Journal of New Business Ideas and Trends 2005 3(2), pp.49-56

Identifying Emerging Industries through Meso-Micro Level Analysis

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This paper examines the methodology employed in a project undertaken in Western Australia to identify and map the existence of industry clusters within the creative digital industries. Utilising a standard industry concentration and location quotient technique, the study team identified above average industry and employment concentrations in 59 selected industries considered to have high levels of digital content intensity. The study found industry and employment concentrations in seven key areas: i) spatial sciences; ii) engineering; iii) construction; iv) education and training; v) creative; vi) media and vii) medical science. These were then grouped into two potential industry clusters. The first focused on the Digital Spatial Industries and the second on the Digital Creative Industries. Analysis of longitudinal data sets found emerging and established industry segments within these two clusters and case study and survey findings identified issues facing businesses within these sectors. These findings point to the need for cluster development to be based on both statistical foundations from established employment and industry data sets, and an in-depth assessment of the activities at the business unit level gathered through survey and case studies.

Defining and Measuring Industrial Clusters

Defining an industry cluster is difficult because part of the definition relies on available data and methodological constraints. Rosenfeld (1997) noted that "there are as many definitions (of clusters) as there are types of organisations using the term". Clusters have been defined as groups of interrelated companies and associated institutions (e.g. industry associations, universities) that cooperate and compete to drive wealth creation within a defined geographic area (Porter, 2000). Measurement and analysis of clusters typically uses employment and industry concentration data (Baptista, 1998). However, what also needs to be measured are factors such as the flow of information, innovation, skills and people, as well as the social factors affecting trust and openness between company owners. According to Doeringer and Terkla (1995):

> "Although inter-industry transactions incorporated within production channels can sometimes be detected in input-output tables, neither the character of relationships among firms nor the benefits of clustering can be discerned in this way."

It is the contention of this paper that a more holistic approach is required to the measurement of clusters; one that encompasses both the macro employment and industry concentration data from industrial economics, and the micro-level

examination of what takes place at the firm level. To achieve this additional methodologies are required that draw from the strategic network theory of the firm.

Cluster Theory – A Brief Overview

While the agglomeration of industries into clusters has been known for centuries, its contemporary analysis can be traced to the 1970s where the dynamic nature of small to medium sized firms collaborated to create enhanced employment and economic growth despite the decline of other, usually larger companies (Isaksen, 1996; Rosenfeld, 1997). This was later recognised as offering region's the potential to create a competitive advantage (Porter, 1990). Of importance was the quality of 'buyer-supplier relationships' and 'competitor and collaborator relationships' which are viewed as essential for cluster growth and development (Anderson, 1994).

In addition to the importance of industry supply chain relationships, cluster theory has seen recognition of the role of human capital and the positive benefit it has when enhanced via education and then concentrated within a region (Lucas, 1988). Glaeser (1998) identified the concentration of human capital (i.e. highly educated people) as important in cluster development as 'places with higher levels of human capital are more innovative and grow more rapidly and robustly over time' (Gertler, Florida, Gates & Vinodrai, 2002). Human capital, particularly creative, knowledge-based skills and diversity of ethnicity and outlook are now recognised as playing an important role (Florida, 2000; 2002). The rejuvenation of many otherwise economically stagnant urban regions has also been attributed to the concentration of intellectual talent and creativity producing 'learning cities' (Larsen, 1999).

Custer Studies and Methodologies

Despite the high level of interest in clusters there remains a body of opinion that industry clusters have been in existence for centuries and occur whenever agglomerations of industries are found, and that such clusters may not offer any intrinsic innovation (Enright, 1996). A major challenge in developing industry policies using cluster analysis methodologies is the difficulties of establishing clear definitions and agreed measures for mapping and analysis. Government interest in cluster research and analysis has been driven by the anticipation that such studies can provide guidance to policy makers seeking to enhance the economic development of regions. However, while such analysis can provide valuable insights into the factors influencing regional economic growth and change, caution needs to be taken to avoid using cluster studies as a means of 'picking winners' (Porter, 2000).

Cluster analysis can be useful for mapping industry landscapes to reveal what already exists within a given region, or to determine if a given region appears to have suitable underlying potential to support certain types of cluster. These studies are often used to either encourage industry and regional economic growth by promoting synergies between existing firms or industries, and those seeking to facilitate the growth of new industries (Fesser & Bergman, 2000). Studies can either be micro-level cluster applications (e.g. targeting single industries or specific firms and their supply chain networks), or 'meso-level' cluster applications (e.g., examining regional industries by sector) (Fesser & Bergman, 2000). Micro level studies tend to employ methodologies that are labour intensive such as face-to-face interviews and focus groups. These techniques yield a rich level of data at the industry or firm level, but are expensive and time consuming. However, the micro level analysis is appropriate when researchers are seeking to study a tightly defined and specific industry looking for evidence of clustering behaviour. By comparison, the meso-level analysis provides a more complete picture of entire industries and is more likely to make use of secondary source statistical data such as employment or industry concentration tables.

While micro-level analysis techniques offer rich data and an opportunity to find out directly from actors within the region's

industries what is being experienced, they suffer from problems of external validity as the findings may not be representative of all regions or even other industries found within the same region. By comparison, meso-level analysis, while often able to provide useful benchmarking, is limited by problems with comparability of data. For example, the standard industry classification index (ANZSIC) forms a useful benchmark for comparison of regional employment and industry concentrations. However, this data is focused on industry sectors not industry clusters that tend to overlap standard sectoral boundaries. Furthermore, these SIC codes are often of limited use when seeking to measure new industries that are not well classified by the established industry schema.

The field of industry cluster analysis has emerged as something of a hybrid discipline, with contributions from economics, geography and management studies to name only three (Baptisa, 1998). An examination of the current cluster measurement approaches suggests that there appears to be no standardised approach to cluster analysis, and only a few generally accepted procedures (Fesser and Bergman, 2000). Use of location quotients identifying employment and industry concentrations or similar concentrations of human capital (e.g. talent, creativity and diversity indices) provides only a partial picture explaining the dynamics of clusters. Also required are micro-level analysis techniques designed to drill down to the firm level and explore the value chain relationships and strategic networks that provide the basis for understanding the full dynamics of industry cluster behaviour.

Mapping the Digital Economy - Definitions

In 2004 the authors were tasked to undertake an industry cluster study designed to determine the prospects for the development of the digital content industries in Western Australia (Mazzarol, Patmore, van Heemst, Wong & Adam, 2004). Funded by the Government of Western Australia, the primary objective of this study was to:

> "Identify opportunities for enabling the formation of a Digital Content Industry cluster in Western Australia. The focus of the industry development and skills development needs necessary for such an industry to be viable."

A major initial challenge for the study team was to develop a workable definition of the 'Digital Content Industry'. Like many newly emerging industries digital content is poorly defined and has not yet generated any universal agreement in relation to its exact boundaries or structure. Digital technologies, particularly those involving information and communications technologies (ICT) have developed at such rapid pace in the past three decades that they have spawned entirely new industry sectors. Furthermore, digital applications have forced a convergence of existing industry activities that were once conducted as separate and discrete sectors (Baldwin, 2004). This has served to blur the boundaries of the established industry classifications making mapping difficult.

Most definitions of the digital economy are very broad, encompassing almost all areas that make use of digital information and technology. However, as the spread of digital technologies widens to encompass an ever increasing number of industry sectors, such definitions become of limited value. Most relevant studies of the digital content industry focused attention on isolating out the creative industries engaged in the production of original digital content (e.g. computer gaming, multimedia, digital film) (Cutler, 2002; NOIE, 2002).

The Australian Federal Government's Digital Content Industry Action Agenda provided a broad definition of the creative industries that complement the digital content industry (UK Creative Industries Taskforce, 1998). While useful this did not provide an adequate distinction between digital content and digital applications and services (Pattinson, 2003). Of key importance to the definition of creative digital content were those industry sectors where there was an identifiable intersection of the three key areas of

telecommunications, information technology and information content (OECD, 1999). A particular focus was placed on those sectors that contained digital content originators who held some or all of the intellectual property (IP) rights to the material they generated. Also of importance was the need to capture communities of practice where participants are difficult to identify as belonging to a particular industry (Wenger, et.al., 2002). For the purposes of this study the digital content industry as it applied to Western Australia was defined as follows:

> "The digital content industry which is of strategic importance within Western Australia can be defined as those activities that generate digitally storable and transferable content in which the intellectual property ownership remains primarily in the state and which use creative and/or technical skills to produce commercially valuable products or services."

This definition was used because it recognised that attention needs to be given to those industry actors and activities that are strategically important to the growth and development of the local digital content sector. Further, the definition highlighted the importance of locally generated and owned IP as a key ingredient in the future of the sector. The definition did not suggest that all the IP should be retained locally, but if the WA digital content industry was not able to control the IP or secure its value, the longer term growth prospects of the sector were likely to be doubtful.

Methodology

The methodology used in this study comprised several phases that involved both meso-level analysis using employment and industry concentrations based on ANZSIC codes, and micro-level analysis using case studies from personal interviews. Initial industry categories were selected from those used by the NOIE (2002) study of the Australian digital content cluster analysis. From within the 2,600 Level 5 industry categories within the Sensis database and 400 ANZSIC Level 4 categories used by the ABS a list of 59 industry sectors were selected. These were chosen for their potential to be engaged in the digital content industry according to the definition employed.

Having selected these potential industry categories a telephone survey was conducted with a sample of 216 businesses drawn from within these industry segments. This survey was conducted with senior managers from each firm and explored their involvement in the digital content industry, how many years the firm had been in the industry and aspects of their production of digital content, plus size and nature of operations. Meso-level data analysis identified potential cluster groups and tracked the growth of industries over a four-year time period.

Micro-level analysis was undertaken via a series of 10 case studies of 'focal' firms within those industry sub-sectors identified at the meso-level to be of potential interest. Case study methodology allows investigation of research issues that cannot be appropriately studied using solely quantitative methods (Yin, 1989). It allows an in-depth understanding of behaviour that is common when studying small business entrepreneurs (Chetty, 1996). The case studies were examined against a framework of strategic networking theory mapping, their production network or supply chain relationships (e.g., customers and suppliers), their links to resource network actors (e.g., financial institutions, universities and colleges), as well as the social networks of their key managers and owners (Holmlund & Tornroos, 1997). A key part of this analysis was the preparation of strategic network diagrams illustrating their production, resource and social networks, indicating both the strength and nature of these relationships.

The findings from the meso and micro level analysis were subsequently used in a series of four industry and stakeholder workshops with representatives from a wide cross-section of industry sectors found within the digital content industry of the State. These provided the research

team with valuable market intelligence from which to design and develop future cluster enhancement strategies and make subsequent recommendations.

Findings

The majority (92%) of digital businesses in WA are concentrated in the Perth metropolitan area, with 82 percent of employment in the digital sector also located in the city. An examination of industry concentrations and industry growth rates over the past three years identified a cluster of high growth, high concentration industries, a second cluster of potential emerging industries and a third cluster of industries requiring attention.

Table 1 shows the findings from this analysis listing those key industry sectors in each category of interest to the study. A high or low industry or employment concentration is reflective of a location quotient. To derive employment and business concentration ratios for an industry, the percentage of regional employment/business in an industry is divided by the percentage of city, state or national employment/business in that same industry. A concentration ratio that is greater than 1 is evidence of an industry or employment concentration within a specific sector that may be important in the formation of a cluster. High or low growth industries are those that have experienced an annual average growth rate of greater than 1 over the time period, which in this case was 5 years of trend data for specified industry sectors.

Table 1: Business Growth and Concentrations in the Digital Content Industries

*GROWTH:**	*LOW*	*HIGH*
*CONCENTRATIONS:*** *HIGH*	• *Design engineers* • *Electrical engineers*	• *mining engineers* • *surveyors* • *cartographers* • *naval architects* • *marine engineers*
LOW	• *photography & video schools* • *music publishers* • *film & TV schools* • *Data processing*	• *Combustion engineers* • *Designers* • *Planners* • *Newspapers* • *Book Publishers* • *Cartoonists* • *Writers* • *Commercial artists* • *Media information services*

** High Growth = those industries with annual average growth > 1*

*** High concentrations = those industries with location quotients > 1*

The high growth, high concentration sectors reflect the nature of Western Australia's core industries, which are based on mining and resources, property development and construction, and shipbuilding. Each of these sectors makes use of digital content to generate 2-dimensional and 3-dimensional models and related software programs used in design and construction or spatial science applications. By contrast the high growth, low concentration sectors reflect a range of creative industries that comprise digital content focusing more on multimedia, graphics and design. These are potential emerging industries within the state.

Two broad communities were identified from this analysis. The first was the creative artistic or Creative (A) community, and the second was the creative technical or Creative (T) community. Most of the Creative (T) industries were located within the high growth high concentration sectors, reflecting their strong footprint in the resource rich WA economy. Most of the Creative (A) industries were located in the high growth, low concentration sectors, suggesting that they may be potential emerging industries.

Of the 216 firms surveyed from within the 59 selected industry sectors the majority (92%) confirmed that they considered their firm was actively engaged in the digital content industry, and 61 percent reported that they were generating such content in-house. Seventy-six percent said that they were aware of examples within their industry in which product would be produced in a purely digital form. The majority of respondents (64%) indicated that they would expect to be moving more into digital content generation in the future. The majority of firms (92%) expressed satisfaction with the skills of their existing workforce. The level of digital intensity of these firms was also examined.

Drawing together the industry and employment concentration data with the findings of this survey a series of seven industry concentrations were identified as comprising the general landscape of the WA digital content industry. These were:

1. Spatial industries (e.g. surveying, map making and satellite imaging)
2. Engineering industries (e.g. mining, electrical, electronic, computer)
3. Construction industries (e.g. architects, civil engineers, structural engineers)
4. Medical and scientific (e.g. medical imaging and virtual reality training)
5. Creative industries (e.g. graphic design, multimedia, film & TV, advertising)
6. Media industries (e.g. newspapers, TV, libraries)
7. Education and Training (e.g. universities and VET colleges).

Two potential clusters were identified comprising a Spatial Industries Cluster that draws together the spatial, engineering, construction and medical scientific sectors, and a Digital Creative Industries Cluster comprising the creative and media sectors. The 10 case studies undertaken for the project highlighted the strong dependency of the spatial industries cluster to the mining and resources sector, and the key role of the WA Government. Within the digital creative industries cluster these cases highlighted the lack of local market access for WA firms, as well as a shortage of investment capital for these industries. Most of these firms were very small and operated more via communities of practice than conventional industry supply chains.

Discussion and Conclusions

This study illustrates the benefits of utilising a range of methodologies when seeking to undertake cluster mapping projects. The combination of meso-level and micro-level analysis techniques provided a more comprehensive picture than would have been the case with only the former or latter. Using employment and business concentration ratio data to help locate potential points of cluster formation is a well-recognised approach to cluster analysis. However, as this study found, such data analysis is limited by the amount of industry data that can be accessed, the aging of some of this data, and the limitations of the ANZSIC codes in adequately mapping new emerging industry sectors and the more informal grouping of communities of practice that would be otherwise missed with meso-level data analysis alone.

Use of micro-level data analysis techniques such as telephone surveys of firms within the targeted sectors, case studies from interview and industry workshops and focus groups, provides an opportunity to balance some of the limitations of meso-level data analysis. It also offers a powerful learning opportunity

with new information emerging about how innovation takes place at the individual firm level. Such analysis allows better targeting of industry support initiatives by policy makers as it has identified specific problems facing the industries that are likely to form potential clusters. Despite these advantages micro-level data analysis is time consuming and expensive to undertake and continues to suffer from issues of external validity.

Future research should focus on development of mapping techniques that allow reliable measures of the business and employment landscape, the human capital landscape, and the firm-level environment. Quantitative measurement of business, employment and human capital concentrations is already possible, additional measures are required to provide similar measures for firm-level strategic networking.

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