum should be able to produce an agreement about what the main issues are and how the cluster development provides a possible option for the development of the region. From this forum the leaders of the cluster should emerge as an active group ready to start developing the cluster.
Leaders as catalyst

The leadership team needs to spend some time exploring the concept of being “agents of local change” before involving the rest of the companies in the cluster. To be an agent of local change means having an active role in challenging ways of thinking that constitute barriers to inter-firm collaboration. It also means stimulating strategic thinking and systemic approaches to the needs of individual firms. The systemic approach focuses on the effects of each decision on the whole cluster, instead of individual cases of cause-and-effect on each company.

A new meeting should be planned, focusing entirely on what is expected from the leaders in contributing to the cluster. Leaders of other clusters from the same or different regions may address the meeting and discuss many of the uncertainties and barriers involved in the process. An expert on local change may also address the issue of how cluster leaders should act as catalysts of development, rather than as administrators.

The next step is to organise a “cluster-muster”, where the leadership team will transmit the vision of the cluster to the rest of the people, helping them to participate in the goals and benefits that the cluster strategy will bring to their firms. The role of the facilitator becomes less important, as the role of the leadership team continues to grow.

The cluster muster is the first meeting of all the members of the cluster, and an opportunity for the leadership team to test what they have learned from the previous meetings. The communication of the vision and the goals of the cluster have to be clear and credible. It is a way to develop trust and to promote participation from new members.

Cluster management

Innovative roles and skills have to be designed and learned to develop the full potential of the leadership team as a sustainable resource. At least three leaders are needed, one each in the roles of architect, lead operator and caretaker. The leaders work together but each one will focus on their area, identified as important to the cluster's development.
The architect will focus on strategies that will make the vision for the cluster operative. This role requires the skill of articulating the shared vision of cluster members with short and long term objectives. It is important to focus on deliverable results in the short term (2-3 months), such as new business alliances or international market opportunities. The architect will also seek financial support from the private and public sectors to organise activities for the benefit of all members of the cluster.

The lead operator works on networking amongst the firms, connecting them and making the cluster operative. This could include organising forums of learning within the organisations, such as workshops, conferences and product-presentation. The lead-operator also looks for opportunities and projects that could be developed between several companies. This role requires skills in fostering more systemic patterns of thinking, so that each company begins to see itself as a part of a larger engine.

The caretaker keeps the cluster informed through the development of communication strategies such as a mailing list, a web page for the cluster in the Internet, and a cluster-newsletter. The caretaker analyses and evaluates the cluster, identifying what helps the cluster learn and work. The caretaker also analyses the development of communication links between the organisations within the cluster and with organisations outside, providing feedback to the cluster about its internal and external development. The caretaker helps to develop the network capital of each company and of the cluster itself. This role requires analytic skills in knowing what are the barriers reducing communication throughout the cluster, such as defensive attitudes that may block its potential development.

To generate a sustainable leadership team requires identifying the best roles and skills to cope with the uncertainty of an organisation based on collaboration. The three roles described earlier could be developed as part of a learning process that includes technical workshops for the leadership team. One of the advantages of a cluster leadership team is that mistakes are permitted to some extent, as a necessary part of the innovative learning approach. However, the cluster should deliver something in the first 2-3 months of development, thus the leaders should be ready to focus on their roles very quickly.
Next generation of leaders

The leaders of the cluster are voluntary members. The benefits they derive from their involvement include gaining experience in the management of innovative organisations, extending their own network capital, and helping to improve the economy in their region.

A leadership team shares responsibilities and does not need more than 2-3 hours per week to keep the cluster going. Innovation and sustainability come from new members, and a system of developing senior and new junior leaders may be developed. As new leaders emerge from the cluster firms, the senior leadership team should accommodate them in a “learning-path” that facilitates the transmission of roles and skills over time.

This is a mentoring program where leaders are engaged with developing apprentices for cluster leadership. This is the key to generating a sustainable leadership team, based on knowledge transfer from old to new. The cluster will grow on innovation, learning and competitiveness over time. Leadership teams are more than management teams, they are collaboration teams with specific roles and skills, which not have been fully developed before at the company level. A good tool to help to establish the next generation of leaders is to develop “knowledge capital”. That is, to produce reports, papers, and books that record the knowledge of the cluster over time for the use of present and future generations of clusters.

Cluster leadership is about feeding the natural curiosity of humans for innovation. Cluster leadership is about exploring the opportunities inherent in building collaboration and communication links between competitors. Cluster leadership is about developing an apprentice model for cluster management, innovating on the ways that managers are usually trained. Generating leadership teams is one of the keys to success in cluster development.
D Strategies for cluster development

The strategies for developing a cluster are oriented around innovation and competitiveness. Saying that, some of the strategies used by classical management are important in the cluster, such as the definition of an operative plan with clear outcomes. However, most of the strategies are associated with the components predicted to be central in successful 21st-century organisations in frequent references in the literature. These components, which will be explored in this section of the paper, are knowledge and learning building, network infrastructure, promotion of innovation, and development of trust. At the end of this section, strategies to foster cluster development and competitiveness will be suggested.

Components of cluster development

Cluster development has attracted the attention of many authors in the last two decades. The literature is extensive and diverse with elements varying from business growth to interpersonal psychology and virtual environments. This section will refer to the main streams in the literature on cluster development, and will cite some of the more prolific authors on the subject.

The work of Porter concerning the competitive advantage of nations (Porter 1990) is probably the most influential for academics and developers of clusters. Porter emphasises the role of regions as platforms for a global strategy, where the region is the home base of companies leading in the global market. In this context, a cluster has to address and anticipate needs at the national and international level. This is itself a strategy for implementation: to go global from the geographic boundaries of the cluster, extending the network outside the limits and dissolving the barriers frequently associated with physical distances. There are three critical issues in global competitiveness:

1. what makes nations, states, and cities prosperous and companies competitive is a relentless focus on innovation and upgrading;
2. competitiveness depends on creating and sustaining specialized and unique local advantages;
Innovation is a central focus in the work of Porter. When he suggests the "four diamonds" of competitive advantage, he is focusing on factors that foster innovation:

1. an innovative environment marked by vigorous competitive pressures from rival firms;
2. a customer base that pressures firms to innovate;
3. access to networks of local suppliers of specialized inputs who themselves are constantly motivated to innovate by fierce competition with local rivals;
4. highly specialized labor and technology that meet the needs of cluster business. (Porter 1990:72)

Porter applies the diamonds metaphors on a nation-wide level, but the same factors can be expanded at the local level. Williams (1997) proposes three broad strategies in stimulating local clusters that add value to the concepts proposed by Porter:

1. Improving local linkages, building trust
   - Generating informal and formal opportunities for the cluster participants to meet and discuss, to learn on each other, and to learn from each other
   - The development of hard business networks between cluster participants, enabling individual companies to undertake activities that would not be possible separately
   - The provision of technology support
   - Facilitating inter-company benchmarking
   - The development of learning circles between cluster participants;

2. Building local competencies
   - The development of industry-specific training through partnerships between business and education providers
   - The enhancement of school-industry links...
   - Attracting immigrants with particular skills;

3. Extending the reach of the cluster
   - Generic promotion...
   - Participation by cluster participants in mini-missions to overseas markets, trade fairs, etc.
   - Attracting cross-border investment, in particular investments that also brings contact with and access to overseas markets and bridges capability gaps in the cluster
   - Upgrading local transport facilities, reducing inter-modal costs, and developing of direct links with overseas markets. (Williams 1997:28-29)

Williams applies these strategies to New Zealand's clusters, one of the best examples of nation wide cluster implementation.

Brown (1996) also proposes five themes which need to underpin successful cluster-based development. These themes are: promoting local leadership, strategic planning, developing partnerships, promoting cocktails and building a facilitative framework. The
emphasis on local leadership brings rationality to the development of local scenarios. This issue has been widely discussed in the previous paper. Strategic planning points to the need to bring rigor into the management exercise and vision for the future, and both conditions are important when looking for investments by governments. Partnerships are extremely important for coordinating efforts in the region, where private and public sectors may combine with the same strategies. Cocktails refer to sharing funding support across commonwealth, state and local governments. It is important to obtain funding to develop clusters, especially in the first stages, because no one party alone has the resources to implement the cluster. Also it is in itself a strategy that benefits clusters, bringing together all supporting agencies around the core firms. The facilitative framework refers to the need for governments to support bottom up thinking with top down policies (Brown 1996: 51).

In addition to these authors presenting a strategic framework for cluster development, there are others that focus on essential factors contributing to cluster success, such as "knowledge and building learning" (Lundwall & Johnson, 1994; Asheim 1996). This refers to the development of an environment where information and ideas circulate freely and fluidly in a learning process that encourages the cluster's growth in knowledge. A well-known example is Silicon Valley and its successful semi-conductors cluster (Saxenian 1990, Joint Venture 1996).

The concept of learning is part of a new theoretical framework describes as the "learning economy" by Lundwall & Johnson (1994).

The Learning economy refers, first of all, to the ICT (information, computer and telecommunication)-related techno-economic paradigm of the post-fordist period. It is through the combination of widespread ICT-technology flexible specialization & innovation as a crucial means of competition in the new techno-economic paradigm, that the learning economy gets firmly established. (Lundwall & Johnson 1994:26)

This concept of the learning economy is expanded later by Asheim (1996) who differentiates knowledge as a modern economic resource and learning as a strategic process:

The learning economy is based on the view that knowledge is the most fundamental resource in a modern capitalist economy, and learning the most important process, thus making the learning
These concepts applied to clusters can make them be seen as learning systems. One way to develop a cluster as a learning system is to conduct “action research”. This involves,

[...] applying a dual focus on planning, taking action, and examining outcomes of these actions in every aspect of developing and managing the network. Such a learning system orientation depends on a continuous flow of valid information about the basic outcomes of actions. (Chisholm 1997:469)

The action research proposed by Chisholm is a technique of analysing the actions taken by the cluster and learning from them. It can be part of the monitoring system of the cluster, adding value to its evaluation.

Other systems for keeping the cluster learning could be adopted from the model of regional learning network effectiveness proposed by Hanssen-Bauer and Snow (1996). The authors suggest up to 18 learning activities at three different levels of learning, individual, company and regional. Some of these learning activities are lectures, professional networking, links to research and development institutions, case analysis in groups, forums for debate, seminars, presentations, communications media and influencing policy institutions. The network objectives are: to increase management capability, to increase company flexibility and effectiveness, and to increase inter-company cooperation. The final outcome is to improve regional competitiveness (Hanssen-Bauer & Snow 1996:424).

There is little doubt that the learning process is central to innovation. However, innovation is difficult to implement. It has been identified that between 10% and 15% of the difficulties inhibiting innovation by firms come from technological problems, a lack of technical knowledge. Suggested solutions for addressing this problem include training human resources (as the key component in the culture of innovation), and linking research to the innovation process (EBN 1996:8).

Complementing this analysis, Doeringer and Terkla (1995) locate innovativeness as a result of competition.
Aggressive competitive pressures from customers, rivals, and suppliers stimulate innovations that continuously raise total factor productivity, lower cost, and promote business growth. (Doeringer & Terkla 1995:232)

This argument for innovation as a natural outcome of competition follows the earlier work of Porter (1990) about the need for rivalry to make firms competitive. It may seem contradictory to argue that clusters are based on firm rivalry, but that they should aim to build knowledge through the free circulation of information. It is suggested here that collaboration is the process necessary to foster innovation at the local level, while regional rivalry should be located at the global level.

Another component of cluster development is the creation of networking opportunities for small firms, so they can explore the production processes of large companies and identify opportunities for outsourcing production (Doeringer & Terkla 1995:234). These small companies may thereby go into the cycle of generating growth and expanding the cluster. An example of how this may be done is the Danish model of encouraging Danish small and medium enterprises to cooperate by:

(1) an exhaustive publicity campaign;
(2) training people, called “brokers” to facilitate cooperative ventures and others called “scouts” to identify network opportunities;
(3) incentives in the form of competitive grants to groups of three or more to design, develop and implement activities jointly. (Rosenfeld 1994:25)

Creating business links will encourage project partnerships that would not have happened otherwise. Building the networking structure will also stimulate transfer of knowledge within the cluster.

Regional policies need to be developed to aid local linkages in order that clusters reach their full potential.

[...]Development policy should create the capacity to mediate and facilitate the development process and foster an environment that encourages collaboration among competing firms...critical elements in the capacity of government to promote growth. (Doeringer & Terkla 1995:235).

The networking exercise between the public and private sectors is needed to foster cluster development and its competitiveness outside the region. Public and private partnership is probably the only effective way to mobilise all the resources around the
competitive advantage of the cluster. Public and private sectors have different roles in the cluster development:

- Private companies: invest in new technologies, build supplier networks through training, production of standards & technology diffusion, seek new markets abroad, and anticipate customer demands for innovation and quality;
- Public sector: worker training programs, technology development programs, business network programs that strengthen supplier networks, government procurement policies create demand for new products, export assistance programs and trade missions to find new markets, and industrial action programs. (Sabety & Griffin 1996:4)

Operative plans could be developed to facilitate the expansion and strengthening of these roles. Porter (1990) and Williams (1997, 1998) refer to similar strategies when explaining the social environment supporting the cluster.

There is another important component of cluster development different from the ones referred to above. This component is “trust”. Trust refers to having confidence in the truthfulness and reliability of a person or group. Trust is not present “per se” in the cluster, but it is the most important factor in the context in which firms collaborate. Williams (1996) has identified the building of trust as one of the key elements in enhancing the wealth creating capability of a local community. To build trust requires time and specific strategies. One strategy is to generate local leaders that will enhance trust in an organic process of development, in a more sustainable way than by using external leaders. Another is to find organisational homes for cluster initiatives (O’Neill 1996). In a more virtual way, the use of new technologies, such as mailing lists, web pages and virtual discussion groups will also allow the strengthening communication links. Frequency in communication links has been identified as a component of trust (Kirman 1998).

Finally, cluster development needs an operative plan to focus on an initiative or project (O’Neill 1996). The project focus is important in delivering something tangible back to the firms in the first three months, and also in developing trust in the cluster strategy amongst the core firms. Clusters can have different focus projects. The following are examples from Arizona industry clusters (Waits & Howard 1996):

- newsletter & electronic bulletin boards
- in-depth analysis of each cluster (in partnership with universities)
- cluster directories
• cluster impact studies about development of jobs and wages within the cluster
• technology exchange missions
• export strategy development
• local legislation
• building next generation foundations (Waits & Howard 1996:8)

Without projects the cluster may become a committee where companies meet together to discuss a few issues, but where there are no operative plans to pursue projects. Thereby, the outcomes could be rare and unclear, impacting negatively on the cluster development. Learning and knowledge might be absent and unable to impact upon innovation. The development of the cluster in this situation would be slowed down and it could eventually disappear.

**Strategies to stimulate cluster development**

In section B of this paper (p. 24) figure B1 shows the life cycle of an industry cluster from its identification to its evaluation. The strategies to stimulate cluster development are located at the third stage (operative plan), and this is the place where much of the action takes place. Local change has to be stimulated in order to keep the cluster evolving and growing in competitiveness. The strategies for cluster development include producing operative plans for the cluster, which may also operate as indicators for evaluating its competitiveness. That evaluation will give feedback during the initial diagnosis of the competitiveness of the cluster, indicating whether or not the cluster is adding value to the core sector firms and the region as a whole.

Another diagram (figure B3 on p. 30) shows an integrated model of cluster maps. That model contains the strategic elements of the cluster: the cluster core of firms; the specialist supporting firms; the demand market conditions; the physical supporting environment; and the social supporting environment.

A model of strategic cluster development emerges from these models of the life map of the cluster, the content of cluster maps, and the work of the authors cited above.

Figure D1: Model of strategic cluster development
Innovation and competitiveness are the two main elements central to cluster development. Innovation has been identified as the driving force of global industry leaders. An example is the continuing innovation of the Microsoft corporation, monopolising 85% of the market with their operating system Windows 95, and gaining control of the Internet with the integration of their Internet browser in their new product, Windows 98. The continuous innovation of Microsoft is central not only to its growth but also to that of the entire information and technology sector. The forces of competition used to be driven by the quality of products and client service but now as important is the capacity to create and to innovate.

To promote innovation requires the involvement of the core firms of the cluster in a strategic learning process. Learning should be stimulated in three areas: the human resources, the knowledge resources and the technical infrastructure. Promoting learning across the cluster should spread knowledge and encourage innovation within the cluster.

However, making the process of learning more strategic requires consideration of two constraints: the global environment and the regional network infrastructure. The global environment is the level where the demand market is located, and the learning process must become orientated to that level. It is one of the educative objectives of the cluster, to facilitate the shift from local thinking to global thinking. The other constraint is the network infrastructure, in particular the implementation of communication and other links between all the actors in the cluster. There are two broad levels of operation: the business level; and the political level. The business level refers to the core firms of the cluster and the specialist supporting firms. The political level has its main impact on the social and physical environment supporting the cluster.
The development of specific strategies to match this model of cluster development depends on the characteristics of the cluster. However, five generic strategies can be suggested: (1) building knowledge; (2) building network structure; (3) building global connections; (4) building local leadership teams; and (5) producing an operative plan.

**Strategy 1: Building knowledge**

As already noted, the literature suggests that a cluster’s knowledge base can be expanded through training the human resources, promoting knowledge and upgrading the technical infrastructure. These are three levels that support this strategy.

Figure D2: Levels of knowledge building

![Diagram of knowledge building levels](image)

Training the human resources of the cluster in new competencies and new technologies will enrich its human capital, benefitting not only individual companies but also the individuals involved and the regional economy as a whole. Specific actions involve partnerships between business and education providers, the enhancement of school-industry links and the application of action research to training programs on a regular basis.

Promotion of knowledge resources will promote products that facilitate learning within the cluster and also expand the value of the cluster outside the geographical boundaries of the core firms. Specific actions involve production of patents, books or papers.

Nowadays, firms have to build technical infrastructure in order to promote production, innovation and communication. Technical infrastructure largely refers to information, to
computer and telecommunication related technology. There is no doubt of the revolution in communications during the 90s and companies which keep up to date with this infrastructure are more prepared to meet future challenges. Actions involve continual revision of each technological hotspot within the companies, and also implementation of mailing lists, web pages, electronic newsletters, teleconferencing systems and technology exchange missions.

**Strategy 2: Building Network Infrastructure**

A cluster is based in the communication and coordination between members. The cluster has to build routes and service stations to facilitate both functions. There are two levels of action in building a network structure: the business level; and the political level. The business level will promote networking across the core firms of the cluster and with the specialist supporting firms. The political level will promote networking with agencies and organisations important for developing the social and physical environments supporting the cluster.

![Figure D3: Levels of network infrastructure](image)

Actions implementing network infrastructure include generating formal and informal meetings that give the cluster participants opportunities to meet and interchange ideas, developing hard business networks focused on specific projects, organising inter-company benchmarking, generating learning circles amongst the supporting firms, and designing social and physical environment improvements with decision makers. It should impact for instances, on local legislation, i.e. land use planning.
Strategy 3: Building Global Connections

The core firms of the cluster provide goods to a market which is global in scope. Knowing the demand market is one condition of the strategic learning process of the cluster. Typical actions involve analysis of global demand and opportunities in another countries, technology exchange missions and export strategy development.

Building global connections requires a generic promotion of the cluster outside the geographical boundaries. Developing a "virtual office" for the cluster is an excellent vehicle for extending the reach of the network. The cluster virtual office is an Internet homepage with several goals. It strengthens the cluster with a projected image of what the cluster could be like; it creates a virtual environment that facilitates communication and publication of knowledge outcomes; and it locates the cluster at the cutting edge of the new interactive technologies. The cluster virtual office will offer a corporate opportunity for electronic commerce and marketing with a very low cost. If the cluster has to go global, creation of a virtual office is an affordable project.

Strategy 4: Building Local Leadership Teams

The previous section of this review explored a model for sustainable leadership teams. This is a strategy of cluster development in itself because it builds a strong foundation for the cluster be far more stable than the "network marriages" of two or three years duration.

Strategy 5: Producing Operative Plans

The final strategy for making clusters sustainable is to produce an operative plan where specific actions to develop strategies will be specified in term of time, resources and outcomes. These strategies could have a time-life from three to five years or even ten years, but the operative plan of the cluster should be a document upgraded on annual basis. The operative plan will have a double objective: firstly to serve as a guide to the
operations of the cluster with a strategic view to what has to be achieved; and secondly as a vehicle of building trust within the cluster and the region. It is designed to promote the cluster and to build a network infrastructure at the business and political level. The operative plan gives a rationale to the cluster activities and it is an enormous source of learning for the leadership team.

As pointed out in this paper, the cluster has to deliver something in the first few months of operation in order to keep people involved. The engagement of cluster participants on the production of the plan may also help engender trust in an uncertain process. Clusters are about innovation and change, and they mean dealing with many barriers put up by people who do not understand the process. The operative plan is a vehicle of change in the cluster, and brings also professionalism to the management process. Finally, it facilitates the evaluation of the cluster and it gives feedback about new actions for fostering the competitiveness of the cluster.

Clusters have a home base in the region, but the ambit of their operation goes beyond it, seeking global opportunities and expectations. The strategies proposed here focus more on the stimulation of an innovative environment which may permit the shift in thinking from local to global. The model presented involves both innovation and competition, being stimulated by the construction of network infrastructure and global connections. Overall, it is the process of strategic learning that facilitates the development of the cluster, driven by local leadership teams.
E Monitoring the cluster

Every firm or organisation envisages success, but only some of them become sustainable organisations. As discussed in this series of papers, clusters require special management features that lead them to have results in the first three or four months. A cluster's success requires trust in the development process so that consistent profits may be yielded in the long term. A cluster needs to develop a monitoring process which focuses on its strategic development. This final section will focus first on how the literature on clusters describes the required components for monitoring an industry cluster, and second, will present recommendations for monitoring cluster activity.

Components for monitoring cluster activity

Little as yet has been written on this particular aspect of industry clusters. So far researchers and especially developers have been more interested in applying action research to the design of the cluster model. However several studies have identified certain required elements for monitoring cluster activity, namely: management skills, job quantity and quality, business vitality, learning evolution, the development of communication links and the satisfaction of members with the cluster development. Each of these elements is discussed below.

Miles and Snow warn that "managerial mistakes in designing and operating" network organisations is their greatest threat. Regarding earlier organisational forms, they write that,

The more intriguing failures are those that arise from two types of subtle managerial 'mistakes': individually logical extensions of the form which in the aggregate push the form beyond the limits of its capability; and modifications of the form which, while reasonable on the surface, nevertheless violate the form's operating logic. (Miles and Snow, 1992:57)

They argue that network organisations can fail

...because of alterations made by well-intentioned managers. The network form has an operating logic associated with each of its variations, and violations of this logic are likely
to limit the form's effectiveness and, in the extreme, cause it to fail. (Miles and Snow, 1992:62)

The authors identify two unique characteristics of the network form which require the development of self-renewal strategies to avoid failure.

The essential relationship among components are external (and thus highly visible to all parties) and these relationship are voluntary (and thus must reflect explicit commitments). Miles and Snow, 1992:68)

Thus, the visible, external links among members must have perceptable and substantive benefits, and voluntarism must operate between partners. It means that partners must feel free to terminate a relationship if they believe it is unfairly structured.

Communications and computer technologies provide a second component requiring monitoring, which has been growing in importance for the last twenty years. Snow, Miles and Coleman (1992:10) state that network organisations cannot operate effectively unless members can communicate quickly, accurately and over long distances. Thus, the monitoring system of the cluster should continually evaluate the evolution of communication links amongst the cluster firms. This means not only a network analysis regarding frequency of communication, but also an auditing of the electronic communication facilities of companies, such as email, Internet sites and video-conference facilities.

Doeringer and Terkla (1995) point to elements linked with competitive advantage economies, such as a specialized network of local suppliers, specialized labor and technology pools, specialized firms linked to one another through business, and social networks and government partnerships. The authors also argue that maintaining cooperative relationships is the more constructive direction for development policy for the cluster, rather than encouraging an intense rivalry amongst firms as proposed by Porter (1990), and discussed earlier in this paper. Doeringer and Terkla's work could be used to extract indicators for monitoring the evolution of network links throughout the cluster as well as evaluating its human and technology capital.

Waits and Howard (1996) report on the industry clusters of Arizona. They suggest an annual cross-cluster analysis which could serve not only to track the success of a
particular cluster, but also to anticipate the next generation of regional clusters. They identify six elements in the continuum of industry collaboration: co-informing; co-learning; co-marketing; co-purchasing; co-producing; and co-building economic foundations.

- Co-inform. Collective action to identify cluster members and impacts; promote a heightened awareness of the industry, and improve communications among firms in the cluster. Examples: newsletter, electronic bulletin boards, databases, industry surveys, cluster directory;
- Co-learn. Refers to educational and training programs sponsored by the cluster. Examples: seminars or conferences to learn where and how to acquire resources and services; training for total quality management and strategic planning exercises to build the vision of business owners and managers;
- Co-market. Collective activities that promote the clusters' products or services abroad or domestically. Examples: joint trade missions, trade shows, industry brochures, newspaper articles;
- Co-purchase. Refers to activities to strengthen buyer-supplier linkages within the cluster and to opportunities for collaboratively equipment that firms could otherwise not afford;
- Co-produce. Cluster firms make a product together or conduct R&D together. Examples: four optics cluster members received funds to build a mobile lidar system that none of them could have undertaken individually;
- Co-build economic foundations. Refer to clusters helping to build stronger educational, financial and governmental institutions that help them to compete better. Examples: cluster train K-12 and community college instructors in cluster workforce needs; create R&D funds; support university centers of excellence. (Waits and Howard, 1996)

The authors present a double entry table specifying the different industry clusters and whether or not they have addressed any of the elements above. The table is useful for monitoring more than one cluster and for extracting conclusions about cluster performance and future trends.

Another set of indicators can be extracted from Brown (1996). The author comments on seven key competencies for successful regional clusters: workforce education; business creation; technology innovation; global trade; physical infrastructure & planning; taxation & regulation; and quality of life. If the cluster evaluation can prove to the members of the cluster, the relevant political forces, and the regional community that there is a growing trend in each of these competencies, the cluster can expect to evolve with substantial support. As Brown states,

These key competencies can be understood and progressed if potential or existing clusters are identified at an early stage. This is considered important in order to flag to private sector interest that the agenda has an industry and outcomes focus. This, in turn,
helps to get industry leaders around the table, discussing their individual and collective aspirations. (Brown, 1996:39)

Joint Venture's third annual Index of Silicon Valley (Collaborative Economics, 1997) provides a comprehensive set of 31 indicators of the region's economy and quality of life, tracking progress towards a 21st century community. The following table summarises the indicators which relate particularly to cluster performance in Silicon Valley.

Table E1: Economic Indicators in Silicon Valley

<table>
<thead>
<tr>
<th>Group indicator</th>
<th>Sub-indicator</th>
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<tbody>
<tr>
<td>Job Quantity</td>
<td>Total number of Silicon Valley jobs</td>
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<td></td>
<td>Cluster job growth</td>
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<td></td>
<td>Local employment growth in the cluster with rapid jobs growth</td>
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<td></td>
<td>Employment in temporary help industry</td>
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<tr>
<td>Job Quality</td>
<td>Average per employee real wages (comparing cluster industries, Silicon Valley average and US average)</td>
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<td></td>
<td>Average employee wages by cluster</td>
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<td></td>
<td>Share of total jobs in professional and technical occupations, comparing state, region and cluster industries</td>
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<tr>
<td></td>
<td>Share of total jobs for occupational categories, comparing state, region and cluster industries</td>
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<tr>
<td>Business vitality</td>
<td>Average annual value added per employee, manufacturing industries</td>
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<tr>
<td></td>
<td>Export sales and the share of California's export sales attributable to Silicon Valley</td>
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<td></td>
<td>Number of publicly held gazelle firms in Silicon Valley</td>
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<td></td>
<td>Number of Valley firms that issued initial public offerings</td>
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<tr>
<td></td>
<td>Number of Women-Owned businesses and average employment per firm</td>
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<tr>
<td></td>
<td>Public's confidence on the economy</td>
</tr>
<tr>
<td>Economic capacity</td>
<td>Percentage of revenue spent on R&amp;D by public firms</td>
</tr>
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<td></td>
<td>Total venture capital financing in Silicon Valley</td>
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<tr>
<td></td>
<td>Venture capital invested in Silicon Valley firms by sector</td>
</tr>
<tr>
<td></td>
<td>Average vacancy rate for office, R&amp;D, industrial manufacturing and warehouse space</td>
</tr>
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<td></td>
<td>Average quoted lease rate for R&amp;D space</td>
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In 1996 the Spanish regional network "Salamanca Emprende" developed an evaluation system that focuses on three main categories: perception of effectiveness by members, test control of activities and macro analysis of the regional economy. The evaluation was applied annually, and submitted to the regional network and the community. This author's study of this cluster in 1997 used interviews and surveys to provide a qualitative analysis which compliments the economic data. The network facilitator of Salamanca Emprende, identified a major factor of success being this annual review, reporting back to network members about the evolution and sustainability of the regional network (Martinez, forthcoming).
Chisholm (1997) proposes that setting in place some monitoring indicators should be a function carried out by the members of the network.

Over time, devising ways of determining the effects of plans and activities should become part of how the network organisation functions. That is, network members should devise ways of determining outcomes automatically as a natural part of conducting work and managing the network development process. (Chisholm, 1997:470)

The author refers to two processes that should go together: action development and action research. Thus all components of planning, implementation, outcomes and learning are driven by research and development.

Very recently Williams (telephone interview by author with E.F. Williams, General Manager of Tradenz, Australia 23 April 1998) has identified three components of a successful cluster:

1. Management skills, involving the completion of time-lines and general management skills.

2. Economic impacts on the cluster core of firms in the long term. It can be measured with four indicators,
   - increase of average wages in cluster jobs
   - number of jobs within the cluster increasing
   - new business start-ups increasing
   - average hours of human resources training increasing

   The evaluation of these factors should be done every three or four year, providing for a long-term evaluation of the cluster.

3. Development of trust is the most important factor impacting on the development of clusters. It is a process linked to the facilitation of communication within the cluster, the expansion of links between the organisations. It applies not only to the core cluster firms but also to supporting firms, and to other institutions in the social and political environment. Trust is in this sense linked to "social capital", to the capacity of companies and members to benefiting from their reciprocal links.

**Recommendations on Indicators for Monitoring Cluster Activity**
Monitoring is one of the core activities of a successful cluster. In section A of this paper, it was presented as a key figure within the cluster life cycle. That diagram is presented again below in order to emphasise the role of monitoring within the system.

Figure B1: Life Cycle of an Industry Cluster

As can be seen from the figure, monitoring the cluster has a direct relationship with the diagnosis of competitiveness on the cluster map. Without the monitoring system, the development of the cluster may be not strategic, and thus may be less effective in its competitiveness.

This section has so far shown that several authors address the issue of monitoring clusters and network organisations from different angles. This section will present a cumulative model for monitoring the cluster, a set of indicators based on the work of these authors as well as previous writers reviewed in this paper.

The following model has a generic orientation and cluster leadership teams should be able to adapt it to their specific characteristics. Here is proposed the creation of an Observatory of Industry Clusters, which will allow a microanalysis of each cluster, a cross-cluster analysis with annual reviews, and a macro analysis every 3-4 years.

Figure E1: Observatory of Industry Clusters

REGIONAL OBSERVATORY OF INDUSTRY CLUSTERS
At the core of this monitoring model is the evaluation of a specific cluster in four indicators associated with competitiveness: network evolution, knowledge capital, economic impact and level of satisfaction within the cluster. The inputs from these core competencies will permit a cross-cluster analysis of the regional industry cluster. Finally, this cross-cluster analysis will facilitate the macro analysis every 3 or 4 years. The life cycle of a cluster is long and for full results may need up to 5 years development. Yearly revision may implement changes to the cluster's strategic development, but the macro review will be the final evaluation. A long-term evaluation will provide the most accurate information. Below are expanded the core indicators of the model, with suggested sub-indicators.

**Network Evolution**

To monitor how the network structure is evolving it is important to check the growth and changes in collaboration links among the cluster. Collaboration has been identified as a key factor for generating knowledge and for fostering innovation in the cluster. The following sub-indicators could help to identify this evolution: network connections, density, frequency, centrality, centralization, project partnership, policy development, and global links.

"Network Connections" refer to the links developed within and outside the network. These connections should provide information about the "frequency of communication", the "density of the network", its level of "centrality", "equivalence" and "centralization". Frequency identifies the level of communication and cooperation between different
organisations. Density may be used to measure levels of un-centralized inter-organizational cooperation (Turk, 1977). The concept of centrality is used to identify network leaders (Mizruchi and Galaskiewicz, 1994). Equivalence is used to identify sets of network actors with similar roles in the networks such as economic “clusters” of development communications (Rogers, 1974). The concept of centralization measures the degree to which an entire network is focused around a few central nodes (Scott, 1991).

A register of the number of project partnerships developed annually is one way of recording some of the developments and outcomes of the more technical network analysis elaborated above. The same register should record partnership projects with the government that produce policy developments upgrading the physical or social environment of the cluster. Finally, registering the number of global links developed with regard to projects, contacts, and customers allows the cluster to transcend geographical boundaries and develop broader ways of doing business.

The structure of the cluster is an environment in evolution. Avoiding failure and fostering competitiveness requires having a bird’s eye view with annual reviews, in order to engineer any parts of the structure that are not fully utilised. The structure of the cluster provides the mechanism for circulating knowledge and learning.

**Knowledge Capital**

To monitor the knowledge capital of the cluster it is important to know if the firms are growing in their learning and if there is knowledge transfer amongst the network. Three sub-indicators can help to evaluate the knowledge capacity of the cluster: human capital, knowledge resources and technology capital.

The human capital can be accounted for through counting the number of training hours per company, so that the skills and knowledge of workers amongst the cluster are increasing and are oriented to the needs of the cluster. A specialised work force will make the cluster more competitive and more prepared to cope with change and uncertainty in the market.

The knowledge resources are linked to innovation. The main idea is that companies develop their own register of the knowledge they hold. Growing in knowledge could be tracked through products such as patents, books, reports, etc. If the cluster grows in knowledge resources, it will grow in learning as well, and these factors foster innovation.

The technology capital is another factor part in the development of a company. Nowadays, technology provides a competitive advantage, and companies have to
invest in order to get up to date with technology and for workers to utilise it fully. In addition, because of its special network configuration, a cluster needs to communicate quickly and effectively, to take advantage of the new communication technologies such as electronic mail, web pages and video conferencing.

Knowledge capital is a fundamental part of the organisations of the 21st century. It implies being open to cultural change and to different ways of doing business, where producing ideas is becoming as important than producing goods.

**Economic Impact**

In evaluating the economic impact of a cluster it is important to be sustainable in the market. The economic impact has to be related not only to the cluster, but also to the regions where the people belong. There are four sub-indicators that could be used: job quantity, job quality, business vitality and economic capacity.

Job quantity provides information about the number of jobs within the cluster and during its evolution. A cross-cluster study will also support the analysis of cluster growth and improve cluster jobs growth. Finally, a perspective on total jobs in the region will indicate the rate of employment growth in the cluster.

Job quality analyses the average of employee real wages, and it provides a basis of comparison with the rest of the region, and even with the state. Job quality also refers to whether or not the jobs are full time, part time or casual, and to the level of the occupations: technical and professional, skilled and unskilled. It is an indicator that informs about the quality of life in the region. Cross-cluster analysis will provide indications of these trends within the regional economy.

Business vitality refers to export sales, the number of new business start-ups, and the average value added per employee per annum. The average number of employees per firm is also an indicator of the evolution of business vitality.

Economic capacity can be measured through the amount of venture capital invested in firms in the cluster, the percentage of revenue spent on R&D by public firms and the average vacancy rates for office space and warehouse space, and money invested in R&D & industrial manufacturing. It is important to observe that the economic capacity of the cluster and the region are growing.

**Confidence in the Cluster**

The level of confidence in the cluster is an indication of business vitality, and it is important to make decisions that may impact on project development and employment. It is also important to generate trust, seen to be one of the major factors impacting upon cluster development. Interviews and surveys should be used to monitor the level of satisfaction and confidence in the cluster. It can be done at all levels of the cluster: the core firms, the political institutions, the community, the supporting firms, and the global customers or partners. Evaluating the level of satisfaction of all members of the cluster at the local and global level is indicative of the cluster's health. It is extremely useful to test how the strategies of the leadership team impact on the cluster members. This is also a measure of the sustainability of the cluster beyond facilitators and brokers.
Monitoring the cluster is perhaps the most important function in the diagnosis of the cluster. Because clusters are an innovative industry strategy, it may difficult to believe in their effectiveness without continual rigorous analysis. Systematic evaluation will monitor whether or not clusters are fostering innovation and competitiveness, not only in relation to its economic impact on the region, but also in relation to its focus on knowledge transfer, communication links and the generation of confidence.
F Conclusions and recommendations

This four month research project has reported on the dynamics of industry clusters as regional agglomerations of industry sectors. The work of academics and developers has been combined to compile models and strategies seen to be contributing to the success of industry clusters. This study has focused on the components of cluster maps, the factors impacting leadership teams, the strategies for cluster development, and the indicators to monitor the cluster.

There are three common factors in these themes: competitiveness, innovation, and the need for using a model of applied research. Competitiveness is the goal of industry clusters, and it requires a common sector strategy to be part of the global market. This strategy should be orientated to the assimilation of information, the facilitation of learning, and a growth in knowledge. However, to be competitive on the global economy requires firms to be innovative, a process not free of barriers. It is innovation in new products and processes that differentiates firms, and clusters should design strategies to promote innovation amongst their firms. Finally, putting in practice a model of applied research will bring insights and feedback into the strategies designed to make the cluster more competitive. This will work as a method of surveying cluster development, from its identification and diagnosis to its short and long time evaluations. Research feeds the need to build knowledge, facilitating learning and promoting innovation. The application of research closes the gap between theory and practice, applying successful strategies from other scenarios and avoiding reported pitfalls.

As an outcome of this research, the following recommendations can be made to government agents, developers, community leaders and researchers.

**Recommendation 1:**

The first recommendation is for interested stakeholders to combine to build a regional network of economic development. Clusters can be identified and mapped out through economic and geographic tools, but for a cluster to be effective it has to have an identity, a perception of operating with common goals, and a perception of the advantages of doing so. An important factor in making a cluster competitive is to build a regional network including the public sector, the private sector and non-profit organisations however all sharing an interest in regional development. It is the effort and awareness of the whole community that will create the competitive advantage that companies seek. Global competition will come from collaboration at the regional level. Clusters need resources to develop, and the public sector should support clusters as a regional phenomenon emerging from market forces which has potential to benefit the whole region.

**Recommendation 2:**

The second recommendation refers to the need to make the community aware of the meaning and benefits industry clusters. Innovative communities share the economic strategies of the region, and participate in its evolution. Ways to communicate the benefits of supporting cluster growth leading to a greater quality of life are the organisation of open workshops, and the production of leaflets explaining the concepts behind clusters and why they are important to the community. Economic strategies are impacting on community life everyday, and promoting an understanding of what these strategies are pursuing and what they may potentially achieve is a responsibility of developers and government agents. A community that knows its economic goals and objectives can positively contribute to the promotion and development of the region.

**Recommendation 3:**
The third recommendation is to organise a national cluster conference. Clusters have attracted attention from several different disciplines such as economics, geography, and political science, but there could be more transfer of knowledge from cluster to cluster within similar socio-political scenarios, such as regions within the same country. A conference or forum will facilitate the extension of linkages to parallel clusters and the organisation of region-to-region networks. Cluster facilitators and cluster members need to design and apply strategies, most of them very innovative. A cluster conference will facilitate learning and transfer of information, both factors which impact on cluster competitiveness.

Recommendation 4:

The fourth recommendation refers to the development of international linkages. Successful industry clusters can be found in different parts of the world, and they have lessons for other cluster developments. Building international networks, cluster to cluster, will provide insights on the dynamics of clusters, their life cycles, barriers and limitations. Such networks would also provide trade opportunities for the regions. International linkages would also promote the region’s strengths permitting to explore new markets.

Recommendation 5:

Finally, further research into industry cluster dynamics will bring insights into the learning process of the cluster, as well as further determining factors impacting on the diagnosis of competitiveness and its evaluation. Applied research on cluster development is one factor of success. Factors identified through research should be applied to the exercise of mapping the cluster, the production of an operative plan and facilitators’ manual, and the exercise of monitoring and evaluating its development.

This study strongly recommends overall that industry clusters be identified and developed on a regional basis. Clusters offer the potential to make regions more competitive on the global market, thus offering a higher and more sustained quality of life.


Crossing into the Heart of Your Business. Oliver Wight, Essex Junction, VT.


