Facilitating Emergence of an ICT Industry Cluster

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Abstract

Michael Porter and others suggest that the interactive dynamics between industrially related organizations within a circumscribed geographic area can help to form an "industry cluster", where the dynamics helps them to substantially improve their international competitiveness compared to organizations working in isolation. Following suggestions based on a paradigm of organizational emergence, the authors have intervened in their local area to see if they can crystallize the emergence of an industry cluster to address the ICT needs of organizational knowledge management. Although the ultimate success of the interventions remains to be demonstrated, this paper outlines the theoretical framework, some interventions, and the results of these interventions towards formation of an active cluster. We have observed that some low cost interventions appear to successfully build the kinds of interpersonal knowledge transfer relationships that historical studies suggest facilitate the emergence of successful clusters.

Keywords

Industry cluster, organizational dynamics, emergence, knowledge sharing, case study

1 Introduction

Technology clusters in some countries and regions have achieved phenomenal successes exporting into worldwide markets, e.g., Silicon Valley for information technology [Kenny & von Berg, 1999], Finland for mobile telecommunication [Paija, 2001], and North Jutland in Denmark for wireless communication [Dahl et al., 2005, Pedersen, 2005]. Michael Porter [1990], in his seminal book, The Competitive Advantage of Nations, suggested that certain kinds of dynamic interactions among organizations facilitated by geographic proximity (i.e., the formation of an "industry cluster") can help to improve their competitiveness compared to organizations working in isolation. These clusters seem to represent a form of concurrent enterprising that may arise autonomously. Many governments seek to facilitate emergence of clusters in their regions, but experience shows clusters do not form easily [Martin & Sunley 2003; Johnston 2003]. This paper explores some factors of organizational dynamics that may facilitate emergence of self sustaining cluster dynamics, and describes early stages of a case where we have used low cost interventions to manipulate some of these factors.

2 Existing Work and Background Theory

2.1 Cluster theory and research

According to Porter [1990], "a cluster consists of industries linked by vertical (buyer/ supplier) or horizontal (common customers, technology, channels) relationships." Key features include local linkages and formal and informal interactions to share ideas and knowledge. Observing successes, many governmental organizations hope to facilitate cluster

formation in their regions. Johnston [2003] lists circumstances that should contribute to cluster formation, including (1) easy exchange of knowledge, information and ideas between firms – especially tacit and informal knowledge, (2) access to generic qualified labour, (3) access to markets, (4) access to new ideas, (5) access to specialised services or facilities and (6) access to highly skilled and specialised staff. However, even when these conditions exist, only occasionally do they give rise to the kind of self-sustaining structure that grows to dominate a market. Yet, when cluster members do interact effectively, the result is a powerhouse for concurrent innovation, development and marketing that can contribute significantly to the total export success of their host nations.

To date most studies have involved retrospective analyses of successful clusters to identify historical circumstances and environmental factors that may have contributed to the growth and maintenance of particular clusters [e.g., Dahl et al., 2005, Paija 2001, Pedersen, 2005]. Pederson suggests that local universities can play a profound role. Our approach to cluster formation begins with practical experience facilitating the coalescence and emergence of self-sustaining communities for knowledge sharing and innovation in distributed engineering, technical and scientific organizations.

2.2 Biological theory of organization

The present work benefits from a "biological" paradigm of the emergence and growth of knowledge-based organizations based on Karl Popper's [1972] evolutionary epistemology and his "three worlds" or ontological domains, combined with Maturana and Varela's [1980] autopoietic definition of life [Hall 2005, 2006a; Hall et al., 2005, Nousala et al., 2005, Nousala, 2006].

Popper [1972] defined three ontological domains or "worlds": W1 – dynamic reality, or the real world and everything that goes on in it without interpretation; W2 – cognition, embodied or "subjective" knowledge, and by extension the control information embodied in the dispositional behaviours of cybernetic structures; and W3 – "objective" knowledge that is persistently encoded in inert structures having the capacity to be decoded to influence the dynamics of W2 processes. W2 and W3 are intimately associated with living things. In humans, knowledge in Popper's W2 equates to Michael Polanyi's [1958] personal or "tacit" knowledge.

Varela et al. [1974] as summarized by Hall, considered that the possession of six criteria were necessary and sufficient to recognize a system as being alive: (1) Self-identifiably bounded, (2) having individually recognizable components within the boundary (complex), (3) being mechanistic, (4) having internally determined system boundaries internally determined, (5) system components intrinsically produced, and (6) where self-produced components are necessary and sufficient to produce the system (autonomy). Maturana and Varela [1980] argued that cognition, and thus knowledge, are fundamental properties of autopoietic life. Hall [e.g., 2006a] also argues that "knowing" and various forms of knowledge are fundamental in the emergence and evolution of autopoiesis, which at least in theory can emerge at any focal level of organization able to support sufficiently complex dynamic systems [Salthe 1993, 2004], whether single cells comprised of macromolecules, multicellular organisms comprised of cells, or organizations comprised of people.

Autopoietic organizations have emergent properties beyond any sum of the properties and capabilities of the individual human members of the organization. To survive in competitive environments, organizations must assemble, deploy, preserve and replicate knowledge in response to environmental demands. Knowledge in the organizational context is that which has survival value, e.g., Nelson and Winter's [1982] observed that organizations have "hereditary" knowledge in their own rights, comprising competence, learning and routines.

In the past we mostly focused on practical issues of implementing ICT systems and communities of practice within autopoietic organizations [Hall et al., 2002, Nousala, 2006, Mo et al., 2006]. We are now attempting to see if these ideas can be applied to the emergence of organizations of organizations, as in the formation of an industry cluster.

3 Research Population and Approach

Co. Name	Location	Product(s)	Exports	Web
Absolute Data Group	Brisbane	eng. tech. doc tools / services	**Y+**	http://www.absolutedata.com/
Allette Systems / Adobe	Sydney	doc tools / support services	**na**	http://www.allette.com.au/
Eurofield Information Solns	Sydney	e-doc compress/ delivery tech	**Y**	http://www.eis.com.au/
Eden Technology	Sydney	maintenance / supply mgmt	**Y**	http://www.eden.com.au/
Turn-Key Systems	Sydney	XML pub solutions	**Y+**	http://www.turnkey.com.au/
Elkera	Sydney	doc automation / content mgmt	**Y**	http://www.elkera.com/
Mincom	Brisbane	maintenance / supply mgmt	**Y++**	http://www.mincom.com/
HarvestRoad	Perth	training / e-content mgmt	**Y+**	http://www.harvestroad.com/
TeraText Solutions / SAIC	Melbourne/ USA	XML content mgmt / delivery	**Y++**	http://www.teratext.com
Exari Systems	Melbourne	XML doc auto / content mgmt	**Y+**	http://www.exari.com
KDR Creative Software	Melbourne	maintenance / supply mgmt	**Y+**	http://www.kdr.com.au/
Concentric Solutions / 3dS	Sydney/ Melbourne	engineering and PLM solutions	**Y++**	http://www.concentric.com.au; http://www.3ds.com
Product Lifecycle Mgmt (Aust) / UGS	Sydney/ Melbourne	engineering and PLM solutions	**Y++**	http://www.plma.com.au; http://www.ugs.com
CommonGround	Melbourne/ USA	e- collaboration / publishing	**Y++**	http://commongroundgroup.com/
Tenix Group subsidiaries	Melbourne	eng systems & project mgmt	**Y**	http://www.tenix.com
Intelligent Transport Systems – Australia	Melbourne	transport R&D	**na**	http://www.its-australia.com.au/
CSIRO	All Australia	technology R&D	**na**	http://www.csiro.gov.au
DSTO	Australia	Defence tech. R&D	**na**	http://www.dsto.defence.gov.au/

Table 1. Commercial organizations available for clustering in Melbourne, Australia. In the Company column, where two company names are separated by a slash "/", the first company provides local domain expertise and the second company is a large overseas owner or technology supplier. In the Exports column, Y indicates that the company successfully exports, Y+ export sales comparable to

local market, Y++ indicates global player (or a global player with a significant presence in Melbourne).

The present work attempts to test our theoretical understanding of organizational forms in a new framework – that of crystallizing the emergence of cluster dynamics in a geographically compact group of organizations (Table 1) available for clustering, who have not previously interacted dynamically, despite geographic and other opportunities to do so.

The city of Melbourne in Australia offers ingredients for a significant industry cluster developing ICT applications for managing and sharing technical data and documentation for extended and virtual enterprises (Figure 1).

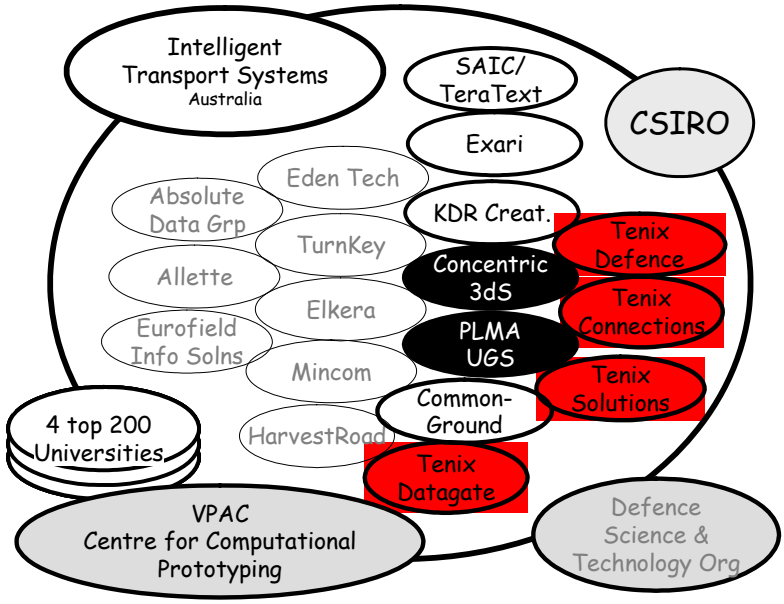

Figure 1. Potential Australian cluster members. Solid borders and print – located in Metropolitan Melbourne. Grey borders and print – located in other Australian regions. White on black background – Enterprise systems suppliers/implementers. Black on red background – Tenix subsidiaries.

Mostly associated with his work for Tenix, a large engineering project management company, Hall has become familiar with these organizations through a variety of one-on-one engagements with them – in some cases going back more than ten years. Nousala has been associated with this work for more than two years, initially as a KM Intern with Tenix. In 2005 we began a series of relatively minor (and un-funded) personal interventions suggested by our theoretical frameworks to see if we could crystallize inter-organizational interactions that would lead to the emergence of self-sustaining (i.e., autopoietic) cluster dynamics.

The ingredients include major aerospace and defence clients for such applications (e.g., Tenix), local SME software developers producing potentially synergistic applications, system integrators, eight large universities - including three ranked by the Times Higher Education Supplement (2006) in the world's top 100, a range of R&D organizations able to provide skills and incubation environments, and local support teams and offices for trans-national companies producing engineering enterprise applications [Hall, 2006b]. Excepting Mincom with around 1,200 employees, IP developers in this group range in size from 10 to 50 staff, but despite their small size, they offer a rich mix of potentially synergistic corporate competencies. The individual products developed by its members all have established export markets. For example SAIC's Melbourne developed TeraText has a significant market in North America, and is used in the knowledge base developed for the EU FP6 Reorient Project [Wigan et al., 2007]. It is also evident that there is the potential for great synergism among the groups products to address technical data and knowledge management requirements for concurrent enterprising in an integrated manner. Hall [2006b] argues that

the intellectual resources this group provides and that are available in Melbourne to address this world-wide need are unmatched in any other metropolitan area in the world..

4 Findings

Before 2005, despite the presence in the local environment of the positive factors mentioned by Porter [1990] and Johnston [2003] as detailed in Hall [2005b], there was no evidence for the development of cluster dynamics among this group of organizations. Factors thought to contribute to cluster development include the use or trialling of several products and services from the group within the Tenix environment, and that IP developers of five organizations and IT labs of two top 100 universities are all located in metropolitan Melbourne within walking distance of each other. Although the group has not yet achieved the status of an active cluster, we have seen that some kinds of intervention have been helpful and identified at least some of the missing ingredients.

4.1 Promising interventions

Although this work is still very much in progress, we have observed that some low cost interventions appear to help establish the kinds of interpersonal knowledge transfer relationships that historical studies suggest lead to the emergence of successful clusters. These interventions include

- Provision of “human attractors”. These are charismatic people whose interests establish connections and a focus among a variety of other individuals sharing those interests in common [Nousala et al., 2005b, Nousala, 2006]. Hall has served in this role through his participation in many industry conferences and interfacing between Tenix and members of the group.
- One-on-one orientation meetings with organization principals. Human attractors meet with principals of the organizations to explain the dynamics that clusters exhibit and show how these can benefit organizations forming a cluster. Hall and sometimes Nousala met with principals and IP developers in most of the group's organizations. Hall's [2006b] working paper was circulated and discussed in these meetings.
- Targeted inter-organizational workshops. Several inter-organizational workshops have been held among cluster members on specific issues of common interest, sometimes in association with Tenix Support Engineering community of practice meetings and/or together with appropriate industry conferences. These workshops have typically involved all of the Melbourne-based SMEs, some interstate SMEs, some potential client organizations and some university members. From group discussions in these workshops it is clear that principals all understand the concept and theoretical value from developing cluster dynamics, and that they would be willing to work together to integrate their products if the opportunity arose to do so.
- Joint projects. Although past projects involving organizations in the community did not result in significant cluster dynamics, there has been some minor exchange of staff among them. Future joint projects will be planned to encourage dynamics.
- Academic involvement. Negotiations are progressing with a major local university to establish a research, development and teaching centre focusing on cluster needs and products [2006b].

4.2 Impediments and missing ingredients

Probably one reason the companies have not interacted synergistically to date is that they have simply been too busy. As is often the case, each of the SME companies was built by a small number of entrepreneurial IP developers who are absorbed in running their own

businesses. In discussion with them it is clear that they understand the advantages of working together with similar organizations, but this is a new way of working for them, and any change will take time and attention away from the current business.

Where Tenix, as a customer, has interacted with members of the SME group, this has been via linear supply chain relationships, in most cases involving only one of the SMEs. In a few cases, the leads have in turn contracted for specific services from one of the others. Except for an unsuccessful bid several years ago to provide an integrated logistics information management system, no attempt has been made to work in a way that has required direct collaboration of the IP developers of different companies. Consequently, close personal acquaintance that is believed to foster cluster dynamics between different organizations [Pedersen 2005] has not developed. For example, there has been little exchange of personnel between organizations in the study group. A possible reason for this is that Melbourne offers a plethora of generic opportunities for people with ICT skills beyond the margins of the study group. Also, one of the key factors Pederson recognized in his study was that a substantial fraction of the cluster's knowledge workers had completed their studies in Aalborg University - the major educational centre in the region offering appropriate programs. In Melbourne, the very richness of its educational establishment and the wide variety of programs offered by the different universities effectively minimized opportunities to establish networks based on shared academic backgrounds.

Finally, the most obvious missing ingredient is an immediate financial incentive to work together. The SMEs depend for their survival on maintaining cash flows, and do not have resources to invest in new ways of working that don't offer the immediate prospect of income, even if these offer the potential to deliver much greater future revenues.

5 Discussion - emergent and sustainable clusters

As Johnston [2003] notes, clusters are not easily brought together by outside intervention. On the other hand Silicon Valley [Kenny & von Berg, 1999], the Nokia Cluster [Paija, 2001] and the North Jutland Cluster [Dahl et al., 2005; Pedersen, 2005] all appeared to emerge spontaneously as dynamic entities able to sustain themselves as economic dynamos in world markets. This seems to have happened without any conscious design or directed processes. Sustainable clusters are complex dynamic systems bound together by ties comprised of personal networks, economic relationships and tacit and explicit knowledge exchanges. As such they appear to be on the borderline of becoming autopoietic entities, where subsystems below the focal level are entrepreneurial companies and other constituted organisations, and the supersystem or environment in which they act is the global economy. In the Danish studies [Dahl et al., 2005; Pedersen, 2005], it is evident that organic processes of largely tacit knowledge exchange (TKE) [Nousala 2006; Nousala et al. 2005b] through close networks have supported the emergence and sustenance of industry clusters as a larger organizations of organizations. The networks have formed spontaneously via common education, staff migration between organizations and involvement in joint projects.

Hall [2006a] argues that the creation of tacit (Polanyi) or "dispositional" (Popper) knowledge at the focal level is causally associated with the emergence of autopoietic dynamics. In a super-organization, as an industry cluster is supposed to be, this organizational knowledge is tacit [Nelson & Winter 1982], represented in such things as undocumented routines, jargons and tacit relationships among people in the different organizational sub-systems contributing to the super-organization. Hall also notes that autopoiesis is a dynamically recursive dissipative process that must continually expend free energy (exergy) in order to maintain regulatory feedback control over its dynamics to avoid dis-integration. In other words, the system must conduct a flux of energy that is partially diverted to feedback mechanisms maintaining the stability of the flow. Thus, for complex dynamics to emerge, there must be a

source of free energy able to support autopoietic "metabolism". In the world of organizational autopoiesis, this "metabolism" is driven by cash flow from "revenue" to "expenses".

In Melbourne, despite the presence of many conditions that appear to be even more favourable than was the case in the Danish cluster [Dahl et al. 2005; Pedersen 2005], the Melbourne group has not developed sustainable cluster dynamics. Conditions in Melbourne are ideal for sustaining TKE via tacit networking, and we have little doubt that TKE would quickly establish itself once the group's organizations began to interact in any regular way. On the other hand, there is nothing in the current economic flows to promote the development of cluster dynamics. Each company is independently fuelled by its own markets. In order to begin working together, funds would have to be diverted from these independent flows to build inter-company relationships. What is needed is either one or more sources of funding that could be accessed only if the companies worked collectively, or the establishment of some collective facility that would provide cost reduction advantages from collective work. An example of the former might be a client contract requirement for an enterprise knowledge management system that would benefit from synergistic capabilities provided by an integration of several currently stand-alone systems. The latter might be provided by establishment of a common R&D and integration lab at one of the academic institutions that could also provide appropriate education for member SMEs and system clients. In either case, the initial seed funding would have to come from external sources.

6 Conclusion

More work will be required before the inter-organizational relationships being built in the incipient Melbourne cluster begin to feed through to increased export success, but as a consequence of the last year's interventions, interactions are beginning to show the advantages of concurrent enterprising. There may be more to report by the time of the Conference.

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(Note: all URLs valid as at 12 April 2007)

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