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Digital Communities

A Study to Determine the Feasibility of Creating a Digital Content Industry Cluster in Western Australia

The University of Western Australia | GSM

CEMI Centre for Entrepreneurial Management and Innovation

CEMI REPORT

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Executive Summary

This report outlines the findings of a study to examine the feasibility of establishing an industry cluster focusing on the digital content industry in Western Australia and the factors and skills development needs required for such an industry cluster to be viable. This study employed a methodology involving a literature review and definition of the digital content industry, the mapping of key industry and employment concentrations within the digital content sectors, a survey of key industry sectors, case studies of selected industry representatives, and a series of industry workshops leading to the study's recommendations.

Definition of the WA Digital Content Industry

The digital content industries are poorly defined and no single definition has been developed to encompass the entire sector in every context. This industry sector has emerged as a result of a convergence of activities within the telecommunications, information technology and information content areas. The study identified two broad communities that comprise the digital content sector. These were defined as the Creative (A) or artistic communities (e.g. multimedia, interactive games and TV producers), and Creative (T) or technical communities (e.g. spatial and engineering sciences). The key to long term development of a WA digital content industry cluster is dependent on the ability of local firms to secure control over commercially valuable intellectual property (IP). The definition of the digital content industry in WA is:

> *The digital content industry <u>which is of strategic importance</u> 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*.

Industry Clustering in the Digital Content Sector

An examination of the process of industry cluster development both within Australia and international highlights the importance of such clusters being built around a few specialised industries concentrated into a given geographical area. Such clusters also have effective local production networks supported by education and training institutions and research centres. Such clusters are highly innovative and grow by the export of their products into global markets. They have access to competent sources of venture financing and are defined by a high degree of collaboration among local industry participants. Finally, such clusters are linked to other clusters located elsewhere that offer opportunities for knowledge exchange. By nature the digital content industries are collaborative as most projects involve a mix of both creative and technical individuals.

Mapping the Digital Content Sector

Using business and employment data classified by ANZSIC code and geographic location, the study produced a series of location quotients in which the concentration of business or employment within a given ANZSIC classification within the state was examined as a proportion of total industry concentrations for this area, and in-turn as a proportion of the concentrations for the same industry sector at the national level. Industries with concentration ratios greater than one were identified as being of future importance as platforms for future cluster development.

From an initial list of 2,600 ANZSIC classifications a final list of 59 sub-sectors were selected as being within the digital content industries. 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. These were identified as:

- High growth/High concentration – mining engineers, surveyors and cartographers, naval architects and marine engineers;
- Potential emerging industries (high growth/low concentration) – designers and planners, newspapers, publishers, cartoonists, writers, commercial artists and media information services;
- Industries requiring attention (high concentration/low growth) – design and electrical engineers,

Findings from the Industry Survey

Telephone surveys of 216 firms were undertaken among the 59 industries selected earlier. When provided with a definition of the digital content sector 92 percent said that they considered their firm was actively engaged in the sector 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.

Digital Industry Clusters

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:

- Spatial industries (e.g. surveying, map making and satellite imaging)
- Engineering industries (e.g. mining, electrical, electronic, computer)
- Construction industries (e.g. architects, civil engineers, structural engineers)
- Medical and scientific (e.g. medical imaging and virtual reality training)
- Creative industries (e.g. graphic design, multimedia, film & TV, advertising)
- Media industries (e.g. newspapers, TV, libraries)
- 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 education and training sector is supportive of both clusters.

Case Studies and Industry Workshops

To explore these clusters a number of industry cases studies were developed and a series of industry workshops were held. These were used to examine the existing pattern of industry networking taking place within the seven industry sectors and to identify barriers and triggers to the development of future industry clusters.

The study identified two clear opportunities for the development of viable creative digital content clusters in Western Australia. These two opportunities exist in the spatial sciences and creative industry sectors. The spatial industry digital cluster offers the benefit of leveraging from its close relationship with the WA mining and resource sector, and the DLI, to develop innovative products that would not only benefit local industry, but also provide opportunities to commercialise world leading intellectual property. The creative industry cluster holds out an initial opportunity to leverage intellectual property developed in the WA education and training sector to provide value added content for broadband distribution to WA schools and colleges. Over the longer term the creative digital sector has other opportunities exporting product into the global educational and entertainment market. Provided they are given the opportunity to flourish, both of these clusters will provide high value employment opportunities to the WA community, and begin to position WA as the “State of Digital Innovation”.

Recommendations
From these considerations a set of ten recommendations were made as follows:

Recommendation 1:
That an action plan (Digital Innovation Strategy) be developed for the creation of digital content industries clusters focusing on the spatial and creative sectors. These should be built around the concept of “WA the State of Digital Innovation” and aimed at the development of local business ventures that possess commercially valuable IP that is predominately owned within the state.

Recommendation 2:
Establish a WA Office of the Digital Economy to be staffed with representatives drawn from a cross-section of government agencies and tasked with the responsibility to develop and implement the State Digital Innovation Strategy. Ideally, this agency should be brought under the Department of Industry and Resources.

Recommendation 3:
That two Digital Cluster Development Task Forces are established to provide a focal and coordination point for activities designed to facilitate the growth of industries in the local spatial and digital creative sectors. These cluster task forces would be led by Industry Advisory Boards comprising representatives from relevant industries as well as education and training institutions and government agencies. They would need an Executive Director appointed from industry and supported by a small secretariat. These task forces would report to the Special Minster for the Digital Economy via the Office of the Digital Economy and would have responsibility for the development of specific strategies targeting their respective clusters.

Recommendation 4:
That a branding and marketing process be undertaken to support the concept of “WA the State of Digital Innovation” and that this incorporate secondary brands focusing on the spatial and digital creative sectors. This process should aim to raise the overall profile of Perth as a centre for digital content generation and industry expertise making use of industry showcase activities.

Recommendation 5:
That the Government, in conjunction with industry, initiate at least two major projects focusing on the education and training sector, and creation of innovative digital spatial information products. The first of these projects would seek to generate a range of high quality interactive education and training products and programs for distribution to WA schools and colleges via the Internet or DVD. The second would seek to commercialise innovative applications of spatial data held by DLI for use in other industries such as agriculture, construction, transport, logistics and asset management.

Recommendation 6:
That a Creative Digital Industries Incubator be established based upon existing infrastructure with a focus on the development of innovation and commercialisation in digital creative products. The incubator would provide both physical and virtual facilities and would offer both common user infrastructure and business support and commercialisation assistance. The incubator should leverage the research, education and training activities being undertaken within existing institutions. While the incubator should serve as a focal point for existing communities of practice within the WA creative digital economy, entry to the incubator should be contingent on the formation of a business venture with commercially valuable IP.

Recommendation 7:
That a WA Digital Industries Fellowships Program be established with the purpose of expanding the international profile of local digital content producers and providing them with the opportunity to make short study tours to centres of best practice overseas. Applications would be competitive and evaluated on the level of innovation demonstrated by the candidate.

Recommendation 8:
That a WA Digital Industries Grants Program be established with the purpose of providing early stage seed funding to local digital content producers and offering them business development and commercialisation support as a preparation for future applications to larger federal funding schemes. Such grants would be competitive and based on demonstrated innovation and commercialisation potential.

Recommendation 9:
That a WA Digital Industries investment strategy be prepared with the aim of configuring the existing range of investment activities coordinated by the State Government to specifically target the digital content sectors. This should include a review of the charter of Screen-West to enable that agency to invest in creative digital content projects. This investment strategy should be coordinated via the proposed WA Office of the Digital Economy (see Recommendation 2), but with reference to the respective Digital Cluster Development Task Forces outlined in Recommendation 3.

Recommendation 10:
That an Internet Portal Architecture be developed with the view to providing a focal point for communities of practice operating within the WA digital content industries. Such portals should make use of the latest portal technologies and offer both a secure and public site for the marketing and showcasing of local digital economy communities, but also a focal point for ideas and information exchange among these communities. It is suggested that these portals (e.g. one focusing on the spatial and

the other on the creative sectors), be coordinated via the proposed Digital Cluster Development Task Forces (see Recommendation 3) under the guidance of the proposed WA Office of the Digital Economy (see Recommendation 2).

A Framework for Developing the WA Digital Content Sector

These recommendations should be viewed as comprising an integrated framework of mutual supporting elements that can serve to assist the long-term facilitation of the digital content industries in Western Australia. As illustrated in the diagram below.

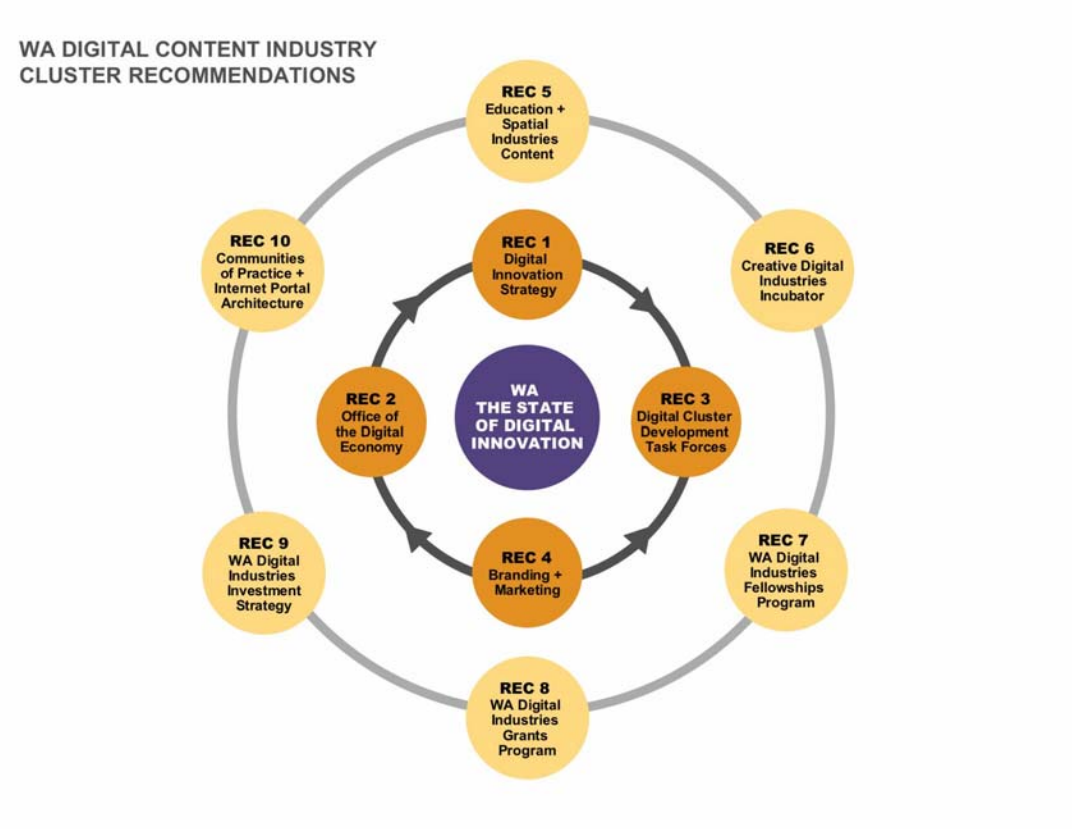


Figure 21: Framework the Digital Creative Industry Cluster

These ten recommendations comprise a central core of four strategic level initiatives designed to provide any future cluster development process with:

- **Leadership** – via the establishment of an Office of the Digital Economy;
- **Strategic Vision** – as provided by a WA Digital Innovation Strategy;
- **Industry engagement** – as enabled by the Digital Cluster Development Task Forces; and
- **Public Awareness Raising** – as enabled by the proposed branding and marketing strategy focusing on WA State of Digital Innovation.

Surrounding these core strategic initiatives are the final six operational initiatives that provide a framework to support and sustain the longer-term growth of the digital industries in the state. These six initiatives are focused on addressing the needs, identified in this study, for:

- **Large scale projects** (REC 5) – able to stimulate increasing digital content production in the state.
- **Enhanced commercialisation support** (REC 6) – able to assist the creation and growth of new business ventures in the WA digital economy.
- **Enhanced international benchmarking** (REC 7) – to assist local industry actors to access best practice networks overseas;
- **Increased Investment within the sector** (REC 8&9) – making early stage seed funding and longer-term business development venture financing more accessible to local firms in the WA digital economy; and
- **Enhanced local production networks** (REC 10) – assisting locally-based digital content producers to source skilled talent, identify local project partners and facilitate the flow of knowledge and creative ideas within the sector.

The Role of Government Agencies

Each of the government agencies that have commissioned and guided this study will need to take responsibility for implementation of each of these recommendations. These agencies will all need to collaborate over all recommendations, but each will have primary responsibility for particular recommendations. These responsibilities for the Department of Industry and Resources (DOIR), Department of Education and Training (DET) and Department of Culture and the Arts (DCA) are summarised as follows:

▪ Recommendation 1: Digital Innovation Strategy	DOIR plus DCA/DET
▪ Recommendation 2: Office of the Digital Economy	DOIR
▪ Recommendation 3: Digital Cluster Development Task Forces o Spatial Industries Cluster o Digital Creative Industries Cluster	 DOIR/DLI DET/DCA
▪ Recommendation 4: Branding & Marketing	DOIR
▪ Recommendation 5: Major projects o Creative Digital education content o Spatial industries projects	 DET/DCA DOIR/DLI
▪ Recommendation 6: Creative Digital Industries Incubator	DCA/DET
▪ Recommendation 7: Digital Industries Fellowships	DCA/DET
▪ Recommendation 8: Digital Industries Grants	DCA/DOIR
▪ Recommendation 9: Digital Industries Investment Strategy	DOIR

▪ Recommendation 10: Communities of Practice & Internet Portal Architecture	DCA/DET

Need for a Coordinated Education and Training Strategy
A particular role for DET will be to work via the proposed Office of the Digital Economy to develop a three-tiered education and training strategy designed to facilitate the work being undertaken in the other parts of the framework. This should focus on:

- **Development of a K-12 Curriculum for the Digital Economy** designed to enhance awareness of and skills in the production and use of digital content. This will require resources for Teacher in-service training and investment in facilities and equipment within the schools system. The creation of special **digital learning hubs** based on High Schools and feeding to primary and other secondary schools in their area is suggested as a potential structure. The primary focus for such a curriculum and strategy would be to bridge the digital divide currently emerging within the community.

- **Develop strategies to foster enhanced multi-disciplinary programs at post-secondary level.** DET should consider using major projects to bring together creative and technical communities within the VET/TAFE and universities sectors to help enhance the level of inter-disciplinary collaboration within both education programs and research.

- **Support the professional and continuing education programs** designed to build the skills and expertise of producers and entrepreneurial directors within the digital content industries. These should be project-based and applied with opportunities for bringing to WA national and international experts in the field of digital creative content production, marketing and distribution. Such programs would ideally be linked into an future incubator program as part of the education process that is critically important for such entities.

Conclusions
It is the conclusion of this study that the future development of a significant digital content industry in Western Australia based on two potential clusters (e.g. spatial and creative digital) is possible. As shown in this report, WA has existing industry and employment concentrations and sufficient business network activity to form the foundation for such clusters. However, industry clusters cannot be built within a short to medium term timeframe, and they will require leadership, shared vision and significant investment in common user infrastructure. There is a significant opportunity for WA to become a significant player in the digital economy, but any sustainable clusters must be constructed on strong commercial foundations.

SECTION 1

Introduction

The following report has been prepared for Government of Western Australia and examines opportunities for enabling the formation of a "Digital Content" industry cluster in Western Australia. The project developed in response to recognition that the development of digital technologies has created significant opportunities for local industry with a range of industry sectors having the capacity to embrace digital technologies.

The digital content industry can include those firms engaged in the design, development and delivery of creative product that can employ multimedia technologies and be distributed via information and communications technologies (ICT) such as the Internet. It can include the computer and interactive games industry, web site developers, digital video arts, film and television production, special effects, animation, postproduction, music, new media and virtual reality and various forms of design (e.g. architecture, graphic and industrial).

Studies undertaken at the national level have indicated that the digital content industry offers significant economic and cultural benefits to Australian industry (DCITA, 2002). It has been estimated that while Australia continues to be a small player within the global digital industry, it has the potential to grow. For example, the digital multimedia games development sector is worth around US$20 billion globally, while the Australian industry generates around AUD$200 million annually and employs around 600 people (Cutler & Co, 2003).

However, despite its size and potential, the digital content industry remains poorly defined and with few acceptable national or international standards for its measurement (Patterson Consulting, 2003). This lack of benchmarking or clear definition for the industry poses a challenge to policy makers seeking to assist the growth of the industry.

As a potential industry cluster, the digital content field encompasses a wide range of industry sub-sectors either directly or indirectly. These include highly creative sectors such as those engaged in multimedia games development, digital Film and TV, music and visual arts, publishing, graphic design and advertising and marketing agencies (NOIE, 2002). However, it can also include the more technical fields such as industrial designers, structural engineers, architects, sound engineers, those engaged in the spatial sciences (e.g. surveyors and map makers), and training and education services sectors.

While attention has been given to the creative industries in the development of the digital content industry in Australia, they represent only part of the total digital industry activity. As technologies involving digital content become more ubiquitous, so too does the overall catchment that needs to be created to secure a fully representative program targeted at the industry.

Project Objectives

The primary objective of this study as outlined in the terms of reference 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."*

To achieve this overall objective the study team set the following key objectives:

- Define the digital content industry as it relates to WA industry;
- Identify and map the industry concentrations that comprise the WA digital content industry;
- Identify potential industry clusters relevant to the WA digital content industry;
- Examine inter-firm and inter-industry linkages and alliances within the digital content industry in WA;
- Identify key groups within the digital content industry of WA that can be targeted for future assistance and support;
- Develop strategies for future cluster facilitation leading to enhanced industry support programs; and
- Assemble composite data for the preparation of regional marketing and promotion campaigns.

Industry clustering is a concept that has become well established within economic development literature since at least the 1980s (Anderson, 1994). It has been used as a framework for assisting the creation of new enterprises, as well as enhancing the sustainability of established ones (Surridge, Dewit-Martin & Kilko, 1997). Within Europe and North America it has become a favoured instrument for directing economic policy seeking to target small to medium enterprises (SMEs) (Humphrey & Schmitz, 1995). The focus on cluster development has become a major feature of policy makers in Australia in recent years (Enright & Roberts, 2001).

From a regional development perspective, clustering is viewed as offering potential for enhancing economic growth due to the perceived ability to concentrate firms in a geographic area and in doing so increase productivity (Baptista, 1998).

Methodology Used in the Study

Identifying and facilitating clusters is not an easy task, as boundaries of the cluster region and the specific industries that are thought to comprise the cluster are not always easily defined. A general principle of cluster facilitation is that industry clusters cannot be readily built from scratch, but must build upon existing industries and industry relationships. Further, the process of facilitating clusters requires long-term planning and frequently requires the establishment of dedicated institutions of collaboration designed to facilitate the exchange of information and technology within the cluster and to foster collaboration and cooperation among firms (Porter, 2001).

The methodology used in this study comprised five phases: i) estimating the size and structure of the WA digital content industry; ii) examination of literature relating to digital content industry development and industry clustering; iii) identification of potential cluster relationships; iv) development of case studies within the WA digital content industry; v) facilitation of industry and stakeholder workshops. These phases are discussed in more detail below.

Phase 1: Identification of Size and Structure of the WA Digital Content Industry

The aim of this phase of the study was to identify concentrations of firms within the digital content industry in Western Australia and compare these with the digital content industry at the national level. This process was facilitated by an examination of employment and business concentrations within industry classifications as defined by the Australia and New Zealand Standard Industrial Classifications (ANZSIC). These ANZSIC codes enable the identification of industries down to four levels of detail, for example:

- Level 1 - Division - "Manufacturing" (ANZSIC Code 2)
- Level 2 - Sub-division- includes "Metal Product Manufacturing" (ANZSIC code 27)
- Level 3 - Industry -which includes "Iron and Steel Manufacturing" (ANZSIC code 271)
- Level 4 - Class - which includes "Steel Pipe and Tube Manufacturing" (ANZSIC code 2713)

Employment concentrations within Australian industry were estimated using data provided by the Australian Bureau of Statistics (ABS) which are classified using ANZSIC codes and geographic location down to small area statistical districts. Business unit data was examined using data supplied by Sensis Pty Ltd, a wholly owned subsidiary of Telstra Corporation. Sensis provides industry data at all four levels of ANZSIC coding, the lowest level (Level 4) covering over 400 industry classifications. It also uses the YellowPages® headings that number approximately 2,600 for a finer level of detail. In addition, Sensis has historical data on all industry concentrations from 1999 onwards and updates this data set annually enabling longitudinal data.

During this first phase of the project, employment and business concentrations or “location quotients” within the WA Digital Content sector were determined by using

ABS and Sensis data. Initial industry categories were selected from those used by the NOIE (2002) study of the Australian digital content cluster analysis.

Phase 2: Literature Review

In this phase of the study a detailed review of existing literature was undertaken with a view to assisting in the definition of the digital content industry as it relates to Western Australia, and to examining trends at the national and international level. This literature review examined the size and scope of the digital content industry and sought to identify case studies of industry clustering within Australia or other countries that might be relevant to the digital content industry in WA.

Also of interest within this literature review was to identify barriers and triggers to the establishment and growth of clusters in the digital content or similar industries. Key trends in the digital content industry were explored, specifically with reference to new technologies. The review also looked for measures of international competitiveness within the global digital content industry.

Phase 3: Survey of Industry Sub-Sectors and Identification of Possible Cluster Relationships

In this phase of the study a random sample was drawn from each of the key industry sub-sectors (e.g. ANZSIC categories) identified in Phase 1. This sample of 200 firms was used in a telephone survey that explored their involvement in the digital content industry, how many years the firms had been in the industry and aspects of their role in the industry, plus size and nature of operations.

Using the data gathered from the survey and the data on industry and employment concentrations as undertaken in Phase 1 a series of industry sub-sectors were identified that might form the basis of the WA digital content industry. In this phase of the project the initial business and employment concentrations within the various digital content industry sub-sectors were examined in conjunction with the results of the literature review to identify where probable relationships exist between various sub-sectors within the digital content industry. Potential cluster groupings were selected on the basis of general industry relationships via conventional supply and value chain interactions.

Phase 4: Multiple Case Studies of Digital Content industry Actors within WA

During this phase of the project a series of case studies were prepared of ‘focal’ firms within those industry sub-sectors identified in Phases 1-3 within the WA digital content industries. Case study methodology allows investigation of research issues that cannot be appropriately studied using solely quantitative methods. It is particularly useful in seeking to undertake investigations that require an in-depth understanding of behaviour that is common when studying small business entrepreneurs (Chetty, 1996).

In multiple case study approaches the focus is on following a replication, rather than a sampling, logic. This enables researchers to identify the similarities and differences within a group of cases, as well as inter-group similarities and differences. Cases should be selected to enable them to predict similar results (literal replication) or predict different results for expected reasons (theoretical replication) (Yin, 1989).

In this study 10 cases were selected on the basis of their ability to typify the sub-sector in which they operate. A focal firm should be an exemplar firm that forms part of a wider network of suppliers, customers and third party sources of resources. Such firms create value for both themselves and other members of their network, while developing their own strong core competencies. These firms are often good at setting strategic goals and structuring their operations to enhance their collaboration within their network.

Phase 5: Industry & Stakeholder Workshops:

During this phase of the project the research team took the findings generated from the first four phases and staged a series of industry and stakeholder workshops designed to drawn together representatives from the key industry clusters identified to that stage of the study. A total of four workshops was held, attracting representatives from a wide cross-section of industry sectors found within the digital content industry of the State.

The purpose of these workshops was to report the findings and to seek feedback from potential participants in future cluster initiatives. These workshops provided the research team with valuable market intelligence from which to design and develop future cluster enhancement strategies and make subsequent recommendations to the steering committee. These workshops were facilitated by the research team and drew together representatives from the various firms comprising the digital content cluster, as well as government (e.g. local, state and federal) agency representatives and third party organisations (e.g. universities, TAFE Colleges) as required.

SECTION 2

Defining the Digital Content Industry

Much of the current debate surrounding the digital content industry is hampered by the lack of universally agreed definitions with regard to: i) the digital content industry; ii) creative digital content industries; iii) creative industries more generally; and iv) the so-called cultural industries. This lack of agreed definitions makes it difficult to compare national or international digital content industry performance due to the lack of standard international industry classifications in this area. Technology is also changing so rapidly and driving a convergence of previously separated activities and tasks that the industrial and professional classifications originally used to define business operations have become blurred.

It is also difficult to fully assess the success or failure of various intervention programs initiated by governments due to the lack of clear definition as to their composition and boundaries. Without adequate definition it is also difficult to measure the spread of digital content products across the economy and to facilitate the efficient provision of financial and other support of the creative digital content industry, or measure the use of creative digital content products in the economy.

However, while it is recognised that a universally agreed definition is unlikely to be found in the short term, this project required an acceptable definition to guide research and formulate strategy for the development of successful creative digital content clusters in Western Australia.

In creating a definition a wide range of literature about the digital content industry was reviewed and characteristics believed to be of particular relevance to the formation of clusters were noted. There were a number of observations that were considered of particular relevance to the formation of digital clusters. These included:

- That digital content encompasses a wide range of existing industries;
- That digital content is most valuable when it is focused on the creation of original intellectual property (IP), and
- That some of the most valuable IP in the digital content industry is generated when a product is developed that requires artistic creative and innovative (creative) technological inputs.

Once these assumptions are accepted, it is apparent that definitions which reference existing industries (e.g. Electronic Games and Films) and/or limit the concept of creativity to traditional artistic activities cannot encompass key characteristics of the digital content industry. It was therefore decided that the digital content industry can best be described with reference to activities specifically associated with the creation of digital content. However such a definition had to also exclude some aspects of digital content creation such as sending email.

Most definitions of digital content are very broad, because the term covers virtually every bit of information that exists in a digital form. This is of limited value given the trend toward digital applications in so many areas of industry activity. Most relevant studies have focused on isolating the creative industries engaged with the production of digital content (e.g. multimedia, computer gaming). This has placed attention on the content originators (e.g. authors, multimedia designers, graphic and industrial designers). However, a wider focus needs to be taken that considers production overall (Cutler & Co, 2002). These aspects of digitisation are important because the digital technologies that are driving this industry are now diffusing throughout a wide cross-section of industries, disrupting existing processes and presenting both threats and opportunities to the way digital content is produced, acquired, distributed and consumed (Baldwin, 2004).

A distinction needs to be drawn between digital content and digital applications and services. While digital image, audio and text content can be transmitted by a digital network, such a network can also support a range of services enabled by interactive, transactional and value-added applications (Pattinson, 2003). For example, banking services can co-exist within the digital network alongside news media, entertainment and education services.

While most definitions attempt to describe the creative digital content industry in terms of it being an aggregation of parts of existing industries such as, advertising, computer games and film, there are limitations with this type of definition. Reference also needs to be made to the nature of digitisation and its effect on the value chain associated with specific industries. For example; advertising is considered to be an industry in itself, but is also part of the media industry, because it plays a vital role as an intermediary in the media industry value chain. Similarly, the advertising industry is considered to be part of the creative digital content industry because digitisation has had a profound affect on key aspects of the advertising value chain, most notably in the way it has enhanced traditional creative processes, changed production methodology and created new media opportunities for the distribution of creative product.

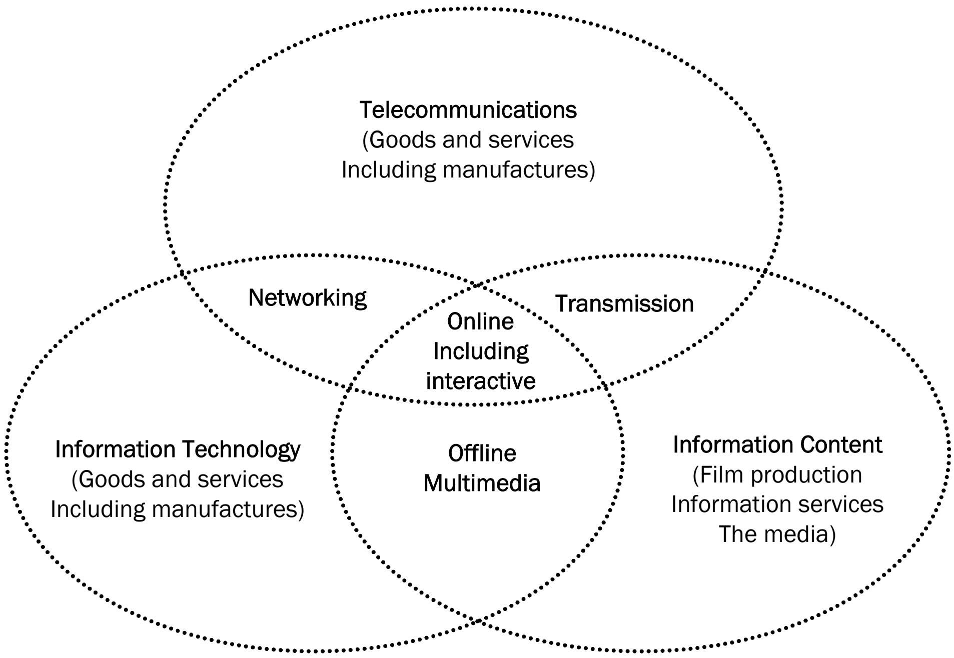
Defining the creative digital content industry is therefore a process of describing those aspects of economic activity involved in the production, value adding, transforming and/or distribution of creative digital content. This definition includes the concept of creativity because, without it, producers of bank statements and telephone bills would be considered part of the industry. However, the concept of creativity is in itself difficult to define. In recent years much has been written about the nature and value of the creative industry and there has been a tendency to describe the creative digital content industry as a sub-set of the creative industry. For example, the National Office of the Information Economy (NOIE) has noted that:

> *"All content industries form part of a cluster of creative industries, but not all creative industries are content industries"* (Cutler & Co, 2002. p.14).

While it is true that not all creative industries produce digital content, all content industries are only part of a creative cluster if the definition of creative is sufficiently broad. Just as it is difficult to define the creative digital content industry in terms of existing industry classifications, the creative industry is equally difficult to define in the same way. For example; an extensive mapping of UK creative industries undertaken by the DTI in the UK included architects, but not civil engineers (DTI, 2001).

Defining the Concept of Digital Content

In seeking a definition of the digital content industry a useful starting point is the definition of the concept of digital content. By its nature the definition of digital content must be broad, as it encompasses every bit of information that is stored and/or transmitted in a digital format. Reference to the digital content industry frequently encompasses some aspect of the production and consumption of digital content. However, with ICT enabling the digital storage, retrieval and transmission of sound, image and text across a wide range of business and domestic applications, this is of limited use from a practical perspective. Figure 1 illustrates the general structure of the convergence now occurring within the ICT sector (OECD, 1999). It includes all digital content, both off and on-line, as well as the hardware systems required for its transmission. However, this description is too broad as it includes all forms of electronic communication, including personal e-mails.



Source: (Patterson, 2002)

Figure 1: Convergence of IT, Telecommunications and Information Sectors

To provide greater focus it has been suggested that the concept of the digital content industry be limited to communications products and include only those that are mass marketed, or intended for a mass audience, rather than just one or two individuals (Patterson, 2003). This re-focusing of the digital content industry aims to distinguish highly commercially valuable content from more routine communications such as email. It serves to filter out that which is commercially valuable and creative, from that which is not. This is a useful starting point as it allows for attention to be given to digital content of substance within an industry context, and content that can be used to assist the economic growth of a local digital content sector in WA.

Definitions of Creative Digital Content

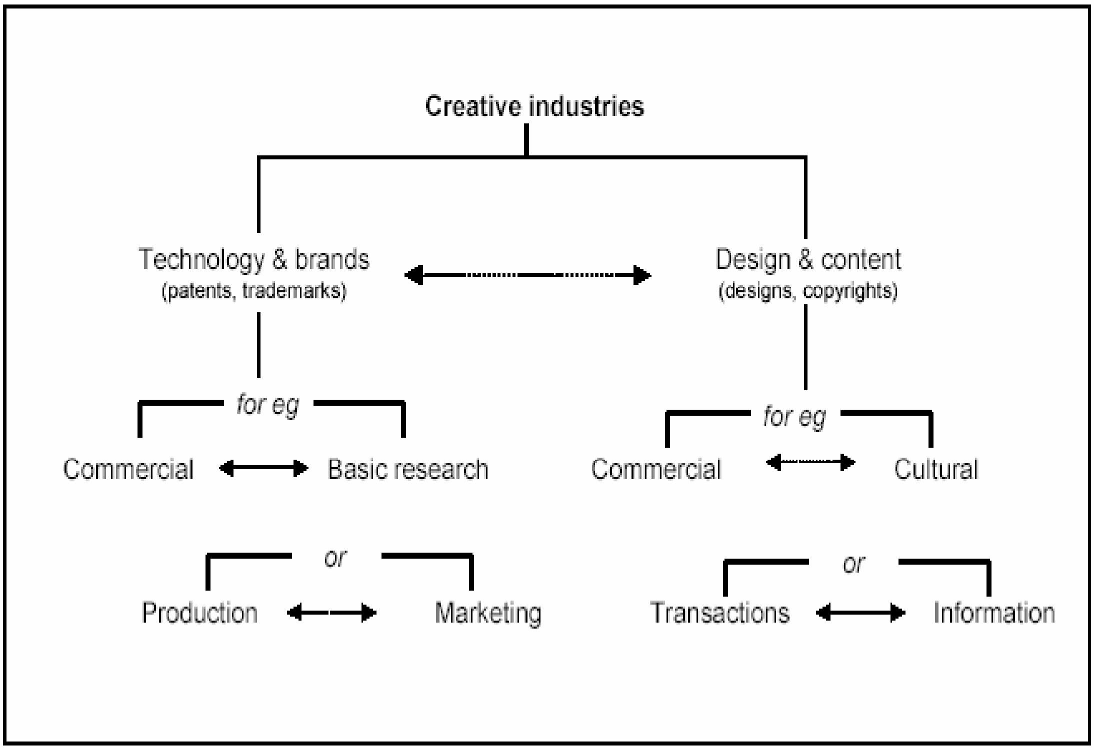
Having broadly filtered out those aspects of digital content which have no real value, it is necessary to define what aspects of the digital content industry are important. An examination of Figure 1 provides a means of addressing this conceptual framework. Of key importance to the definition of creative digital content are those areas within the diagram where the three areas of telecommunications, information technology and information content intersect (OECD, 1999).

These intersecting areas are of interest because this is where the process of digital convergence is most intensive, and where the new technology is having its most disruptive impact. It is the areas of online and offline multimedia that the greatest threats and opportunities lie for Australian industry. Local firms will need to address this convergence process and embrace the need for the production, acquisition, distribution and consumption of creative digital content (Baldwin, 2004).

Furthermore, within these intersecting areas there are two levels of technological disruption. The first relates to opportunities for new digital network services carrying content such as video, voice, text and transactions; while the second relates to the interactive, transactional, and value-added applications which interact with each other and consumers via this network. However, of particular importance to this study is the impact of technological convergence on the production of digital content and the way digital content producers will need to respond to this rapidly changing environment (Culter & Co, 2002). Of particular importance will be the ability of local producers of creative digital content to identify and subsequently secure the value of their intellectual property (IP). However, before examining the importance of IP, the nature of creativity within the digital content industry needs to be addressed.

The Nexus Between Creative and Technical Disciplines

The creative industries have been the main focus of recent attention given to digital content, specifically in relation to the production of multimedia applications. (Howkins 1991) describes the creative industries as those involved in the creation of intellectual property, namely patents, trademarks, copyright and design. Figure 2 illustrates the distinction between industrial ('Technology and Brands) and cultural creativity (Design and Content), but accepts there is considerable overlap between the two, which is represented by the dotted lines. Furthermore the distinction also alludes to differences between for example: commercial and noncommercial activities, transactions and information, production and marketing and digital and non-digital representations.



Source: (Howkins, 1991)

Figure 2: Creative Industries Transaction

To illustrate this nexus between the creative and technical aspects of the digital content industry reference can be made to the construction sector. For example, the broad job description of a civil engineer is to plan, design, construct, operate and maintain roads, bridges and other physical infrastructure. Their role is technical and while they may apply creativity to their work the primary orientation is technical in nature. By contrast the architect is more creative than technical. The architect needs technical skills and an understanding of structures and materials to allow them to design buildings and outline specifications that can be subsequently built. However, the architect is essentially more creative than the civil engineer despite the close association between the two and the use both professions make of digital content applications.

While the highly creative industries have attracted the most attention in the digital content sector, it is important to balance the debate with adequate reference to the technical fields. Similar anomalies can be found throughout most of the literature, in particular the absence of simulation software developers appears to be an interesting omission in many. Given the definitional problems associated with describing creative industries using specific categories a definition using underlying processes or outputs appears to be more useful in this case. The multi-disciplinary nature of digital content production suggests that two generic communities need to be considered. The first is creative artistic or Creative (A) and the second is creative technical or Creative (T) communities.

The Creation and Value of Intellectual Property

While many definitions attempt to describe the creative digital content industry in terms of it being an aggregation of parts of existing industries such as, advertising, computer games and film, these types of definition do not describe what it is about those industries that warrant their inclusion. Certainly advertising can be included because within the industry value chain digitisation has impacted three key areas. First, digitisation has enhanced aspects of the creative process by facilitating greater improvisation, experimentation and cooperation between creative individuals. Second, digitisation has profoundly changed production methodology by which press and TV commercials are produced. Finally digitisation continues to create a number of new media opportunities for the distribution of creative product and its intellectual property (IP) on to new technology platforms such as the internet and mobile phones.

This type of value chain analysis leads to a definition that is grounded in a process – i.e. the creation, and distribution of creative digital IP. However close analysis of the impact of digitisation on the advertising industry value chain identifies a number of different IP development activities. For example; an advertising agency creates original IP when it creates the script and visuals for a TV commercial (TVC). In the digital production of the TVC a number of creative visual effects are realised because of software IP owned by major software vendors. Once the TVC is produced it is distributed using digital networks, which require new IP to be developed to facilitate its distribution via the internet and mobile phones.

As the IP moves through its various phases in the production process different levels of value are created. For example, the value of IP developed by the advertising agency is limited by the fact that it is basically a fee for service proposition. The agency provides creative input, but usually does not take IP ownership of the content it generates. By comparison, the IP developed for the creation of special effects and the multi-platform environment inherent in contemporary TVC distribution offers considerably greater recurring revenue generating opportunities.

The nature of IP and its ownership has considerable impact on the value of the digital content industry. For example the electronics games industry in Australia is estimated to be worth around AUD $100 million annually in initial production value, while the publishers realise around AUD $750 million in international sales (Baldwin, 2004). The reason games' developers make such a small percentage of the total revenue is that they have to sell their original IP to publishers in order to maintain cash flows and thereby sacrifice future revenue earning potential. A similar situation exists for many film makers and other creative content originators.

The creation and ownership of IP is therefore an essential element in any definition of the digital content industry. However, depending on the desired outcomes, the strategic value of that IP and its capacity to earn recurring revenues must generally be taken into consideration. Understanding the nature of an industry value chain and the context of IP development will help when making decisions in relation to desirable outcomes.

Mapping the Digital Content Value Chain

Any industry comprises one or more business activity systems through which the production of goods or services are undertaken. Conceptually an industrial market or business activity system comprises at least six key elements: i) actors; ii) activities; iii) resources; iv) routines; v) relations; and vi) fitness functions (Matthews, 2001). The first of these (actors) refers to those entities (e.g. individuals, organisations), that are engaged in the industry. These actors undertake a series of activities that contribute to the overall production of the end-use product or service. Which activities an actor undertakes depends on their resources and routines. Not all actors possess the same assets (resources) or skills, capabilities (routines), and as such tend to undertake those activities that best suit their distinctive competencies (Prahalad & Hamel, 1990).

Complex industrial production systems require a variety of actors to collaborate, each undertaking different specialised activities best suited to their respective resources and routines. The interaction between such actors or their relations can determine how well the business activity system functions. Of key importance are the strategic decisions made by industry actors as to how they will relate to each other and configure their activities, resources and routines into the most effective fitness functions (Matthews, 2001).

The ability of each industry actor to add value to the production system through the best configuration of their respective resources and routines has been likened to a value chain (Porter, 1980). Each actor must seek to add value to the overall business activity system by contribution of innovative and cost-effective tasks that allow it to capture the value that best suits their competencies (Jarillo, 1993).

Within the digital content arena the business activity system generally comprises a wide range of different industry actors that must collaborate in the production of final end-use products and services. Many different value chains are likely to be found with varying degrees of digital intensity. Not all activities within the sector are entirely digital in nature. For example, musicians or illustrators may create original content in a non-digital form that is subsequently placed into digital format by other actors within the value chain. While some value chains in the sector are highly digital in terms of their final output (e.g. multimedia games), not all production systems that contain digital content generate digital product. The construction industry, for example, makes use of digital content throughout much of its activities, but its final end use products are physical structures.

There can be considerable feedback and inter-relationships between different actors within the value chain, particularly between IP owners and gatekeepers. Activities within the industry can involve simple or highly complex value chains with technology serving as a key driver for how value chains are configured.

Diagram A

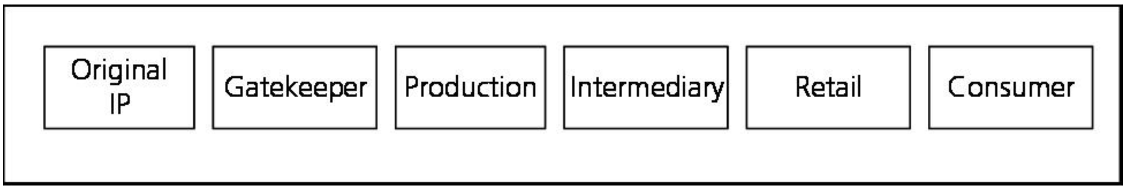


Diagram B

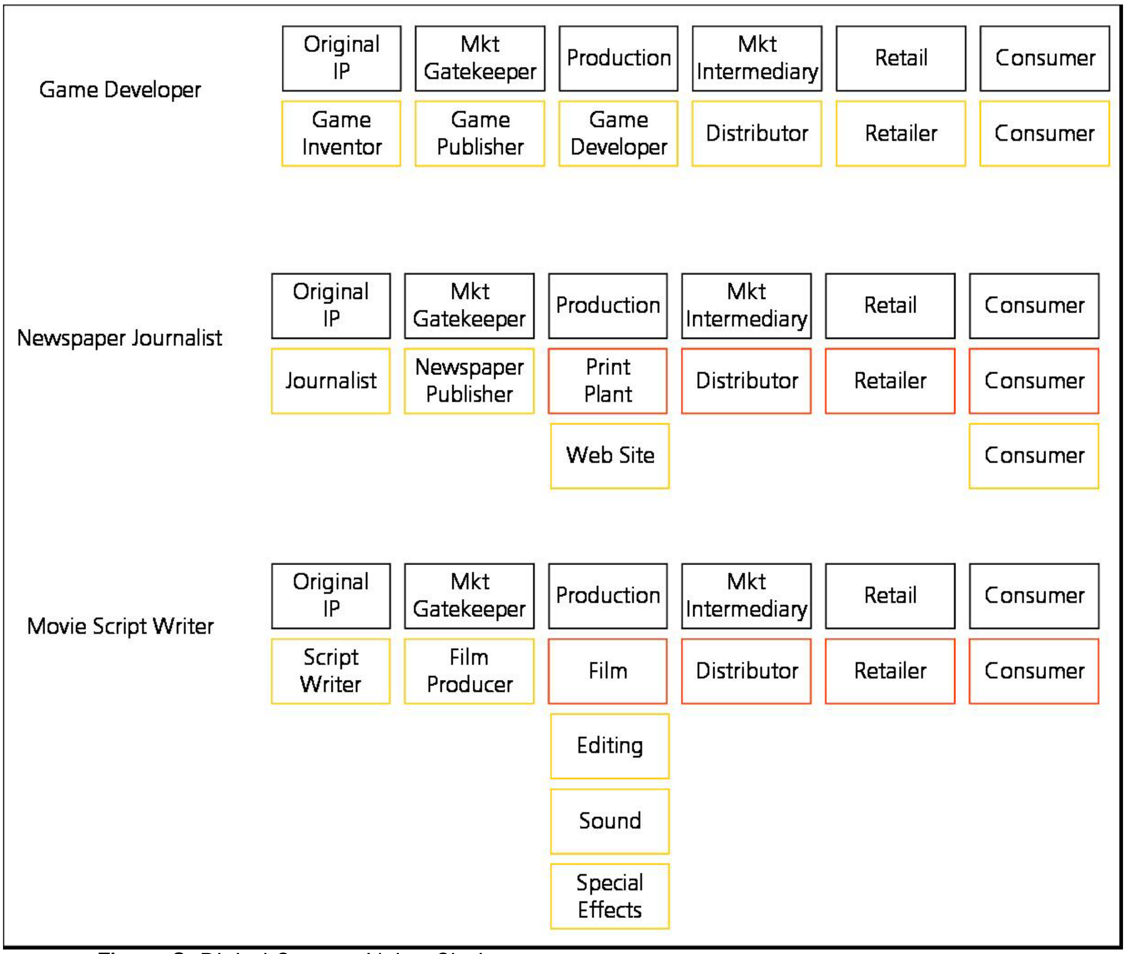


Figure 3: Digital Content Value Chain

Analysing the various value chains within different industries provides some insight into the industry's level of participation in the creative digital content industry. Diagram A above, (which will be described in detail later) provides a general overview of the value chain as it applies to the production of creative digital content. By contrast, Diagram B describes how all digital content originates from some form of intellectual property and passes along the value chain until it is consumed. The processes outlined in Diagram B show three variations on the value chain with respect to the use of digital content. The yellow boxes relate to digital content, the red to traditional media. In this diagram, it is clear that the game developer is the only actor that operates exclusively in the digital environment, whereas the newspaper and movie maker demonstrate how traditional creative industry processes have been impacted by digitisation, which can also (as in the case of the newspaper) open up new product marketing opportunities.

The processes illustrated in Diagrams A and B of Figure 3 enable a means by which we can understand that the creative digital content industry is made up of actors that have different levels of involvement in terms of the activities that they perform and different levels of digital intensity.

IP Originators

The diagrams above all take as a starting point the creation of some form of intellectual property. Depending on the context (industry and/or product) the value of the IP at its point of creation may or may not be known. For example, a freelance journalist writing a story for a magazine knows what the publisher will pay, but a game development team creating new 3-D characters and associated programming, in most cases, has no idea of the ultimate value of their IP. For example the nature of the IP developed by a website copy writer is different from the graphics used in a computer game and different again from the algorithms developed by a games programmer.

Market Gatekeepers

The next stage in the digital content value chain is the gatekeeper. Gatekeepers play a major role in the commercialisation of IP, by either controlling the resources for production, access to essential technology, and access to distribution or retail channels. For example, console game developers may need to convince console technology owners such as Sony; publishers and venture capitalists before they can move to the next stage of commercialisation. Even IP owners looking to the internet as a means of dis-intermediating the gatekeeper will find barriers to entry such as the costs associated with content development, web hosting, marketing and customer service. The major challenge for those wishing to establish digital content clusters is how they facilitate the role of gatekeeper.

Production

The production phase of the value chain can be broadly sub-divided into two stages. The first stage is mainly associated with the production of some form of master copy from which multiple copies are manufactured or are made available online. In film for example, phase one production is the realisation of original IP through the whole process of shooting and editing in order to create a master from which various copies of the film are manufactured in stage two. For many industries it is this first stage of production where digitisation has had the most impact, in that it has taken over or greatly enhanced traditional methodologies. In general the first stage digitisation has been associated with enhancing the creative process, improving productivity and providing product enhancement (such as digital visual effects).

The film industry provides a good example of the innovation that arises when technical creative and artistic creative actors begin to work in close proximity during first stage of production. However, many traditional content producers such as TV and Film have not experienced the same level of innovation due to digitisation in the second stage of production. Certainly the Film and TV industries have taken advantage of the secondary market offered by DVD and some have moved content onto games platforms such as the Harry Potter PS2 game. However there are relatively few examples of traditional content producers re-purposing existing content into rich (sound, vision, animation etc) interactive multimedia product. As a recent report to the Australian Parliament explained:

> *In film industry terms, this equates to placing a greater emphasis on distribution, compared with production. A film's benefits, both cultural and economic, are likely to increase with audience size* (Baldwin, 2004).

Innovation in Production

There are many reasons for the lack of innovation in digital content production in Australia. Factors have been the comparatively low penetration of broadband access and industry concerns with digital rights management for online content. Such issues are major influences affecting decisions to move into this area (NOIE, 2002). However, the comparative lack of innovation in this area is due in part to a lack of interaction between the Australian film industry and other local digital content industry actors (Baldwin, 2004).

For those wishing to encourage the formation of digital content clusters there are a number of challenges to consider. First, governments must address how they can encourage continued innovation in the production of digital content by fostering an environment in which Creative (A) and (T) communities – and other actors in the value chain – can interact. Second, governments should encourage content producers to leverage the advantages of digital production and re-purpose existing product or create new products for alternative digital platforms from digitised content.

Market Intermediaries and Retailers

The distribution and retail phase of the value chain varies greatly for different industries and products. Some actors in the digital content industry such as games developers distribute digital media such as CD-ROM through established non-digital channels, while others rely entirely on the internet to deliver their product to end users. Other actors, such as newspaper publishers, produce non-digital product distributed through traditional channels, as well as digital product distributed through digital channels. Innovation in the retail environment will most likely follow any product innovation as discussed previously.

Defining the Digital Content Industry in WA

Defining the digital content industry is therefore a process of describing those aspects of the business activity system where IP is produced, value added, transformed and distributed. This definition includes the concept of creativity because without it producers of bank statements and telephone bills would be considered part of the industry. However, the concept of creativity is in itself difficult to define. The creative industries have garnered much attention at the national and international level with specific focus given to the digital content industry as a specific sub-set of the creative industries. Yet while not all creative industries produce digital content, not all digital content is creative in the artistic sense.

The Federal Government's *Digital Content Industry Action Agenda* has provided the following definition of the broader creative Industries that complement the digital content industry. This definition is as follows:

> *"The broader Creative Industries have been defined as 'those industries which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through the generation and exploitation of intellectual property'*, (UK Creative Industries Taskforce*, 1998*).
>
> *Digital content production includes an extremely wide range of industry sectors, such as interactive multimedia, digital film and television production and post-production, interactive and digital television, digital video arts production, computer and online games, design and advertising, educational content production, digital publishing, digital and online music, and digital applications."*

The above definitions of the creative industry are fairly universal, but need to be qualified in the context of the digital content sector. Our definition of the creative digital content industry is that area of digital content production that involves the creation of intellectual property and is generally economically disruptive, creating threats and opportunities. This definition provides a broad framework for a study of creative digital content clusters that avoids some of the issues previously discussed. In particular the definition is useful in that it does not exclude industries that fall outside traditional descriptions of what constitute creative industries, nor does it exclude communities of practice where participants are difficult to identify as belonging to a particular industry (Wenger, et.al. 2002).

Definition of the WA Digital Content Industry

For the purposes of this study the digital content industry as it applies to Western Australia may be defined as follows:

> *The digital content industry <u>which is of strategic importance</u> 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 is used because it recognises 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 highlights the importance of locally generated and owned IP as a key ingredient in the future of the sector. While digital content might be created by either the Creative (A) or (T) communities, local ownership of IP ensures that value and control is retained within the State. It does not suggest that all the IP should be retained locally, but if the WA digital content industry is not able to control the IP or secure its value, the longer term growth prospects of the sector are likely to be doubtful.

SECTION 3

Industry Clustering in the Digital Content Sector

While many definitions exist, industry clusters are generally identified as possessing at least four dimensions: i) a geographical focus on a particular region; ii) an institutional focus on networking and linkages between firms; iii) a vertical layer (comprising suppliers and customers); and iv) a horizontal layer (comprising competitors and sources of knowledge, technology or resources) (Muizer & Hospers, 2000). One of the more commonly accepted definitions of clustering is as follows:

> *Geographic concentrations of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions (e.g. universities, standards agencies, trade associations) in a particular field that compete but also cooperate.* (Porter, 2000)

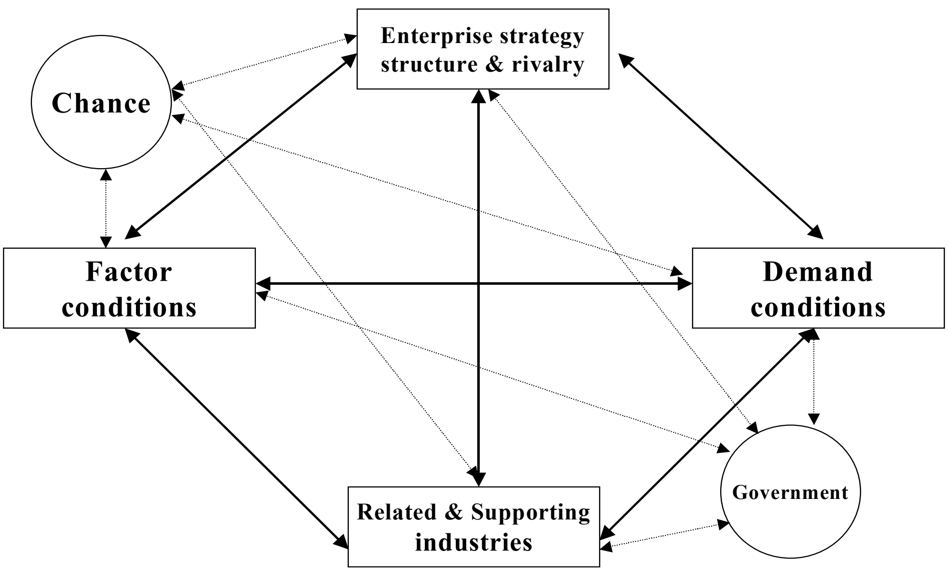
Successful industry clusters are usually specialised into a few key industries and have effective local production networks involving supply-chain relationships at both the local and international level, plus involvement with related and supporting industries such as research centres and educational institutions (Porter, 2000). The geographic concentration of firms that are interconnected and have specialist capabilities also creates a pool of skilled and productive workers who generate knowledgeable milieux in which innovation can be facilitated via knowledge transfer (Isaksen, 1996). This concentration of firms and innovative potential within a defined geographic area (e.g. country, state, region or city), serves as an attractor for investment, and generates the emergence of competent financial institutions able to supply the venture financing to assist the growth of business activity (Rosenfeld, 1997).

Identifying and facilitating clusters is not an easy task, as the boundaries of a cluster region and the specific industries that are thought to comprise the cluster are not always easily defined. A general principle of cluster facilitation is that industry clusters cannot be readily built from scratch, but must build upon existing industries and industry relationships. Further, the process of facilitating clusters requires long-term planning and frequently requires the establishment of dedicated institutions of collaboration designed to facilitate the exchange of information and technology within the cluster, and to foster collaboration and cooperation among firms (Porter, 2001).

From an economic development perspective the boundaries of a cluster can span a city, a region, a state, a country or even several neighbouring countries. Of importance is not the geographic boundaries encompassing the cluster, but the links that exist between firms and the capacity for such interaction to (e.g. via transfer of information, products, finance or ideas) create value or enhance efficiencies. The analysis of clusters suggests that a substantial amount of the competitive advantage that may be generated by a firm may actually lie outside these companies and occur through the interaction between firms and across industries (Porter 2000). Focusing on clusters of industries and firms rather than the individual industries or firms themselves is preferable because cluster behaviour is more aligned with the reality of industry competition and the formation of sources of competitive advantage. Cluster analysis enables the facilitation of innovation and coordination for mutual enhancement of all industries in a given region (Porter 2001).

Clusters and Competitiveness

Economists have identified clustering as offering potential enhancements to industry competitiveness by concentrating physical and human capital to produce both economies of scale and scope, and the innovation that can flow from interaction between individuals and firms. Porter (1990) has described the process in terms of a 'diamond model' (see Figure 4), in which four elements – i) enterprise strategy, structure and rivalry; ii) factor conditions; iii) demand conditions; and iv) related and supporting industries – come together within a regional economy with indirect influences from both government policy and historical chance, to create dynamic clusters.



Source: Porter (1990)

Figure 4: The Competitive Diamond

Two key drivers within this model are domestic inter-firm rivalry and geographical concentration. The level of domestic rivalry that exists among firms within a cluster is important to the level of productivity and innovation that may be generated in these industries. A geographic concentration of firms in a particular area can also assist in increasing the intensity of the interactions within the system (Baptista, 1998).

Factor conditions (e.g. natural resources, availability of skilled labour and venture capital) are clearly important to the creation and sustaining of industries within a cluster. On the supply side, geographic concentrations through clustering can assist by enhancing the quantity and quality of such factors. Krugman (1991) has suggested that this stems from three sources. The first is through labour market pooling in which the existence of many firms from the same industry in a single location can support specialised labour. For example, industry concentration in the mining and resources sector in Western Australia has enabled the State to support a high proportion of specialist engineers, geologists and other professionals (including environmental scientists) that might not otherwise have been able to find steady employment here.

The second source of supply-side benefits stems from intermediate inputs where the concentration of particular industries allows the creation of a series of related and supporting industries that supply to the core industry. Once again, the mining and resources sector in WA has supported many manufacturing, engineering, finance and professional service firms that may not otherwise exist were it not for the core industry.

The third source of supply-side benefits flows from technological or innovation spill overs in which ideas, knowledge, products and processes can transfer from one firm or industry to another via formal and informal networks. Such informal networks can include communities of practice that frequently stimulate new ideas and can result in innovation. Although geographic proximity is not essential to this transfer, there is some evidence that concentration of firms in regions can enhance the process. This appears to be particularly important to industries in their formative stages where the cost of transfer is easier to absorb where geographic distances are not too great (Baptista, 1998).

On the demand side the conditions that are necessary for dynamic growth are the capacity of the region's industries to offer competitive products or services that can offer sustainable advantages over time. Unless the local market within the region is sufficiently large and growing to sustain industry concentration and growth, the majority of successful clusters will need to target markets outside their regional boundaries. Firms that can position their products or services into global supply chains, have significant growth potential. Such firms will need to benchmark their products and processes against international best practice, and are unlikely to survive over the long term if they don't continue to remain responsive to demand conditions. Clustering can assist such firms achieve and sustain international competitiveness by encouraging positive inter-firm rivalry within industries, and securing enhanced access to factor conditions and related and supporting industries.

Principles of Cluster Development

During the 1980s and 1990s the importance of enterprise clustering became widely recognised with a variety of countries demonstrating similar enterprise regions to those found in Italy. Examples were cutlery industries in Solingen, Germany, silk manufacturing and carbon fibre in Japan, and the technology cluster of Silicon Valley in the United States (OECD 2000; Gordon 1998; Kenney 2001). The term was being used in the United States in the late 1980s by consultancy firms assisting local government authorities with regional development (Anderson 1994). However, Harvard University economist Michael E. Porter further promoted the concept in his book, *Competitive Advantage of Nations* in the early 1990s (Porter 1990).

From a conceptual perspective five generic types of cluster have been identified: i) regional; ii) cohesive; iii) new industrial districts; iv) innovative milieux; and v) proximity clusters (Hart, 2000). The first of these refers to those clusters that are bounded within a defined geographic area. The second relates to those drawn together to secure lower costs of factor inputs such as transport or labour. A new industrial district is a cluster based upon a desire by industries to concentrate in order to access specific expertise or managerial resources. By contrast the innovative milieux seek to concentrate firms so as to share knowledge and ideas. Such clusters are frequently more social than economic in nature. Finally, the proximity cluster describes the concentration of firms into local production networks (LPN). Not surprisingly there is some overlap between these generic types.

The Role of Focal Firms

Of key importance is the focal firm, or those industry actors that create value for both themselves and other members of their strategic network. Such firms are usually the central actor in an LPN comprising a range of sub-contractors that supply to the focal firm, and a distribution network of leading customers. The focal firm is essentially the centre of a strategic network and is a coordination point for the LPN and encourages enhanced quality and innovation among its suppliers (Lorenzoni & Baden-Fuller, 1995).

A focal firm is often the clearing house of ideas for enhanced product development within the LPN and seeks to foster capabilities within its strategic network of suppliers and sub-contractors. It may also serve as a transfer point for new technologies that might diffuse within the LPN and eventually within the industry sector, often from outside the industry in which the focal firm is operating. Focal firms have been noted as following a Borrow-Develop-Lend model in technology or innovation diffusion. This involves the firm identifying new innovations within or outside their own industry, borrowing them either through purchase or licensing. This technology is then further developed within the focal firm and its strategic network, and then lent back into the network eventually diffusing to the wider market (Lorenzoni & Baden-Fuller, 1995).

Facilitating Clusters

Cluster facilitation as an economic development process requires broad based collaboration among a wide range of industry actors. Government agencies have an important role to play at both the national and local level, but cluster facilitation should not be left solely to government. Critical to successful cluster development is the active participation of industry actors, particularly private sector firms or entrepreneurs that can serve as focal firms.

Successful industry clusters should be concentrated into only a few specialised industries comprised of a core of firms that are innovative, internationally competitive, export focused and able to draw upon a strong LPN and local pool of skilled labour. Innovation within the cluster can be enhanced by inter-firm collaboration and engagement between industry actors and research centres such as the CSIRO or universities. A strong international orientation and export performance among key actors within the network is important to ensure that the cluster is able to benchmark itself against world best practice.

An important first step in the development of industry clusters (assuming that they have been adequately identified), is the creation of a common vision or shared sense of longer term economic direction. This should be accompanied by strong political and industry leadership that is committed to achieving this economic vision. It has been suggested that industry clustering can be enhanced via a four stage process. The first stage involves a process of mobilisation where key actors from industry, government and the academic community can be drawn together into a strategic network. Not all actors will readily cooperate (e.g. competitors). However, they can be engaged by neutral actors to get them to support the vision common to the cluster. There must also be a process of diagnostic analysis that examines the nature of the industry sector, maps its size, structure and capabilities; and identifies strategic challenges and opportunities. Once the cluster mapping process has been completed and the strategic network of actors formed, it is possible to develop a series of industry cluster development strategies can be outlined. These can then be implemented, but will require leadership, usually in the form of industry cluster task forces or leadership groups (EDA, 1997; Enright, 2001).

Facilitating Technology Clusters

While the concept of clustering has been applied to a wide range of different industry sectors the success of such examples as Silicon Valley in California, USA has focused attention on the high technology industries. High technology clusters have been found to benefit from similar factors likely to drive other industries, such as taxation, a sound economy, access to skilled labour, accommodation and financial capital. However, high technology industries also benefit from proximity and interactivity with research centres. Of importance is the ability for research undertaken within universities or publicly funded centres to be transferred into the wider industry. Also important is the access high technology firms can get to venture capital financing for seed, early-stage and growth funding. Lifestyle within the surrounding region or city has also been found to strongly influence the development of high technology industries (Devol, 2000).

International Examples of Technology Clusters

The following section outlines some examples of how industry clusters, specifically within the technology sectors, have emerged within other countries. Such case studies offer lessons for Western Australia of how such clusters form and the key factors likely to influence their formation. Examples are drawn are from Silicon Valley, USA; and the ICT clusters that have emerged in Ireland and India over recent decades. They are drawn from a study undertaken by Gale (2003) for the Centre for Entrepreneurial Management and Innovation (CEMI).

Silicon Valley, California

The origins of Silicon Valley, California's famous high technology precinct can be traced back to the 1930s when Frederick Terman, a professor of electronic engineering at Stanford University established a graduate program in innovative electronic technology. This program developed a national reputation for excellence and produced a series of graduates who went on to found some of America's most successful technology companies. Hewlett and Packard were among the more prominent examples (Leslie & Kargon, 1996).

World War II served as a major watershed for the growth of the electronic engineering sector in Silicon Valley with substantial defence contracts enabling Hewlett-Packard to grow from US$34,000 annual turnover to over US$1 million over the period from 1940 to 1943. The electronic engineering faculty at Stanford University continued to play a crucial role in the region's industry development, with Professor Terman focusing on the development of high profile research projects that enhanced local expertise in niche areas, and attracted researchers from across the country to come to California. Stanford University became the focal point for federally funded research projects that brought together some of the best research engineers and students, and forged close links with local industry. Engineers from local firms were invited to teach within the university and an honours program sponsored by corporate partners enabled local workers to study while working full-time.

Following the war Stanford University continued to foster innovation within California and collaborated with industry to establish the Stanford Technology Park in 1951 that housed Hewlett-Packard, Varian and the Lockheed aerospace missile division. By the early 1960s the concentration of industries and research activity around Stanford University resulted in 30 percent of all the country's electronic and microwave industries being located in Santa Clara. Linkages between the university and local industry become intense with graduates securing jobs with local firms, academics joining the boards of local companies, and numerous spin out ventures emerging from the research undertaken (Gale, 2003).

California was therefore well placed to take advantage of the emerging information technology boom in the second half of the 20th century. Stanford University offered both world-class research centres and high quality graduates for firms seeking to set up in the area. Ongoing research into semiconductors and microprocessors fostered this process, as did the strong links between the academic research and local business community. Hewlett-Packard became a focal firm and led the formation of such groups as the West Coast Electronics Manufacturers Association and Santa

Clara County Manufacturing Group. These associations served as knowledge exchange arenas and provided a voice for the local industry. The corporate style of Hewlett-Packard (the "HP Way") became a role model for other Californian firms with emphasis on devolved authority, informality and openness, innovation, collaborative networking and entrepreneurship (Gale, 2003).

By the mid-1960s California had become the home of a wide range of major firms including Bell Laboratories, Esso, Merck and Ciba. Over 50,000 scientists and engineers were employed there along with 725 corporate research centres. However, growth continued to outstrip local supply of skilled engineers with the majority of professionals continuing to be recruited outside the state. Texas had also emerged as a rival technology cluster with the Dallas–Fort Worth area becoming the focal point for a defence related aerospace industry concentration based on General Dynamics, Lockheed and Ling-Tempco-Vought. Large defence contracts associated with this aerospace sector soon attracted new companies with Texas Instruments becoming a major semiconductor producer, growing from 4,500 to over 17,000 employees in less than five years (Gale, 2003).

The Silicon Valley case highlights the importance of concentrating effort on the development of a few specialised industries, but also the crucial role of key actors such as Professor Terman and David Packard. Forging a strong nexus between the education, research and business communities can foster the growth of local industry. However, there must be sound commercial reasons for companies to seek to locate in a particular area. The role of government can be seen in the defence sector as World War II and then the Cold War served as a stimulus for large scale projects capable of attracting business activity.

The Irish ICT Cluster

During the late 1990s the Republic of Ireland developed a strong information and communications technology (ICT) sector that has been recognised as one of the largest in the OECD. This ICT cluster has become the centre of manufacturing in a range of electronics components, computer software products and services. From a negligible base, Ireland emerged as the fifth largest exporter of computer products in the world and one of the world's leading software exporters (Green, et. al., 2001).

The antecedents of Ireland's ICT cluster date back to the early 1970s with the establishment of a computer manufacturing facility by Digital Electronics Corporation in 1971. This operation grew steadily throughout the 1980s and had become a focal firm in a small local production network of around 40 suppliers by the early 1990s. However, in 1993 Digital closed its Ireland plant laying off over 1,000 workers and leading to the loss of significant jobs among the supplier network (Green, et.al, 2001).

Faced with this crisis a series of industry support agencies was established with the participation of regional economic development organisations and the local chambers of commerce and industry. One of the most successful of these agencies was the Galway Technology Centre (GTC) that worked with the National University of Ireland and local business advisory services to assist redundant workers to start up new ventures. Generous redundancy payouts, tax concessions and training support enabled many to take this step. Government assistance was provided in the form of small business training and incubator facilities. Also important were the ongoing social networks of former Digital employees who collaborated and shared knowledge (Gale, 2003).

However, the main stimulus for the growth of Ireland's ICT cluster was the injection of significant levels of foreign investment. This was led by the country's Industrial Development Agency (IDA) and assisted by European Union grants. Ireland was able to promote itself as an attractive location for the manufacture of ICT components with relatively low labour costs, good lifestyle and a skilled and productive workforce.

Throughout the 1990s 19 of the top 25 computer firms in the world established manufacturing facilities in Ireland. These included IBM in 1996, Dell Computer Corporation, Hewlett-Packard, Microsoft, Intel and 3Com Corporation (Cornell, 2000). Each of these companies invested multiple millions of dollars into the establishment of major manufacturing facilities in Ireland during this period. Major attractors for this investment included the offer of generous taxation policies for foreign direct investors (Campbell, 2002), but also the country's competitive human resource base. Also of importance was the role played by the Irish education sector, with universities and colleges producing graduates that were well suited for employment in the fields of computer science and engineering (Green, et.al., 2001).

In conjunction with this growth in the number of major foreign ICT corporations locally-basing in Ireland, the country also experienced an expansion of its own indigenous software industry which grew strongly over the decade of the 1990s. In the period 1993-1997 the Irish software industry grew by 60 percent with a doubling of the workforce and gross turnover to around UK £4.5 billion (Gale, 2003). As the sector expanded the number of new start ups and spin outs increased with enhanced spill over effects as ideas and technologies diffused throughout the cluster. This has become a self-perpetuating process in the Irish ICT industry with positive impacts on economies of scale and scope (EE Times, 2002).

Ireland's success within the ICT sector has resulted in the development of other knowledge-intensive industries in regional areas and recognition that inter-firm collaboration, innovation and industry clustering are valuable foundations for a small regional economy such as Ireland's. Key lessons that can be drawn from this case are the importance of focal firms that can stimulate local production networks and foster the growth of new ventures. Also important is the role of government in ensuring that the broader economic conditions are attractive to investors and the need to actively promote foreign direct investment, while simultaneously supporting the emergence of local indigenous ventures. Finally, credit must be given to the regional business support structures which developed and assured skilled people, became employed and remained in the area (Clancy, O'Malley, O'Connell & van Egeraat, 2001). As noted by Gale (2003):

> *The Irish ICT cluster illustrates the benefit of the presence of a large anchor or focal company. It provides a useful catalyst and focus for cluster development by affording the opportunity to local industry to develop capabilities which can then be applied to the wider industry through other vertical links of the supply chain and ultimately horizontally. (p.15).*

India's ICT Cluster

Since the 1980s India has emerged as a major competitor in the field of computer software engineering, attracting foreign investors seeking to secure high quality but low cost skilled labour in order to reduce their operating costs and enhance their profit margins. Bangalore, India became a major centre for software engineering frequently with US trained graduates working on routine coding projects for major American corporations such as General Electric and Citibank. India's well-educated and English speaking work force combined with attractive tax concessions to lure foreign investors (International Tax Review, 1999).

Throughout the 1990s India continued to open up its economy and attract foreign investors in the ICT sector with such firms as Texas Instruments, Intel, Oracle and Microsoft all establishing significant operations there (Holland, 2002). Each of these major foreign focal firms stimulated the development of a series of local production networks, with some providing investment and technology transfer to assist the growth and quality of their local suppliers. Over time the capacity of the local Indian software engineering sector grew with increased value adding from simple code writing to the development of new products and applications. Companies such as the food giant Nestle and tobacco group Philip Morris become leading customers for India's local software development industry (Kripalani, 2002).

India became host to a number of technology and science parks collocated with educational institutions such as the prestigious Indian Institutes of Technology. This served to concentrate research, education and industry actors in close geographic proximity enhancing the flow of knowledge and linking India's industry into a global innovative milieu (Kripalani, 2002).

The low cost advantage that India enjoyed in its early years with relatively low skilled labour, has transformed into a high value added industry concentration based on a combination of continuous innovation, customer service, marketing and international benchmarking. India sends thousands of postgraduate students overseas each year to study science and engineering; particularly in the electronic and computer disciplines, with many securing postgraduate work within American firms prior to returning to India (Mazzarol, Choo & Nair, 2001). India's education system has made a solid contribution to the production of a highly skilled workforce with advanced training in both engineering and management (Chordas, 2003).

Key lessons from this case study are the ability of a region or country to leverage a comparative advantage (e.g. low labour costs), but to build on this over time and add value so as to ensure that a competitive advantage is achieved. Once again we can see the role of focal firms, government economic policies, skilled labour pooling and the contribution of the education and research communities. However, the actual growth of such clusters ultimately remains contingent on the capacity of local firms to emerge within a competitive environment and secure opportunities for themselves.

Australian Experience with Industry Clusters

Australian experience with Industry clustering as an economic development concept has been traced back to the early 1990s with the *Australian Manufacturing Report* (1990) (Pappas, Carter, Evans, Koop & Telesis, 1990). This it did by suggesting that regional industry growth could be enhanced by partnerships in which a core or "flagship" local industries could interact with regional firms to strengthen networks and encourage innovation, development and technology transfer (Enright & Roberts, 2001). Throughout the 1990s a series of studies was commissioned by the Federal Government to explore ways to enhance industry and economic development using clustering principles (Kelty 1993; McKinsey & Company 1994; Ministry of Industry 2000). Support for industry clustering was strongest in the early 1990s under the Hawke-Keating Federal Government, which incorporated cluster policy concepts in its *Working Nation* program launched in 1994. However, following the election of the Howard Government in 1996 this momentum dissipated, although it continued to focus on regional economic development via the *Regional Assistance Program* (Enright & Roberts, 2001). Within the technology field the main focus of clustering has been via the Cooperative Research Centre (CRC) program, designed to link university research with industry to enhance innovation and technology diffusion (Ferris 2001).

Historically the earliest attempts to employ cluster frameworks to local industry development were the Cape York Space Port and the Multi-Function Polis (MFP) in South Australia. The first initiative involved the creation of an international space port in far northern Queensland using the area's proximity to the equator as the key natural advantage for such a project. Commencing in 1988 the space port project enjoyed initial success at drawing together a network of engineering and aerospace partners but failed to move beyond the planning stage. The MFP sought to take a green field site and create a high technology urban environment blending lifestyle, employment and technology bridges between Australia and Japan. Originally targeted at the Gold Coast, the MFP switched to the outskirts of Adelaide following greater support being shown by the SA Government. Although the project received a good deal of interest throughout the 1990s it was officially abandoned in 1998 and declared a white elephant, although it has been accredited with spawning several industry clusters within the Adelaide region (Enright & Roberts, 2001).

Adelaide Metropolitan Industry Cluster Program

By the mid-1990s the lessons derived from the MFP project encouraged South Australian planners to focus on industry clustering as a means to revive the state's flagging manufacturing sector and rising unemployment. Led by the MFP Development Corporation and drawing on the lessons of Silicon Valley, a regional development program was developed for the Adelaide metropolitan region targeting industry clusters. This process commenced by engaging industry "champions" and other key stakeholders who formed a "cluster leadership group". Research was then commissioned to map the existing structure of regional clusters and a series of community meetings was held to foster trust and consensus on how firms within each cluster might collaborate. From such meetings action and business plans were developed for each cluster and additional resources were sourced for industry development projects utilising the influence of the cluster leadership group. The program was followed up with a series of plans designed to facilitate the long-term growth of each cluster (Enright & Roberts, 2001).

The Adelaide metropolitan industry cluster program was led by the MFP Development Corporation but actively supported by the South Australian State Government and the SA Chamber of Commerce and Industry. Two clusters that were successfully developed from the program were in the areas of defence and multimedia. The same methodology that was used to create the initial pilot program was replicated in the creation of these two clusters. Following some initial success a further two industry clusters were formed in the areas of spatial information and water management. Despite the collapse of the MFP project at the end of the 1990s, the defence, spatial and water clusters continued to develop with support from the state government (Enright & Roberts 2001).

Far North Queensland Regional Cluster

Although the *Cape York Space Port* project did not succeed, the far northern Queensland region has enjoyed some degree of success in creating a cluster model focusing on tourism and mining. Traditionally the region was dependent on agriculture, particularly bananas, tobacco and sugar. However, the area possesses abundant mineral resources (bauxite, gold and silicon), as well as World Heritage listed natural assets such as the Great Barrier Reef and tropical rain forests. Initial development commenced in 1982 with the construction of an international airport at Cairns capable of receiving inbound tourism directly from Japan and the United States. Throughout the late 1980s significant investment (estimated at over AUD$1 billion) flowed into infrastructure projects targeted at the tourism sector. Economic growth driven by tourism grew strongly in response to such initiatives only to be severely dampened by the 1989 pilots strike and subsequent recession of 1991.

Faced with the economic crisis of the early 1990s the *Far North Queensland Regional Planning Advisory Council* drew up a regional development strategy in 1994 designed to manage the region's growth over the period to 2010 (Enright & Roberts, 2001). An important element of this process was the establishment of the *Far North Queensland Regional Economic Development Organization* (FNQREDO). This entity secured financial support from the federal government and commissioned research into mapping industry clusters. These studies identified some 16 separate industry clusters ranging from agribusiness to the arts and culture. Suspension of federal funding in the late 1990s saw the dissolution of FNQREDO and the formation of the Cairns Regional Economic Development Corporation (CREDO) in 1998 with joint funding from the Queensland State Government, and local industry. The CREDO management Board is comprised of representatives from the various local industry clusters.

The CREDO approach to cluster development has been to organise meetings – "cluster musters" – comprised of representatives from local businesses identified as sharing common markets, suppliers or information networks. Facilitated by CREDO staff, these meetings provide information on the nature and benefits of industry clustering, and extol the virtues of cooperation and information exchange at a regional level. Firms are screened to determine what attributes they possess and how best to link them together: e.g. for growth, exporting, labour pooling, competitive advantage or joint ventures. Participating firms are all volunteers and generally have strong local networks and a willingness to collaborate. CREDO produces a strategic development plan for each cluster that seeks to identify the competitive advantages, core competencies, strategic infrastructure, regional risk and economic development opportunities. CREDO has been successful in developing strong clusters focusing on Eco-tourism, tropical fruits, agribusiness, marine technology and international education (Enright & Roberts, 2001).

Newcastle-Hunter Region Clustering Program

The decision by BHP Ltd to restructure and eventually withdraw from steel manufacturing in the City of Newcastle in the 1990s sparked a major program within the Hunter Region of NSW to seek strategies for economic renewal. With existing strengths in coal mining, aluminium smelting, steel manufacturing and wine making, the Hunter Region was launching from a sound base. Commencing in 1994 the Hunter Urban and Regional Development Organisation (HURDO) was established with financial assistance from the Federal Government's *Working Nation* program. HURDO drafted an economic development strategy for the region and staged a major conference with input from Professor Porter of Harvard University. This was followed by a research project designed to map the existing clusters within the region, which was funded by the BHP Development Trust fund (Enright & Roberts, 2001).

The research study findings were then used in a series of meetings to educate business, government, regional development agencies and the wider community on the merits of clustering. A total of 23 clusters were identified from the mapping process ranging from the well-recognised mining and wine sectors, through to emerging industries focusing on sustainable energy technologies, education and information technology. Once identified meetings were held with representatives from each cluster and commitment sought to cooperative engagement between industries. A series of strategic plans were then drawn up for selected clusters and arrangements made for ongoing management and networking. Action was galvanised by identifying specific projects through which the cluster participants could cooperate. Management of the cluster development was facilitated by the creation of incorporated entities to provide leadership and focus for each cluster.

Although HURDO was dissolved in 2000 following the cessation of its federal funding, it was replaced with the Hunter Economic Development Corporation (HEDC) and the Industry Development Centre (IDC). HURDO has left a legacy of several clusters including: 1) EDNET – an education cluster (established 1999) that links the region's universities and VET colleges together to jointly market international education and develop training products; 2) Global Build Incorporated – a cluster focusing on building and construction that draws together industry, government, unions and university faculties; and 3) Hunter Tech Inc – an information technology cluster focusing on cross-industry collaboration initiatives (Enright & Roberts, 2001).

The Australian Marine Complex

Within Western Australia the creation of the Australian Marine Complex (AMC) represents an example of a locally generated industry cluster with a high level of innovation intensity that has emerged over the past twenty years. By 2004 the AMC had become the largest shipbuilding and marine construction concentration in Australia accounting for 55 percent of the country's national construction. Located at Cockburn Sound south of the Port of Fremantle and close to the Royal Australian Navy (RAN) FLEETBASE WEST HMAS Stirling on Garden Island, the AMC is organised into four adjacent precincts. These include: i) shipbuilding; ii) marine support; iii) heavy fabrication; and iv) technology (Mazzarol, 2004).

The AMC cluster comprises shipbuilding, boatbuilding, naval defence systems and the design and fabrication of offshore oil and gas platforms and related equipment. At the core of the AMC is the shipbuilding sector with major focal firms such as Austal Ships and Tenix that together hold around 47 percent of the national market (IBIS, 2003). Traditionally these firms have constructed high speed aluminium ferries but have diversified into naval patrol vessels and other defence related production in recent years.

The origins of the AMC can be traced back to the 1980s with the conjunction of several otherwise unrelated activities. First, there was the decision made by the Federal Government to establish FLEETBASE WEST at HMAS Stirling on Garden Island. This concentrated around half the RAN fleet on the western seaboard and included a decision to home port the entire submarine fleet in WA. The next activity was the success in 1983 of the WA-based Australia II syndicate in the America's Cup yacht race that highlighted the capacity of local boat design. Despite the unsuccessful America's Cup defence, by the end of the 1980s the WA ship and boat building sector was internationally recognised. Parallel with these events was the establishment of the offshore extraction and local production of liquid natural gas (LNG) via the North West Shelf project. In 1984 the "North Rankin A" offshore gas production platform commenced operations brining together a collection of joint-venture partners: Woodside Energy Ltd; Shell Development (Australia) Ltd; BHP Petroleum (North West Shelf) Pty Ltd; BP Development Australia Ltd; Chevron Australia Pty Ltd and Japan Australia LNG (MIMI) Pty Ltd. Finally, there was the establishment of Austal Ships Ltd in 1988, a local WA firm committed to a vision of building high quality commercial vessels for the export market.

Throughout the 1990s the WA State Government, with support from Federal and Local Governments invested in the development of the 200 hectare Henderson Marine Park, now known as the AMC. Over the decade from 1990 to 2001 the AMC has seen the expansion of the WA Shipbuilding sector with shipbuilders such as Austal, Strategic Marine and Wavemaster, and local suppliers such as Capral (aluminium) and Beurteaux (seats) emerging as major players. This expansion was mirrored by the boat building sector with numerous small firms plus designers and suppliers producing prestige and luxury leisure craft primarily in fibreglass (Mazzarol, 2004). As a result of this growth the AMC attracted a large concentration of skilled labour in the form of naval architects, designers, shipwrights, aluminium welders and marine engineers.

In addition to the growth of the commercial shipbuilding sector, the AMC became home to a growing naval defence concentration, with firms such as Austal, Tenix, Raytheon Australia Naval Systems, the Australian Submarine Corporation (ASC) and Nautronix Ltd, all operating within the cluster (Mazzarol, 2004). An important trigger to this defence activity was the need to undertake major upgrades to the RAN fleet of Collins Class submarines during the 1990s. This has been supplemented by a contract to supply naval patrol vessels and routine maintenance work on other RAN ships home based at HMAS Stirling.

With the expansion of the offshore LNG projects in the North West Shelf during the 1990s and more recently, the opportunity for major construction projects fabricating gas extraction platforms, barges and service vessels has further enhanced the AMC. Perth is the headquarters of such focal firms as Woodside, Transfield-Worley and Clough Ltd and also key local fabricators such as the AusClad Group who supply to the major engineering project leaders (e.g. Clough and Transfield-Worley) (Mazzarol, 2004).

Lessons from the AMC for Future Cluster Development in WA

The AMC marine industry cluster offers several useful lessons for the development of future industry clusters in WA. It demonstrates the importance of securing a strong commitment from government to invest in the development of new industries through the creation of common user infrastructure and dedicated precincts. It also highlights the need for strong leadership with project teams that combine government and industry actors including chambers of commerce and industry. It also points to the value of such groups as the WA Shipbuilders Association or the Petroleum Club to serve as social exchange arenas.

Cluster development requires the concentration of several internationally competitive focal firms including local entrepreneurs with strong leaders, good products and international export orientation and activities. Clusters need to have viable and sustainable Local Production Networks (LPN) to bind the local industry and allow the micro firms to learn how to trade and benchmark their skills. The creation of the Industrial Supplies Office of WA (ISOWA) in 1987 served to enhance the LPN by giving large national and international focal firms moving into the State, information on local suppliers and sub-contractors. Such LPN must expand to include specialist support services such as export assistance and venture funding agencies, as well as R&D centres that can link the education sector with industry. This remains an area of weakness for the AMC (Mazzarol, 2004).

While the cluster must be primarily export focused, there should be sufficient local market activity to concentrate effort and assist smaller firms to get established (this was critical in the defence area with the establishment of HMAS Stirling (Fleet Base West) and then the need to do a lot of work on the Collins Class Submarines during the 1990s). It also applies to the North West Shelf LNG sector. There is merit in creating a well defined brand name (e.g. Australian Marine Complex), that serves to identify the cluster and focus attention for new investors, customers and industry cluster members. Finally, the AMC has also illustrated the need to enhance the social environment to facilitate knowledge transfer within the cluster.

The success of the AMC supports Enright's (2001) guidelines for cluster development that suggest the need for having clear goals and a sensible mechanism for identifying and prioritising clusters within the economy. It is also important to secure the participation of all key actors and to build a sense of common purpose and urgency. When seeking to develop the cluster it is important to target areas of real market failure and develop projects that can be achieved as "little victories" to encourage future action. Collaborative organisations that are dedicated to the growth of the cluster should be formed, and they should be tailored to the needs of each industry environment. Attention should be given to building up the institutional and support systems available to the cluster (e.g. research, education and training). The focus should also be on the development of the cluster, not the growth and survival of a particular firm or industry sector. Finally, initiatives that fail or no longer need public support should be terminated (Enright, 2001).

Clusters and the Creative Digital Content Industry

A range of programs has been undertaken to facilitate the development of the creative digital content industries in both Australia and overseas. While some are targeted specifically at digital content industry sectors (e.g. multimedia, digital games production), others are more general. These programs fall into three categories, namely specific, non-specific and incidental.

Specific programs are those that directly target actors within the digital content industry, seeking to address particular areas of need. An example of this is the way the State Government of Victoria has facilitated low cost access to expensive game development software for interactive game developers in that state.

Non-specific programs are those that provide more generic support for the entire digital content sector. The provision of low cost broadband access to firms working in the creative digital content industries would be an example of such a program. To date such an initiative has not be undertaken by Australian governments.

Incidental programs are those that indirectly provide support for the digital content industry through the provision of assistance to another industry sector that is only partially engaged with the sector. For example, the Film and TV industry is involved in digital content activity in-part, but such activity continues to be an important but peripheral element within the sector. ScreenWest is involved in seed funding the development of local Film and TV projects. It receives funding from the WA State Government to enable it to achieve its goals and indirectly supports the local digital content industry where digital content is used within the production of Film and TV product.

The 'Creative Industries Cluster Study - Stage One Report' stated that

> *Cluster development in the Australian digital content and applications industries is embryonic and patchy based on the limited data available* (NOIE 2002).

Part of this "patchiness" can be explained by the problems associated with definitions and standard industry classifications (ANZSIC) discussed earlier in this report and part is due to the way digital content cuts across a range of creative and cultural industries, as it relates to the value chain process described earlier. For example (Cunningham, et al, 2002) identified a number of creative industry clusters that have strong digital content components such as TV program production, while others have less, such as dance, drama, and performance art. Therefore any analysis of digital content industry clusters will cover a wide range of different industry clusters, which are to a greater or lesser extent involved in the production of creative digital content. While the electronics games development area is highly digital content intensive, the Film and TV production area is less so.

One of the major benefits of clustering is that it brings together individuals with different experience and expertise. As was stated in the second NOIE study:

> *The second characteristic of digital content production is that it is inherently a team game (more so than in earlier content business). In part this is because of the inherent mix of techno nerds and non technical creatives. In part this is because the art of the content production has become inherently more collaborative (as a necessary corollary of interactivity and the re-purposing of content"* (Cutler & Co 2002).

The term "techno-nerd" is a little misleading, as many such "nerds" have been responsible for creating some very valuable intellectual property. Therefore they are, under our definition, to be considered part of the expertise necessary to create valuable digital content within any future WA digital content industry cluster.

The combination of what we have described earlier as Creative (A) and Creative (T) communities of practice is essential to the development of any future interactive multimedia industry focusing on computer games, where the development team requires both types of expertise (Crawford, 2003). A major challenge for the future development of a digital content industry cluster is likely to be the need to create the social and infrastructural environments necessary to bring these two communities together. While not an easy goal to achieve, the development of strategies designed to achieve convergence between the Creative (A) and (T) communities will be necessary to keep pace with the requirements of the new digital technologies.

Digital Content Clusters in Australia and the UK

Mapping digital content clusters in Australia or anywhere else is complicated by the definitional problems explored previously in this document. For example, a study into four segments within the Australian digital content industry, namely; Interactive Games, Interactive Multimedia, Advertising, and Digital Content in Education, noted:

> *It became evident that the segments chosen for focus in this work were "points of entry" into the exploration of the overall field rather than natural industry segments in their own right. The segmentation of content industries is messy and not stable* (Cutler, 2002).

Cluster studies of the digital content industry are therefore rare due to the relative novelty of the sector as an area of research, and its relatively immature state of evolution. Given this situation it is necessary to look into studies of closely related sectors such as the creative industry when seeking to investigate examples of industry clustering within the digital content sector.

Governments around the world have completed cluster studies into the so-called "creative industries", which have resulted in various recommendations for creative industry cluster policies. Cutler (2002) for example, compares two different approaches, one in Scotland and the other in Canada. Both studies noted the value of the creative industry to their respective national economies and made similar recommendations with regard to encouraging cluster formation through government support, encouraging private investment, improving skills and raising awareness in key markets.

Digital Clustering in the United Kingdom

One of the largest studies into mapping the creative industry was completed by the Department of Trade and Industry (DTI) in the United Kingdom. The first study undertaken by the DTI was completed in late 1998, and updated a little over two years later (DTI 2001). The original study helped the UK government set up a Creative Industries Task Force which:

> *investigated generic issues which impacted the creative industries and has made recommendations for change in areas such as skills and training, finance for creative venture, intellectual property rights and export promotion* (DTI 2001).

One of the major practical outcomes of the study was an increasing number of local authorities that recognised the contribution creative industries "can make in economic development, regeneration and social inclusion", which resulted in a number of major initiatives such as the Cultural Industries Quarter in Sheffield, the Jewellery Quarter in Birmingham, Huddersfield Media Centre, Grainger Town in Newcastle, the Cathedral Quarter in Belfast and the City Fringe area of London (DTI 2001).

Another major benefit arising from the report was a commitment to provide more timely and consistent data on the activity of the Creative Industries. This resulted in regular Creative Industry bulletins published in hard copy and online. These bulletins provide a wide range of data on the UK creative industry suggesting that the sector now contributes around 8 percent of the national GDP, £11.5 billion in export revenues and 1.9 million jobs (DCMS, 2004).

Digital Clustering in Australia

The number of clusters or potential clusters in Australia, whether they be in the digital content industry or not is unknown, although a study in 2001 identified around seventy known clusters (Brown, 2001). Many cluster programs in Australia, are managed by local governments, civic associations, regional bodies and statutory authorities. These programs include: the South Australia Business Vision 2010 Program; the City of Playford Economic Development Plan; the Cairns Regional Economic Development Corporation; the Hunter Economic Development Corporation and Industry Development Centre; the Office of Western Sydney and the Brisbane City Council Plan (Ammirato, et al, 2003).

In Australia as in the rest of the world, many cluster development programs have evolved out of economic mapping studies. Due to the evolving nature of the industry, cluster studies generally focus on mapping creative industry clusters rather than purely digital content clusters, which as has been discussed previously, cuts across a wide range of industry sectors.

In a study of the audiovisual and creative industries in the Northern Rivers Region of New South Wales, the existence of a number of allegedly existing industry clusters was identified within the audiovisual and cultural sectors (Henkel, 2002). This same study concluded that:

> *Potential does exist in the region for a number of burgeoning industry clusters, but that significant obstacles and barriers exist in local, national and international trends that need to be overcome if this potential is to be realised* (Henkel, 2002).

The study concluded that these industry clusters would need to overcome a range of barriers to future growth including access to broadband networks, the identification of a viable market niche and the need for strategic partnerships.

Some of these cluster development strategies have given rise to specific programs targeting digital content clusters. For example, the Victorian Government's *Game Plan* is reportedly a blueprint for the development of that state's computer gaming industry. It has provided a range of support services, material and common user infrastructure to the sector, such as the provision of funding to purchase Sony Games development software and enhanced networking and communications systems to link games development firms with venture financiers (Anson, 2003). This program has achieved some notable success. Victoria can now claim to be home to around 50 percent of Australia's computer game development industry and also accommodates the Asia-Pacific headquarters of such leading United States games publishers as Acclaim Entertainment and THQ (Baldwin, 2004).

The Queensland State Government has also invested around $15 million to support the development of a *Creative Industries Precinct* near the Queensland University of Technology (QUT). The Queensland Government provided $2 million for 80 games scholarships and helped establish the Queensland Games Industry Cluster. This was an aspect of the *Smart State* strategy undertaken by Queensland. This focus on the creative industries also encouraged QUT to restructure its programs and launch the first Creative Industries Faculty and associated research activities the Creative Industries Research and Applications Centre. Queensland is now host to an estimated 40 percent of the Australian computer games industry and has a burgeoning film production sector focused on international film projects (Baldwin, 2004).

During 2004 the State Government of Western Australia established its *Creative Industries Policy* Taskforce with the objective of identifying the creative industries sector within the State (Redhead, 2004). The task force noted that WA had several real or perceived problems that included: i) the small demand in the local market; ii) the lack of critical mass; iii) gaps in some key skills areas (business, marketing etc); iv) the lack of an entrepreneurial culture; v) low collaboration and remoteness; vi) lack of studios and other premises; and vii) problems in linking the education sector with the manufacturing sector (Readhead, 2004). Similar findings have been reached in other studies examining the opportunities for cluster development in the WA ICT sector (Gale, 2003).

SECTION 4

Mapping the WA Digital Content Sector

Industry clusters are most likely to emerge where above average concentrations of employment or industrial activity occur within a given geographic area. Such agglomerations at a local level can create specialisation and local production networks (LPN) (Isaksen, 1998), Such networks can be beneficial to small firms that may be sub-contracting or supplying to larger focal firms, or that might need to share specialised common-user infrastructure. Concentration of business and employment within a given region can also create skilled labour pools and may stimulate knowledge hubs via interpersonal networking among entrepreneurs (Ostgaard & Birley, 1994).

Such networking enables businesses, particularly small firms, to access specialised support services, common user infrastructure and skilled labour pools, at a discount because they are not required to carry the full cost of developing and keeping such intellectual or physical assets. Clustering supports this process by attracting to a region, specialised services that would otherwise be difficult to secure by more isolated industries (Rosenfeld, 1997).

To provide an appropriate mapping of the digital content industry in Western Australia, the starting point was the examination of business and employment concentrations in sectors considered to be potentially digitally intensive. The aim of this phase of the study was therefore to identify concentrations or *location quotients* of employment and business activity within the digital content sector in the State. This process was facilitated by an examination of business and employment concentrations within industry classifications as defined by the Australia and New Zealand Standard Industrial Classifications (ANZSIC).

Digital Content Industries

The data used for the business and employment concentration analysis was sourced from the most recent business statistics (1999-2002) available through Sensis Pty Ltd (Yellow Pages® *Business Activity Reporting*), and the most up to date employment statistics (2001) available through the Australian Bureau of Statistics (ABS). The employment numbers sourced from the ABS were for the working population. Both the *Yellow Pages®* and ABS classify businesses and persons employed using the ANZSIC classification system.

The ANZSIC classification traditionally has four levels. Level 1 ANZSIC codes provide figures for the major industries of which there are 17 in total. These major industries are broken down into more detailed sub-sectors, with level 2 providing 53 industries, level 3 providing 158 industries and level 4 providing 491 industries. The Yellow Pages® provides an additional level (level 5), with 2,600 categories. This study utilised categories down to level 5 for *Yellow Pages®* data and level 4 from ABS.

Categories that featured as 'undefined' were omitted, as they did not add meaningful information to the study.

The selection of industries that were included as possibly belonging to the digital content sector was based on judgment and an appreciation of the potential types of firms that may operate within the digital content sector as defined by the working definition described earlier in Section 2. This process commenced with an examination of all 2,600 ANZSIC classifications within the Sensis Level 5 database. From this, a large number of industry classifications was excluded and a final list of 59 categories was drawn up. The most detailed industry classification level for employment was ANZSIC level 4. Therefore the ANZSIC level 4 industry category which the identified industries at level 5 *Yellow Pages*® belonged to were chosen for the employment concentration analysis. This provided 28 digital content industries for analysis of employment concentrations. The business and employment industries that were chosen as being possibly involved in the digital content sector are summarised in Table 1.

Digital Content Location Quotients

Concentrations or *location quotients* of business and employment activity within the digital content sector in Western Australia were undertaken by comparing the business or employment concentration of the digital content industries within WA and the Perth metropolitan area and comparing it with the concentration within Australia and the other Australian capital cities. The calculation for deriving a WA business digital content concentration is shown below:

$$\frac{\textit{(No. of WA digital content industry businesses/Total WA business)}}{\textit{(No. of Aust digital content industry businesses /Total Aust business)}}$$

Ratios greater than one indicated that business/employment in the industry had a higher concentration than the comparative area. For example, a ratio of 2.0 would indicate that WA had a concentration in an industry twice that of Australia. When the ratio for a specific industry is greater than one, it can be assumed that the particular industry in the region is significant and may be forming the core of a potential cluster. Using these ratios, all digital content industry sectors in the region can be ranked in terms of their probable importance as exporters and wealth generators (Anderson, 1994). Attention was also given to any evidence of these business concentrations having grown or declined over time.

Care needs to be taken when interpreting the employment concentrations within the digital content industries. This is because in most cases industries identified at *Yellow Pages*® level 5 were very ad hoc, and came from a variety of level 4 sub-sectors. This has led to many more industries being included in the employment analysis, many of which we did not identify as being likely to be associated with the digital content sector. Table 2 summarises this, by showing the total number of industries at *Yellow Pages*® level 5 that we identified as being possibly associated with the digital content sector within their associated ANZSIC level 4. Also shown is the total number of *Yellow Pages*® level 5 industries within the ANZSIC 4 level. For example, we identified Medical Equipment &/or Repairs (*Yellow Pages*® level 5) as being part of the digital content sector. This industry belonged to the Medical and Surgical Equipment Manufacturing ANZSIC 4 level, of which 6 other Yellow Pages® level 5 industries additionally did, none of which we felt were associated with the digital content sector.

Table 1: Industries at Yellow Pages® level 5 identified as possibly belonging to the digital content sector, along with the level which it belongs to at ANZSIC level 4.

Yellow Pages® level 5	ANZSIC level 4
Medical Equipment &/or Repairs	Medical and Surgical Equipment Manufacturing
Desktop Publishing Services	Services To Printing
Pre-Press Production Services	Services To Printing
Directories	Book and Other Publishing
Publishers Book	Book and Other Publishing
Newspapers Business	Newspaper Printing or Publishing
Newspapers Rural	Newspaper Printing or Publishing
Newspapers Religious	Newspaper Printing or Publishing
Newspapers Sporting	Newspaper Printing or Publishing
Newspapers General	Newspaper Printing or Publishing
Publishers Music	Recorded Media Manufacturing and Publishing
Data Preparation &/or Processing Services	Data Processing Services
Multimedia Services	Information Storage and Retrieval Services
Advertising Agencies	Advertising Services
Libraries Photograph &/or Film	Advertising Services
Artists Commercial	Commercial Art and Display Services
Designers Graphic	Commercial Art and Display Services
Media Information &/or Services	Business Services n.e.c.
Training Films & Videos	Business Services n.e.c.
Medical Research	Scientific Research
House Planning Services	Architectural Services
Drafting Services	Architectural Services
Architects	Architectural Services
Landscape Architects	Architectural Services
Mining Engineers	Consultant Engineering Services
Naval Architects	Consultant Engineering Services
Chemical Engineers	Consultant Engineering Services
Civil Engineers	Consultant Engineering Services
Electronic Engineers	Consultant Engineering Services
Designing Engineers	Consultant Engineering Services
Combustion Engineers	Consultant Engineering Services
Electrical Engineers	Consultant Engineering Services
Structural Engineers	Consultant Engineering Services
Marine Engineers	Consultant Engineering Services
Designers Product & Industrial	Consultant Engineering Services
Maps &/or Mapping	Surveying Services
Sound Engineers	Technical Services n.e.c.
Continued over page:	

Yellow Pages® level 5	ANZSIC level 4
Photography &/or Video Schools	Other Education
Radio & Television Schools	Other Education
Universities & Tertiary Education Colleges	Higher Education
Technical & Trades Colleges	Technical and Further Education
TAFE Colleges	Combined Primary and Secondary Education
Music Arrangers & Composers	Creative Arts
Writers, Consultants &/or Services	Creative Arts
Illustrators	Creative Arts
Cartoonists & Caricaturists	Creative Arts
Musicians &/or Musicians' Agents	Music and Theatre Production
Recording Services	Sound Recording Studios
Film Production Services	Film and Video Production
Film Production Facilities & Equipment	Film and Video Production
Theatres & Theatre Companies	Motion Picture Exhibition
Television Stations	Television Services
Television Programme Producers &/or Distributors	Television Services
Slides &/or Film Strips	Photographic Film Processing
Photographic Processing Services Professional	Photographic Film Processing
Photographers Scientific	Photographic Studios
Photographers Commercial & Industrial	Photographic Studios
Photograph Restorations & Retouching	Photographic Studios
Compact Discs, Records & Tapes W'salers & Mfrs	Wholesaling n.e.c.

Source: Yellow Pages ® (2003)

Table 2: Number of Industries at ANZSIC level 4 identified as possibly belonging to the digital content sector, along with the total number of industries within their sub-sector classification

ANZSIC level 4	Total No. of industries identified as possibly belonging to Digital Content	Total No. of industries within Sub-sector classification
Medical and Surgical Equipment Manufacturing	1	7
Services To Printing	2	13
Book and Other Publishing	2	2
Newspaper Printing or Publishing	5	5
Recorded Media Manufacturing and Publishing	1	1
Wholesaling n.e.c.	1	46
Data Processing Services	1	1
Information Storage and Retrieval Services	1	1
Advertising Services	2	14
Commercial Art and Display Services	2	10
Business Services n.e.c.	2	60
Scientific Research	1	7
Architectural Services	4	7
Consultant Engineering Services	11	40
Surveying Services	1	9
Technical Services n.e.c.	1	27
Other Education	2	34
Higher Education	1	1
Technical and Further Education	1	1
Combined Primary and Secondary Education	1	1
Creative Arts	4	11
Music and Theatre Production	1	3
Sound Recording Studios	1	1
Film and Video Production	2	3
Motion Picture Exhibition	1	2
Television Services	2	3
Photographic Film Processing	2	5
Photographic Studios	3	7
TOTAL	59	

Source: Yellow Pages ® (2003)

Western Australian Digital Content Business and Employment Numbers

The number of persons employed within the digital content industries was 55,421 in 2001, representing 7 percent of all persons employed within Western Australia (Table 3). In 2002 there were a total of 3,241 businesses classified in WA within the identified digital content industries (Table 4). This represented 4 percent of all businesses within WA. It should be recognised that we do not suggest that these firms are definitely engaged in the industry, but that they may profile as being likely to be engaged. The employment figure in particular is likely to over-estimate the actual number of persons employed within the digital content sector. This is because many of the businesses and persons employed within these industries are likely to be involved only partially or not at all in digital content.

Table 3: Number of persons employed in the digital content industries within WA

ANZIC level 4	Employment	ANZIC level 4	Employment
Services to Printing	456	Commercial Art and Display Services	1,270
Newspaper Printing or Publishing	2,570	Business Services, nec	3,200
Book and Other Publishing	333	Combined Primary & Secondary Education	2,844
Recorded Media Manufacturing and Publishing	70	Higher Education	9,539
Medical and Surgical Equipment Manufacturing	662	Technical and Further Education	4,035
Wholesaling, nec	1,125	Other Education	5,379
Scientific Research	2,271	Film and Video Production	386
Architectural Services	2,590	Motion Picture Exhibition	903
Surveying Services	1,330	Television Services	875
Consulting Engineering Services	7,909	Music and Theatre Productions	877
Technical Services, nec	2,176	Creative Arts	755
Data Processing Services	182	Sound Recording Studios	72
Information Storage and Retrieval Services	170	Photographic Film Processing	844
Advertising Services	2,010	Photographic Studios	417
		TOTAL	55,421

Source: ABS (2003)

Table 4: Number of digital content related businesses within WA during 2002

Yellow Pages® level 5	Businesses	Yellow Pages® level 5	Businesses
Medical Equipment &/or Repairs	37	Designing Engineers	27
Desktop Publishing Services	59	Combustion Engineers	12
Pre-Press Production Services	21	Electrical Engineers	65
Directories	16	Structural Engineers	33
Publishers Book	93	Marine Engineers	60
Newspapers Business	5	Designers Product & Industrial	33
Newspapers Rural	5	Maps &/or Mapping	61
Newspapers Religious	1	Sound Engineers	9
Newspapers Sporting	1	Photography &/or Video Schools	0
Newspapers General	78	Radio & Television Schools	1
Publishers Music	2	Universities & Tertiary Education Colleges	41
Data Preparation &/or Processing Services	10	Technical & Trades Colleges	27
Multimedia Services	104	TAFE Colleges	39
Advertising Agencies	152	Music Arrangers & Composers	22
Libraries Photograph &/or Film	10	Writers, Consultants &/or Services	63
Artists Commercial	50	Illustrators	29
Designers Graphic	387	Cartoonists & Caricaturists	18
Media Information &/or Services	22	Musicians &/or Musicians' Agents	116
Training Films & Videos	16	Recording Services	64
Medical Research	20	Film Production Services	63
House Planning Services	30	Film Production Facilities & Equipment	16
Drafting Services	416	Theatres & Theatre Companies	41
Architects	362	Television Stations	17
Landscape Architects	45	Television Programme Producers &/or Distributors	17
Mining Engineers	78	Slides &/or Film Strips	2
Naval Architects	14	Photographic Processing Services Professional	18
Chemical Engineers	7	Photographers Scientific	1
Civil Engineers	76	Photographers Commercial & Industrial	100
Electronic Engineers	69	Photograph Restorations & Retouching	37
		Compact Discs, Records & Tapes W'salers & Mfrs	23
		TOTAL	3,241

Source: Yellow Pages ® (2003)

Growth and Change in Western Australia's Digital Content Businesses over Time

Within WA the number of digital content businesses stayed relatively stable for the period spanning 1999-2002. There were a few exceptions, where business numbers increased or decreased by 10 percent or greater. These have been summarised in Tables 5a and 5b.

Table 5a: Industries at the Yellow Pages® level 5 that increased by 10% or greater during the period 1999 to 2002

Yellow Pages® level 5	Business Numbers		% Change in Number
	1999	2002	
Newspapers Business	2	5	150%
Directories	11	16	45%
Combustion Engineers	9	12	33%
Cartoonists & Caricaturists	14	18	29%
Media Information &/or Services	17	22	29%
Training Films & Videos	13	16	23%
Designers Graphic	318	387	22%
Television Programme Producers &/or Distributors	14	17	21%
Landscape Architects	39	45	15%
Writers, Consultants &/or Services	56	63	13%
Universities & Tertiary Education Colleges	37	41	11%

Source: Yellow Pages ® (2003)

Table 5b: Industries at the Yellow Pages® level 5 that decreased by 10% or greater 1999 to 2002

Yellow Pages® level 5	Business Numbers		% Change in Number
	1999	2002	
Photography &/or Video Schools	3	0	- 100%
Slides &/or Film Strips	5	2	-60%
Radio & Television Schools	2	1	-50%
Desktop Publishing Services	96	59	-39%
Publishers Music	3	2	-33%
Data Preparation &/or Processing Services	14	10	-29%
Newspapers Rural	7	5	-29%
Designers Product & Industrial	46	33	-28%
Designing Engineers	35	27	-23%
Compact Discs, Records & Tapes W'salers & Mfrs	29	23	-21%
Electrical Engineers	79	65	-18%
Electronic Engineers	81	69	-15%
Civil Engineers	88	76	-14%
Chemical Engineers	8	7	-12%
Advertising Agencies	172	152	-12%
Mining Engineers	88	78	-11%
Photographers Commercial & Industrial	112	100	-11%

Source: Yellow Pages ® (2003)

It is important to look behind the percentage change figure at the actual number of business driving the growth or decline of 10 percent or greater to ensure the percentages provide an accurate representation of business activity. Tables 5a and 5b highlight that many of the digital content industries with large percentage increases are associated with very few business numbers.

Western Australian and Perth Metro Digital Content Business Concentrations

The analysis did not highlight either an overall digital content business or employment concentration within Western Australia in comparison to Australia. For the digital content sector, both the business and employment ratios generated a ratio of 1.0. This indicates that WA does not exhibit a higher or lower concentration of digital content businesses or employment in comparison to Australia. The Perth metropolitan area contributed 92 percent to the WA business digital content sector ratio and 82 percent to WA employment digital content sector ratio. This highlights that the majority of the activity within the digital content sector is occurring within the Perth metropolitan area. Since most of the digital content activity occurs in Perth, the remainder of the report focuses on Perth, in comparison to Australia's capital cities. The full list of Perth and WA concentration ratios are reported in Appendix A.

Perth's digital content industries that had business and employment concentration ratios equal or greater than 1.0 in comparison to Australia's capital cities are detailed in Tables 6 and 7. The tables highlight that there is a high degree of correlation between industries which had business and employment concentrations greater than 1.0. Business and employment concentrations were calculated for newspaper printing or publishing, architectural services, consulting engineering services, surveying services, technical services, nec, and combined primary and secondary education. The finer level of detail at level 5 provided additional business concentrations that were not picked up as employment concentrations at the 4-digit level.

Table 6: Perth digital content industries at Yellow Pages® level 5 that had business concentration ratios in comparison to the Australian capital cites ≥ 1.0

Yellow Pages® level 5	ANZSIC level 4	Perth business ratio
Directories	Book and Other Publishing	1.5
Publishers Book	Book and Other Publishing	1.2
Newspapers Rural	Newspaper Printing or Publishing	1.6
Training Films & Videos	Business Services n.e.c.	1.2
Medical Research	Scientific Research	1.2
House Planning Services	Architectural Services	1.6
Drafting Services	Architectural Services	1.5
Mining Engineers	Consultant Engineering Services	3.3
Naval Architects	Consultant Engineering Services	2.2
Chemical Engineers	Consultant Engineering Services	1.2
Civil Engineers	Consultant Engineering Services	1.2
Electronic Engineers	Consultant Engineering Services	1.3
Designing Engineers	Consultant Engineering Services	1.7
Combustion Engineers	Consultant Engineering Services	1.6
Electrical Engineers	Consultant Engineering Services	1.3
Marine Engineers	Consultant Engineering Services	2.1
Maps &/or Mapping	Surveying Services	2.2
Sound Engineers	Technical Services n.e.c.	1.3
Technical & Trades Colleges	Technical and Further Education	1.1
TAFE Colleges	Combined Primary & Secondary Education	1.9
Illustrators	Creative Arts	1.1
Theatres & Theatre Companies	Motion Picture Exhibition	1.5
Television Stations	Television Services	1.4
Photographers Commercial & Industrial	Photographic Studios	1.1
Photograph Restorations & Retouching	Photographic Studios	1.3

Source: Yellow Pages ® (2003)

Table 7: Perth digital content industries at ANZSIC level 4 that had employment concentration ratios in comparison to the Australian capital cites ≥ 1.0

ANZSIC level 4	Perth employment ratio
Newspaper Printing or Publishing	1.1
Architectural Services	1.0
Consulting Engineering Services	1.6
Surveying Services	1.8
Technical Services, nec	1.6
Combined Primary & Secondary Education	1.2
Technical and Further Education	1.1
Higher Education	1.1

Source: ABS (2003)

Looking at the Perth metropolitan industries growth or decline in business concentration over the period spanning 1999-2002 identifies industries that are growing faster or slower than in comparison to the Australian capital cities. Figure 5 plots the change in business concentration (1999-2002) across the x-axis and the business concentration along the y-axis. Figure 5 identifies digital content industries that have: i) high concentration ratios and experienced high growth (top right corner); ii) high concentration ratios and experienced low growth (top left corner); iii) low concentration ratios and experienced high growth (bottom right corner); and iv) low concentration ratios and experienced low growth (bottom left corner).

High Concentration, High Growth Industries

Industries which have very high business concentrations and experienced positive growth included mining engineers (17), maps and/or mapping (33), naval architects (26) and marine engineers (20). This reflects the underlying industry structure within Western Australia, with the large mining and resources sector, which also make significant use of aerial surveying; and the emerging marine engineering and shipbuilding cluster (e.g. AMC). Increasing use of digital content in such industries, either as producers or consumers, creates a potential opportunity for building clusters. Although this will be dependent on the nature of how digital content is used within each industry sub-sector.

Potential Emerging Industries

Industries that experienced greater growth, but are currently less concentrated than the above mentioned industries included house design and planning (8), combustion engineers (5), rural newspapers (10), and book publishers (7). Such industries may be potential emerging industries and deserve some attention when seeking to develop future clusters.

Potential emerging Perth industries that currently have business concentrations just below the Australian capital cities, but have experienced significant growth include newspaper business (1), cartoonists and caricaturists (6), writers, consultants and/or services (16), artists commercial (15) and media information and/or services (12). Other industries which have shown significant growth but currently have a concentration significantly below the Australian capital cities include photographic scientific (2), pre-press production services (4), television programme producers and/or distributors (9) and film production facilities and equipment (14).

Industries Requiring Attention

Important Perth industries that currently have business concentrations greater than the Australian capital cities, but may require attention due to declining growth include TAFE colleges (46), designing engineers (49), electrical engineers (45) and technical and trade colleges (47). Such industries have good concentration, but their stagnant growth or decline may suggest that they have either begun to mature or that there is potential leakage of activity from the region.

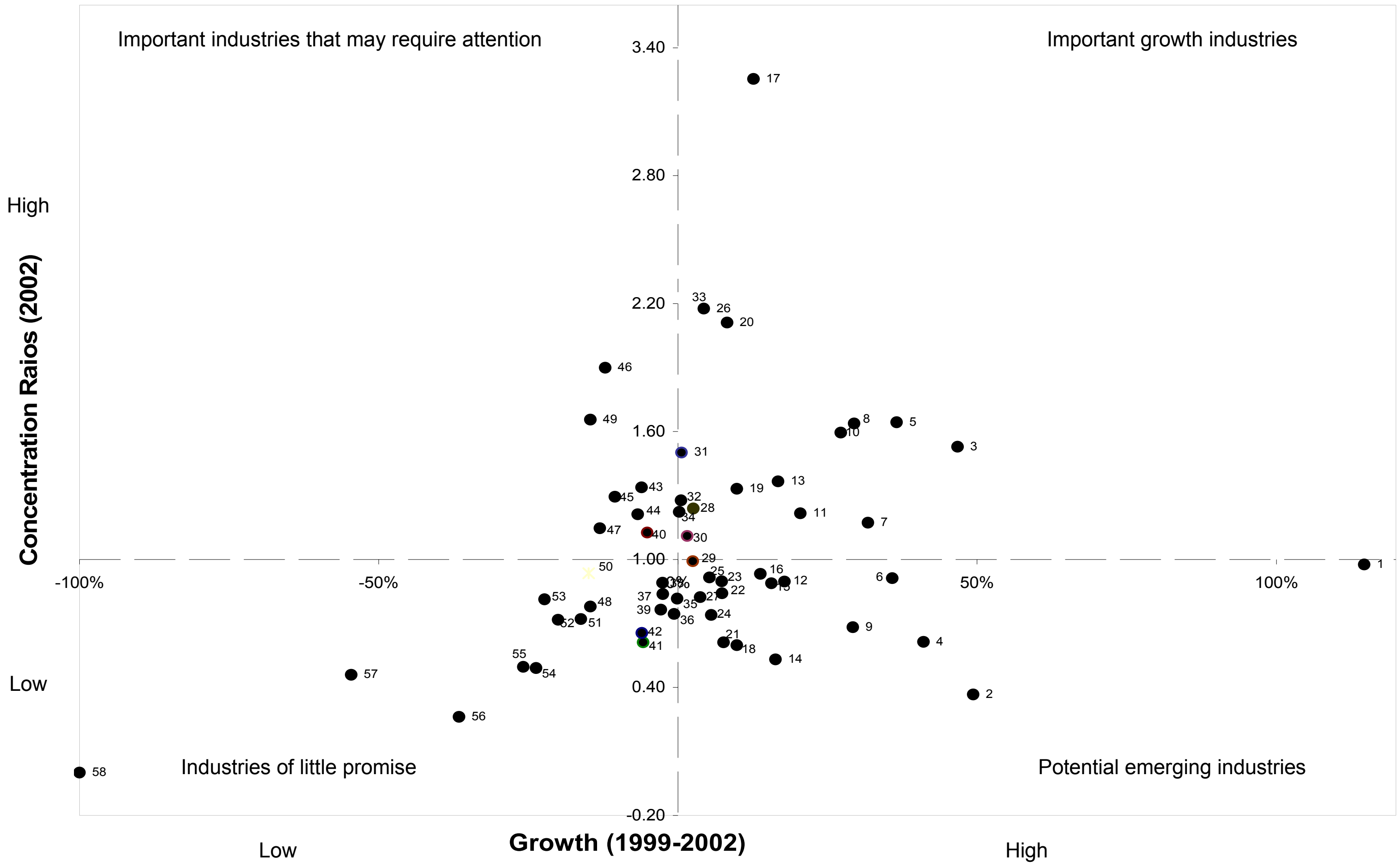


Figure 5: Business growth (1999-2002) and business concentrations (2002) for potential digital content industries

Source: Yellow Pages ® (2003)

Yellow Pages® level 5	Number	Comment
Newspapers Business	1	
Photographers Scientific	2	Potential emerging sector
Directories	3	Important growth sector
Pre-Press Production Services	4	Potential emerging sector
Combustion Engineers	5	Important growth sector
Cartoonists & Caricaturists	6	Potential emerging sector
Publishers Book	7	Important growth sector
House Planning Services	8	Important growth sector
Television Programme Producers &/or Distributors	9	Potential emerging sector
Newspapers Rural	10	Important growth sector
Training Films & Videos	11	Important growth sector
Media Information &/or Services	12	Potential emerging sector
Television Stations	13	Important growth sector
Film Production Facilities & Equipment	14	Potential emerging sector
Artists Commercial	15	Potential emerging sector
Writers, Consultants &/or Services	16	Potential emerging sector
Mining Engineers	17	Important growth sector
Film Production Services	18	Potential emerging sector
Sound Engineers	19	Important growth sector
Marine Engineers	20	Important growth sector
Newspapers Sporting	21	Potential emerging sector
Libraries Photograph &/or Film	22	Potential emerging sector
Medical Equipment &/or Repairs	23	Potential emerging sector
Structural Engineers	24	Potential emerging sector
Newspapers General	25	Potential emerging sector
Naval Architects	26	Important growth sector
Recording Services	27	Potential emerging sector
Civil Engineers	28	Important growth sector
Landscape Architects	29	
Photographers Commercial & Industrial	30	
Drafting Services	31	
Electronic Engineers	32	
Maps &/or Mapping	33	Important growth sector
Medical Research	34	
Designers Graphic	35	
Music Arrangers & Composers	36	
Architects	37	
Advertising Agencies	38	
Photographic Processing Services Professional	39	
Illustrators	40	
Newspapers Religious	41	
Universities & Tertiary Education Colleges	42	
Photograph Restorations & Retouching	43	
Chemical Engineers	44	
Electrical Engineers	45	
TAFE Colleges	46	
Technical & Trades Colleges	47	
Multimedia Services	48	
Designing Engineers	49	
Musicians &/or Musicians' Agents	50	
Compact Discs, Records & Tapes W'salers & Mfrs	51	
Desktop Publishing Services	52	
Designers Product & Industrial	53	
Data Preparation &/or Processing Services	54	
Slides &/or Film Strips	55	
Publishers Music	56	
Radio & Television Schools	57	
Photography &/or Video Schools	58	

SECTION 5

Findings from the Industry Survey

A telephone survey was undertaken with a view to gathering a more detailed picture of the digital content industry in Western Australia and to serve as a platform upon which to recruit future case study firms. As outlined in Section 4, the initial list of 2,600 level 5 ANZSIC classifications were analysed and a short list of 59 industries drawn which were viewed as having potential for engagement in the digital content industry. This list was used to develop the sampling frame for the industry survey.

Sampling

The survey involved a telephone interview of 217 respondent firms drawn from an initial database of firms mapped against the 59 ANZSIC classifications identified as potentially being engaged in the digital content industry. All firms in the final sample were classified against the ANZSIC categories drawn from the *Yellow Pages®* database.

Table 8 shows the number of firms captured in the sample by each of the industry classifications. Those industry sectors that were found to have an above average concentration within the State as compared with the rest of Australia, or within the Perth metropolitan area as compared to other Australian capital cities are shaded.

It should be noted that some of the categories within the ANZSIC code at Level 5 are duplicates of each other. For example, sound engineers are also counted within the category recording studios. The sample also sought to draw upon those industry categories that were likely to contain high levels of digital content activity, not just those that had an above average level of industry concentration within the State.

The final sample contained a balance between those firms that were identified as being among the more heavily concentrated within the State and those that were more likely to be heavily engaged in the digital content industry.

Size of Firms

The majority of firms surveyed were micro-enterprises, followed by small firms as shown in the following breakdown of the sample:

- Micro-enterprises (<5 employees) 62%
- Small enterprises (5-20 employees) 28%
- Medium enterprises (20-200 employees) 7%
- Large enterprises (>200 employees) 3%

This is a typical pattern within WA industry where the overwhelming majority (99.8%) of all business ventures are small to medium, with 84 percent being micro-enterprises (e.g. with less than 5 employees). It is important to note that the majority of firms in Australia and WA more specifically, are non-employing micro-enterprises in which the only employee is the owner-manager (ABS, 2002).

Table 8: Sample Business Categories – number of firms in the survey sample by category

Business Categories	n	**Business Categories**	n
Advertising Agencies	10	Multimedia Services	14
Architects	29	Music Arrangers & Composers	2
Artists☐Commercial	3	Musicians &/or Musicians' Agents	9
Audiovisual Equipment & Productions		Naval Architects	1
Cartoonists & Caricaturists	1	Newspapers☐Business	
Chemical Engineers	1	Newspapers☐General	5
Civil Engineers	4	Newspapers☐Religious	
Combustion Engineers	1	Newspapers☐Rural	
Compact Discs, Records & Tapes☐W'salers & Mfrs	2	Newspapers☐Sporting	
Data Preparation &/or Processing Services	1	Photograph Restorations & Retouching	3
Designers☐Graphic	28	Photographers☐Commercial & Industrial	7
Designers☐Product & Industrial	2	Photographers☐Scientific	
Designing Engineers	2	Photographic Processing Services☐Professional	1
Desktop Publishing Services	3	Photography &/or Video Schools	1
Directories	1	Pre-Press Production Services	1
Drafting Services	24	Publishers☐Book	5
Electrical Engineers	4	Publishers☐Music	
Electronic Engineers	5	Radio & Television Schools	
Film Production Facilities & Equipment	1	Recording Services	5
Film Production Services	5	Slides &/or Film Strips	
House Planning Services	1	Sound Engineers	
Illustrators	2	Structural Engineers	1
Landscape Architects	3	TAFE Colleges	
Libraries☐Photograph &/or Film	1	Technical & Trades Colleges	
Maps &/or Mapping	3	Television Programme Producers &/or Distributors	1
Marine Engineers	4	Television Stations	1
Media Information &/or Services	1	Theatres & Theatre Companies	3
Medical Equipment &/or Repairs	3	Training Films & Videos	1
Medical Research	2	Universities & Tertiary Education Colleges	
Mining Engineers	4	Writers, Consultants &/or Services	4

Years in the Industry

Just fewer than half the firms had been in the industry for less than five years:

- Less than 5 years 47%
- Between 5 and 10 years 18%
- Between 10 and 15 years 22%
- More than 15 years 13%

Involvement in the Digital Content Industry

During the telephone survey, all firms were called and advised that for the purposes of the study, the digital content industry was defined as:

> *Those firms engaged in the design, development and delivery of creative product that can employ multimedia technologies and be distributed via information and communications technologies such as the Internet. It can include the computer and interactive games industry, web site developers, digital video arts, film and television production, special effects, animation, postproduction, music, new media and virtual reality and various forms of design (e.g. architecture, graphic and industrial).*

Respondents were asked to indicate whether they considered that their firm was engaged in the digital content industry and then a series of questions was explored, dealing with different levels of participation in the industry.

Against the definition outlined above, 91 percent of firms surveyed indicated that they considered they were engaged in the digital content industry in some way. Of these firms 44 percent felt that they were engaged at a major level, 33 percent considered that they were engaged at a moderate level and 23 percent at a minor level.

Of those firms that considered they were engaged in the digital content industry, the majority (59%) said that they were producing digital content and had a need for digital content to be in a format such as 3-D or 2-D Animation, Rich Multimedia e.g. motion picture, sound or in stream on-line format.

At first glance this appears to be an exceptionally high number of firms or industry types that consider they are engaged in the digital content industry. However, it should be remembered that the ANZSIC classifications selected were chosen on the basis that they were most likely to be engaged in this industry in some manner.

This very high proportion of involvement suggests that either the industry is significantly more pervasive than first thought, or the definition used for this phase of the study was substantially wide. Further investigation suggested that the diffusion of digital technology within industry was indeed highly pervasive but that the original definition also needed refining. As noted in Section 2 this refinement was undertaken.

How is Industry Currently Fulfilling its Requirements?

When asked how they were currently fulfilling their requirements in the area of digital content the majority (61%) said that they were doing so internally, 23 percent said that they were doing this through outsourcing, 14 percent were doing both and only 2 percent were doing neither.

Sixty-four percent of firms indicated that they knew of examples within their own industry where there was a move to generate output in a purely digital format such as 3-D or 2-D Animation, Video, Audio or Web. These findings suggested that the level of digital content generation within WA industry may be quite high, although the precise nature of such digital content creation is worthy of further exploration. It might be expected that more self-generation of digital content will take place over time as the accessibility of easy to use software programs expands.

Future Digital Activity

Firms were asked if they had any future plans to increase their level of engagement within the digital content industry. Seventy-four percent of firms said that they thought it likely that their business would move into the digital content output in the near future. This finding suggests that the overall level of digital content activity within WA industry may increase in the future and that it may do so across a relatively wide range of industry sectors.

Level of Satisfaction with Staff Skills

To gauge the level of employee skills and training within the sector the firms were asked how satisfied they were with the skill levels of their existing staff in relation to digital content production or use. Results were as follows:

- Very satisfied 34.6%
- Satisfied 58.1%
- Unsatisfied 6.9%
- Very unsatisfied 0.5%

These findings suggest that the needs of industry may be reasonably well met in relation to existing employee skills in the digital content area. It should be recognised that this question only examined a fairly crude level of satisfaction and did not deal with specialist areas where gaps may exist.

Difficulties in Finding Staff

When asked if they had ever experienced any difficulties in finding new staff with appropriate skills that can be applied to the digital content industry the majority (65%) said that they had not had any difficulties. Once again this suggests that most firms may not be experiencing skills shortages and that the level of training within the WA workforce in this area is generally good. However, this response was not fully explored in the survey due to time constraints. Later in this report it will be seen that some sectors have experienced skills gaps and this is being driven by the continuously changing nature of technology. Many older workers may require continuous education in these new technologies throughout their careers.

Digital Content Activities

Firms were also asked to list their main three business activities. When mapped against the ANZSIC codes the pattern of digital content related activity emerges as shown in Table 9. Key sub-sectors that appear to be most digitally intensive are shaded.

Table 9: Business Categories and Main Business Activities

Business Categories	Digital	How supplied	Format 2-D/3-D	Activity	Level
Advertising Agencies	Yes	Both	Yes	Branding	Major
Advertising production	Yes	Outsourced	Yes	Design	Minor
Graphic design				E-marketing	Moderate
				Media production	Minor
				Web design & dev	Major
Architects					
Architectural design	Yes	Outsourced	Yes	Architectural work	Major
Computer aided design	Yes	Internal	Yes	Building processes	Minor
Architectural drawings	Yes	Internal	Yes		
Consulting engineering	Yes	Internal	Yes		
Artists□Commercial					
Architectural illustration	No			Marketing/profiling	moderate
Artist portraits	No				
Graphic design	Yes	Internal	Yes		
Audiovisual Equipment & Productions	n/a	n/a	n/a	n/a	n/a
Cartoonists & Caricaturists					
Graphic design	Yes		No	Cartooning	moderate
Chemical Engineers					
Process technology oil & gas	Yes	Outsourced	Yes		Major
Civil Engineers				Civil design &	
Civil construction	No			construction	
Civil design & supervision	Yes	Internal	Yes	investigation	Major
Civil consulting	Yes	Internal	Yes	Precast	Minor
Urban development	Yes		No	manufacture	
Combustion Engineers					
Combustion engineering mining	Yes		No		Minor
Compact Discs, Records & Tapes, W'salers & Mfrs					
CD manufacturing	Yes	Both	Yes	Manufacturing	Moderate
Multimedia packaging	Yes	Both	Yes	Music distribution	Major

Business Categories	Digital	How supplied	Format 2-D/3-D	Activity	Level
Data Preparation &/or Processing Services Paper to digital format preparation	Yes	No	No		Major
Designers☐Graphic 3-D computer games Advertising Brand strategy Data solutions Digital & Offset printing	Yes Yes Yes Yes No	Outsourced Both Both Both	Yes Yes Yes Yes	Brand management Branding Photography Multimedia Internet hosting Logo design Marketing Training Video production Web design/develop Visualisation	Moderate Major Major Major Major Major Moderate Moderate Major Moderate Major
Designers☐Product & Industrial Commercial design Product design	No Yes	Internal	Yes	Mechanical eng	Major
Business Categories	Digital	How supplied	Format 2-D/3-D	Activity	Level
Designing Engineers Industrial design	Yes		No		Moderate
Directories Publishing	Yes		No		Moderate
Desktop Publishing Services Editing Graphic design Pre-press printing	Yes Yes No		No No		
Drafting Services Architect design/draw Architectural drafting Building design/drafting Construction Design, drafting/detailing Electrical-Eng design/drafting Engineering drafting Map preparation	Yes Yes Yes Yes Yes Yes Yes Yes	Internal Internal Internal Both Internal Internal Internal	Yes Yes/No Yes No Yes Yes Yes Yes	Concrete wall panels	Minor
Electrical Engineers Circuit board manufacturing Consulting Electrical maintenance Electrical manufacturing	Yes Yes Yes Yes		No No No No		Minor
Electronic Engineers Electronic & industrial Electronics manufacture/design Manufacturing auto door ops Manufacturing sheet metal	Yes Yes Yes No		No No No No		Moderate
Film Production Facilities & Equip Video production	Yes	Internal	Yes	Maintenance	Moderate

Business Categories	Digital	How supplied	Format 2-D/3-D	Activity	Level
Film Production Services					
3-D Animation	Yes	Internal	Yes	Video & multimedia duplication	Major
Digital video production	Yes	Internal	Yes		
Documentary production	Yes	Outsourced	Yes		
Video production	Yes	Internal	Yes		
House Planning Services					
Drafting & architectural	Yes	Outsourced	Yes		Major
Illustrators					
Commercial illustration	Yes		No		Moderate
Technical documentation	Yes		No		
Landscape Architects					
Landscape design & architecture	Yes	Internal	Yes		Major
Libraries☐Photograph &/or Film	Yes	Internal	Yes		Major
Researching images					
Maps &/or Mapping					
Calculation dredging ops	Yes	Internal	Yes	Geographic IS	Major
Surveying	Yes	Internal	Yes	Hydro survey	Major
Document registration	Yes		No	Spatial records	Major
Marine Engineers					
Engine reconditioning	Yes		No	Sales	Minor
Sales and service	No		No		
propellers	No		No		
Welding					
Media Information &/or Services	Yes	Internal	Yes	Media distribution	Minor
Media monitoring					
Medical Equipment &/or Repairs					
Medical equipment sales & service	No				
Medical instrumentation sales	Yes		No		Minor
Splashbacks manufacturing	No				
Medical Research					
Clinical treatment	Yes	Internal	Yes	Media creations	Minor
Pathology testing	Yes		No	Pathology research	Minor
Mining Engineers					
Engineering – mining	Yes	Internal	Yes	Accounting	Major
Manufacturing	Yes	Neither	Yes	Design	Major
Multimedia Services					
Computer drafting	Yes	Internal	Yes		Minor
Film & video editing	Yes		No	AV machines	
Multimedia creation	Yes	Both	Yes/No		Major
Multimedia manufacture	Yes	Internal	Yes		
Sales data projectors	No			Wholesale/retailing	
Website development	Yes	Internal	Yes	Website hosting	Major
Music Arrangers & Composers	Yes		No		Minor
Arranging & producing music	Yes	Internal	Yes		
Song writing					
Musicians &/or Musicians' Agents					
Arranging & producing	Yes	Internal	Yes		Moderate

Business Categories	Digital	How supplied	Format 2-D/3-D	Activity	Level
music		Both			
Entertaining & musical	Yes		Yes/No		
performance	Yes	Internal	No		
Music consultancy	Yes		Yes		
Service provision					
Naval Architects					
Engineering consultancy	Yes	Internal	Yes		Minor
Newspapers☐General					
Editorial	Yes		No		
Newspaper production	Yes		No	General	Moderate
Newspaper publishing	Yes	Internal	Yes/No	Sales	Major
Photograph Restorations & Retouching					
Photo restoration	Yes		No		Major
Photo processing	Yes		No		
Photographers☐Commercial & Industrial					
Advertising	Yes	Outsourced	Yes	Photo shopping	Major
photographers	Yes		No		
Commercial					
photographers	Yes		No		
Wedding & portrait photographers					
Photographic Processing					
Services☐Professional	Yes	Internal	Yes		Minor
Photography &/or Video					
Schools	Yes		Yes		Moderate
Commercial photographer					
Pre-Press Production					
Services	Yes		Yes		Major
Printing					
Publishers☐Book					
Graphic design	Yes		No		
Book publishing	Yes/No		Yes	Writing	Moderate
Research of gold industry	No				
Recording Services					
Copying & packaging CD,					
DVD & cassettes	Yes		No		Moderate
Property development	No		No		
Music recording	Yes		No		Major
Structural Engineers					
Engineering building	Yes	Internal	Yes		Major
services					
Television Programme Producers &/or Distributors					
Media & marketing	Yes		Yes		Moderate
Television Stations					
Maintaining capacity for	Yes	Internal	Yes		Major
ABC TV					
Theatres & Theatre					
Companies	Yes		No		
Theatre performance	Yes		No		Minor
Theatre production					
Training Films & Videos					
CD-ROM production	Yes	Internal	Yes		Moderate
Writers, Consultants &/or Services					
Teaching writing	Yes		No		Moderate

Business Categories	Digital	How supplied	Format 2-D/3-D	Activity	Level
Counselling Public relations practitioner Text editing	Yes Yes Yes	Outsourced	No Yes No		

Mapping Potential Digital Content Industry Clusters

The information generated from both the industry concentration analysis as outlined in Section 4, and the industry survey described above, suggested that the digital content industry in WA might be broadly divided into seven segments comprising both Creative (A) and Creative (T) communities. These segments include:

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

The seven segments capture all 59 *Yellow Pages* ® level 5 industry categories that were chosen as potentially being involved in the digital content sector and the segment to which we have included them in is shown in Appendix B. Summarising the earlier business and employment concentration analysis with the findings of the intensity of industries engagement in digital content from the telephone survey provides an indication of the involvement of these segments in digital content.

Figure 6 plots the average business concentration for the seven industry segments along the x-axis and the average employment concentration for the seven industry segments along the y-axis. The average intensity of the seven industry segments in terms of digital content is represented by the size of the circle and is based on the survey participants' perception of their involvement in digital content activity. It is important to note that because the telephone survey did not call education and training businesses that this study has assumed that it is moderately involved in digital content.

Figure 6 highlights that the spatial science segment has both a business and employment concentration significantly higher than the Australian capital cities and is additionally involved in digital content in a major way. Engineering also exhibited business and employment concentrations significantly higher than the Australian capital cities. However, its involvement in digital content appeared to be only in a minor-moderate way.

The construction, education and training and medical science segments had business and employment concentration similar to the Australian capital cities. The telephone questionnaire however suggests that the medical science segment only has a minor involvement in digital content, compared with construction which had a moderate to major involvement. The media and creative industry segments both had business and employment concentrations less than the Australian capital cities and appeared to have a moderate to major engagement in digital content activity.

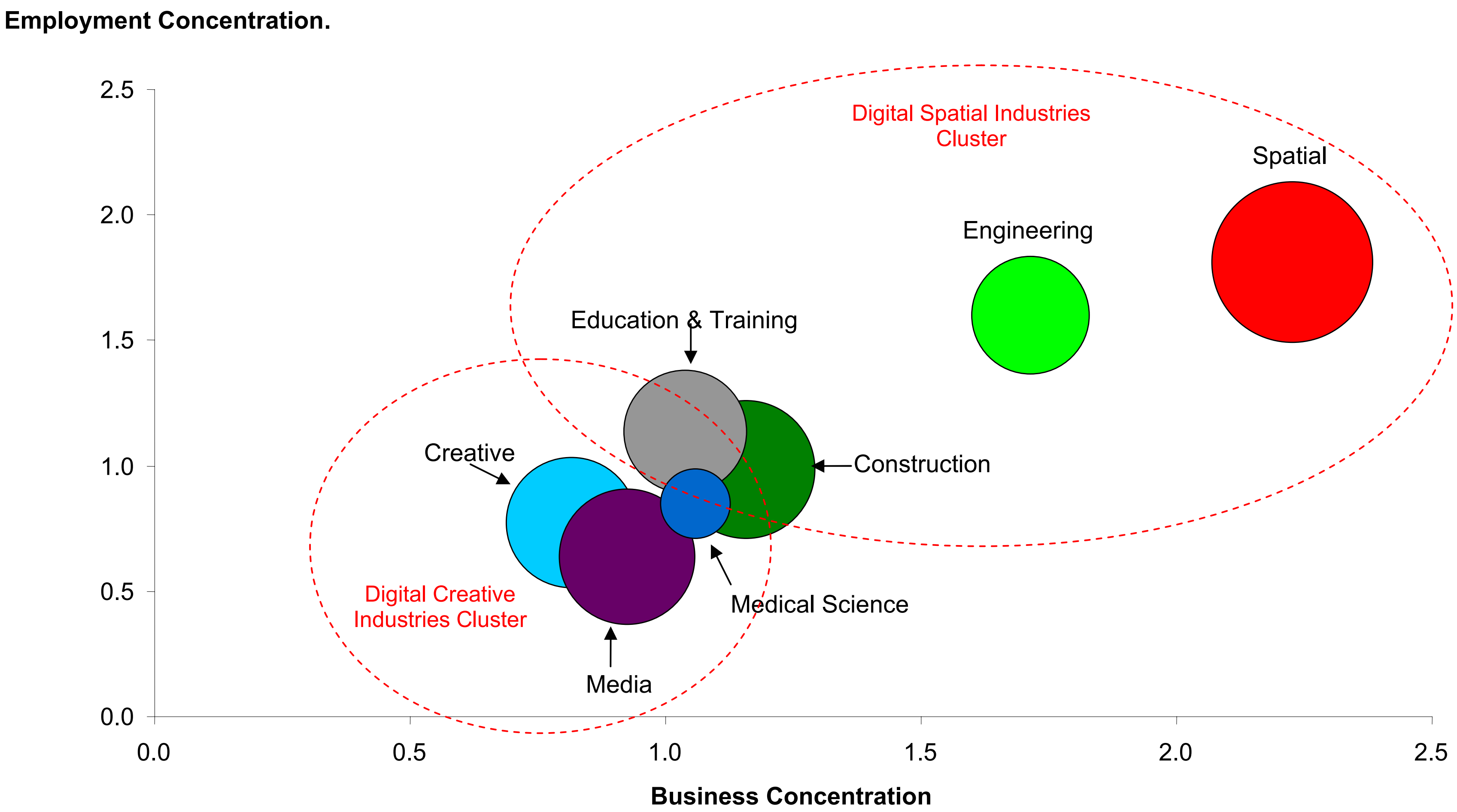


Figure 6: Business and employment concentrations and intensity of engagement in digital content activity for seven industry segments

Industry Cluster Structure

An examination of the data shown in Sections 4 and 5 suggest that the digital content industry in Western Australia might be broadly divided into at least two potential clusters. As shown in Figure 6, these are a Digital Spatial Industries Cluster and a Digital Creative Industries Cluster. The first of these comprises the industry concentrations of: spatial science, engineering and construction, with the education and training concentration providing support. The second cluster comprises the creative and media concentrations and includes the education and training, and the medical science and parts of the construction sector. Tables 10 and 11 outline the likely composition of these clusters.

Table 10: Potential Digital Spatial Industries Cluster and Segments

Industry Sector	Core actors	Peripheral actors
Spatial Industries:		
	Maps &/or map making Surveyors & Planners	Photographers commercial & industrial? Property developers & valuers
Engineering Industries:		
	Chemical Engineers Combustion Engineers Electrical Engineers Electronic Engineers Marine Engineers Mining Engineers Naval Architects	Oil & Gas process technologies Mine processing & operations Electrical product manufacturing Electronics manufacture & design Shipbuilding & maintenance Mine site engineering & operations Shipbuilding & maintenance
Construction Industries:		
	Architects Civil Engineers Structural Engineers Designers Product & Industrial Landscape Architects	Drafting services House planning services Commercial Artists Photographers commercial & industrial
Medical Science Industries:		
	Medical Research Medical Imaging Virtual reality training	Clinical treatment Pathology testing
Education & Training:		
	Universities TAFE & VET Colleges	Spatial Sciences & Surveying Urban planning & Geography Engineering, Computing & Mathematics Property Studies & Valuation Drafting and CAD design Photogammetry & GIS

As shown in Table 10, the general composition of the Digital Spatial Industries Cluster includes those industries within the spatial, engineering and construction concentrations, as well as those areas within the education and training sector most likely to support or compliment these. The medical science concentration is also included in this cluster. Core and peripheral actors have been identified with the distinction being the level of activity within the digital content arena. In general, core actors are more likely to be originators of digital content and to use such content within the main stream of their work.

Table 11: Potential Digital Creative Industries Cluster and Segments

Industry Sector	Core actors	Peripheral actors
Creative Industries:		
	Advertising agencies Graphic designers Multimedia services Film & television production Training films & videos Recording services	Commercial Artists Cartoonists & Caricaturists illustrators Film & television facilities & equipment Music arrangers & composers Musicians &/or Musician's Agents Photographers commercial & industrial Libraries photographic & film
Media Industries:		
	Newspapers Pre-Press production services Publishers Book Television Stations	Commercial Artists Cartoonists & Caricaturists illustrators Photographers commercial & industrial Photographic processing Television Programme Producers &/or Distributors Writers, Consultants &/or Services
Education & Training Industries:		
	Universities TAFE & VET Colleges	Music, Design, Computer Science, Multimedia, Visual Arts, Audio & Sound Engineering, Film & TV production.

As Table 11 shows, the Digital Creative Industries Cluster includes those industries within the creative and media concentrations, as well as those areas within the education and training sector most likely to support or complement these. This cluster is less well established in comparison with the Spatial Industries cluster and lacks a dominant focal firm such as DLI to assist its development.

It should be noted that these two clusters are merely proposed and do not exist in any identifiable way. This is typical of cluster formation, where the creation of the industry concentrations takes place naturally and any identification of these industry groupings as representing a cluster is undertaken post facto.

Case Study Development

In the following sections these two proposed clusters are examined with reference to case studies of organisations within them that provided examples of practice and also lessons for future cluster formation. To gauge a more detailed understanding of the dynamics within the digital content industry in Western Australia a series of case studies were prepared with a view to exploring how such actors operated within their production, resource and social networks.

Case studies were selected on the basis of their ability to provide a model for how particular actors in selected industry sub-sectors operate. During the survey the majority (62%) of firms indicated that they were willing to participate in future research and become a case study if asked. Firms that had agreed to participate were subsequently called and recruited to participate in the case studies.

Approach to the Case Studies

The cases were prepared with attention given to mapping business activity on the following three levels:

Production Network Layer – examination of the firm's leading customers and key suppliers, their location (e.g. local, national or international), their role in assisting the firm to achieve enhanced levels of quality and innovation; and how such customers and suppliers fit into the firm's value chain and general industry production system.

Resource Network Layer – examination of the firm's linkages with third-party support actors such as banks, venture capital firms, education and training agencies, government organisations and research and development centres. How such support networks assist the firm to enhance its market position and innovation levels will be explored.

Social Network Layer – the cases were also examined in terms of the interpersonal relationships between individuals within these firms and their customers, suppliers and third-party network support actors. It has been found that many opportunities for innovation emerge from informal interaction between people within the firms.

Following the gathering of such data a series of diagrammatic representations of these three layers was produced to illustrate the behaviour of the case study firms.

Case Studies Selected

Nine case studies were completed for this phase of the study. Every effort was made to ensure a good cross-section of cases was drawn, although difficulties were found with getting participation from some industry sub-sectors. The final selection of cases comprised representatives from both the Creative (A) and Creative (T) communities and a cross-section of actors from within the key industry concentration groups identified in Figure 6. Table 12 outlines these cases.

Each of these firms has claimed it is engaged in the digital content industry in a major way and makes use of 2-D & 3-D format. Most have indicated that they fulfil much of their needs internally and plan to move more into digital content production in the future. The selection of these case studies has been conducted with a view to representing as many of the key digital industry concentrations as possible. While some cases were selected on the basis of their ability to provide a typical example of a firm of this type operating within the Western Australian digital economy, others were selected due to their atypical nature. PORT 80, for example, is not a company, but a community of practice and this case seeks to highlight the role of such professional and social exchange networks within the wider digital industry. Similarly, ITRI does not seek to represent the entire education and training sector, but is an example of a university research centre of significance to the sector.

Table 12: Case Study Organisations from WA Digital Content Industry

Industry Concentration	Case Study	Description
Spatial	DLI.	Department of Land Information (DLI), a government agency involved in capture, warehousing and wholesaling of digital spatial data.
Spatial	MAP Co.	A medium sized map making & survey company engaged in digital GIS product involving major level production of 2-D & 3-D format. Operated in WA for over 15 years.
Creative Community	PORT 80.	A local industry support network designed to assist the production of digital media product in WA.
Creative	MULTIMEDIA Co.	Medium sized multimedia, interactive and graphic design company engaged in 2-D & 3-D, in-house production on a major level. Operated for 5-10 years in WA.
Creative	DESIGN Co.	Small graphic design company engaged in moderate 2-D & 3-D format production. Has operated in Perth for 10-15 years.
Creative/Media	AD Co.	Large marketing & advertising company engaged in 2-D & 3-D format, in-house production of digital content on a major level.
Creative/Media	FILM Co.	A media production group engaged in the development and distribution of digital film, TV and multimedia production in WA.
Education & Training	ITRI	The Interactive Television Research Institute (ITRI) based at Murdoch University, WA.
Construction	CIVILENG Co.	A large civil engineering company with over 15 years of operations in WA that is engaged in 2-D & 3-D format production in a major way.
Construction	ARCHITEK Co.	A medium sized architecture firm with offices both across Australia and in Europe, Asia and the Middle East.
Medical & Scientific	MEDI Co.	A small medical technology firm with a virtual reality training product.

SECTION 6

The Digital Spatial Industries Cluster

The spatial sciences sector comprises a range of firms engaged in surveying, mapping and map making, including the application of aerial and satellite information systems to produce land information for use in a wide range of products and services. Many of the firms interviewed for the survey described in Section 5 indicated that they were engaged in work servicing the core resource, agriculture and engineering industries within the State. This included such activities as geographic information services (GIS), hydro-graphic surveying and spatial information data capture, storage and retrieval. All such activities were considered to involve a major level of digital intensity.

Spatial Science has emerged in response to the introduction of new technologies that enable the convergence of surveying, cartography and GIS applications, including the generation of 2-D and 3-D digital models using spatial information and imagery. A wide range of industries relies on spatial information provided in digital format. For example, all land in Western Australia has been surveyed and logged to provide a record of its cadastre (boundaries), tenure (ownership), topography and physical condition, and also its estimated value. This is of significant value to those in the real estate and property services sector and those engaged in planning and land development.

Information from aerial surveying and satellite remote sensing is now available – with appropriate analysis and interpretation – to assist farmers determine the quality of their pasture or crop growth; it can also assist bushfire control teams and those in the natural resource management. In the transport industries, roads and other physical property (e.g. bridges) can be examined for maintenance purposes and also for logistics management. Road transport distances, road surface quality and travel times can now be accurately mapped for such companies as Coca Cola and Grace Removals who need to move a lot of road freight.

In addition to the use of spatial data for surveying and the management of property, the use of digital data can be applied to engineering and construction. Digital information taken from survey photographs and other sources can be used. In the process of photogrammetry digital data is used to develop 3-D models that can be manipulated in a CAD design program for subsequent visualisation. While aerial photogrammetry is employed in the production of topographic maps and as a data acquisition method for geographic information systems (GIS), close range photogrammetry is used in medicine, engineering, architecture and construction projects.

Production Networks in Spatial Science

The production network for the spatial science sector involves a number of actors including both large and small firms and government agencies. Figure 7 shows the generic value chain for the sector in which the key activities include custodians, providers and commissioners of data, as well as technology enablers, information retailers and those engaged in research, education and training. Many of these activities are undertaken by a single large actor that controls much of the value chain.

The two spatial case studies examined for this research were the Department of Land Information (DLI) and a medium-sized firm we will identify as MAP Co. As a State Government agency, DLI is a significant actor within the Western Australian spatial science sector. DLI is essentially a data wholesaler and provides a range of data usually via online services. The organisation delivers spatial data via its Shared Land Information Platform (SLIP) that will deliver via the State Government's internet portal, Land Gate, through which digital property and land information can be accessed.

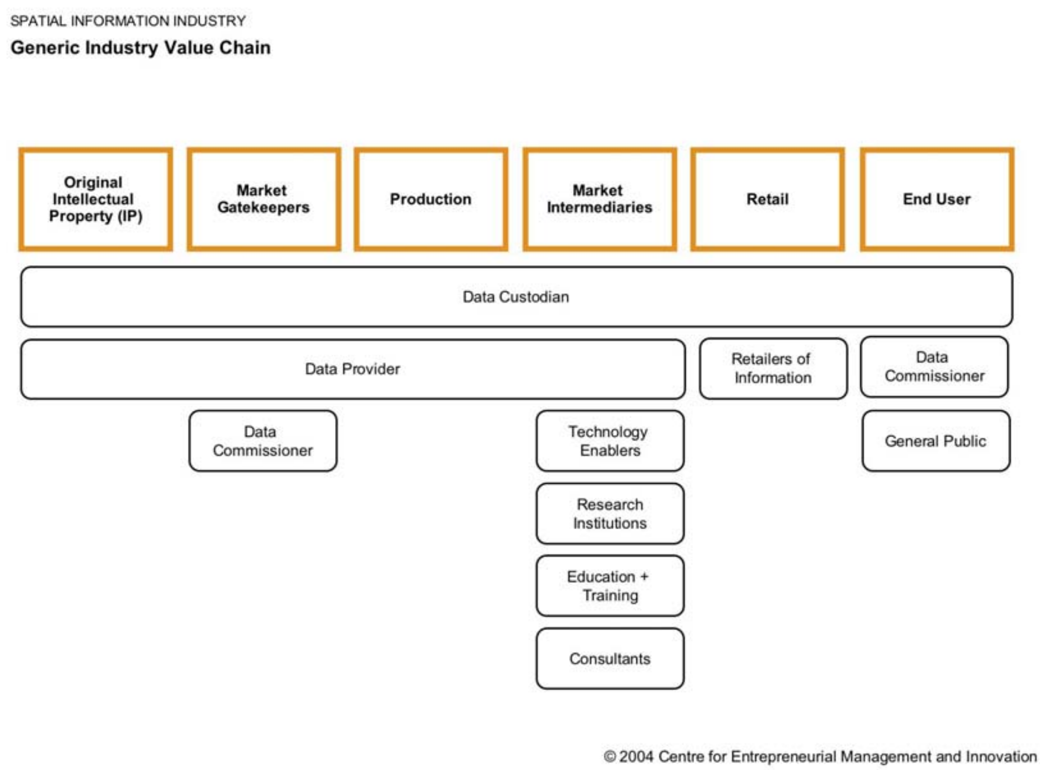


Figure 7: Spatial Science Generic Value Chain

DLI is also actively involved in the development of other spatial information technologies, such as the application of satellite information to provide farmers with information for precision farm management. Collaborative research projects with the CSIRO, WA Department of Agriculture and industry have produced digital information services for pasture management in the wool industry and crop management in the grains industry.

DLI services a wide range of customers including both large and small firms. Major customers of DLI are property developers, planners and also those engaged in the conveyancing industry. Other customers include environmental scientists, farmers and agricultural consultants, local government authorities and real estate agencies. Within the spatial sector DLI also provides data to surveying and mapping firms as it acts as both a retailer and wholesaler. Such customers may use the DLI data for further value adding into GIS, surveying or engineering products. DLI is also the main data regulator for the State and is the data custodian and principal data provider in the value chain, as well as being the data commissioner. All spatial data involving land titles, cadastre and related information must be lodged with DLI which serves as the prime data library or warehouse for Western Australia.

By comparison MAP Co. services a range of customers including state and local government agencies and private industry. Listed among its leading customers are such agencies as the Main Roads Department, Water Corporation and Landcorp. Their work involves 2-D and 3-D modelling for the design of new roads or land development projects. Digital spatial information can be modelled to provide accurate representations of landforms that corrects for errors in aerial or satellite imaging. With the development of new technologies – such as digital aerial photography – this work will become somewhat easier with direct transfer of digital information. Work of this type is undertaken for the mining and resource sector and agriculture. The mining industry also provided substantial work in the area of geo-surveying.

The production network layer of MAP Co. is illustrated in Figure 8. It can be seen that the key activities with the value chain are the tendering and marketing, planning and processing of photography (supplied by other firms), the production of digital product such as maps and models and then the output and delivery of the information. There is also an important requirement to store such digital information and be capable of quickly retrieving it when needed.

The production network within the Spatial Science sector comprises a wide range of activities including photogrammetric mapping using aerial survey data, and the use of digital spatial information to construct 2-D and 3-D digital models for use by Main Roads, mining firms or those in the construction sector. Another service provided by this sector is asset management for such groups as the Main Roads Department which can use the information for monitoring the condition of roads, bridges and other assets.

Data provided by DLI to MAP Co. is reworked and then returned or lodged with the agency in order for titles to be tracked. The planning process cannot be approved unless the data is lodged with DLI. The work undertaken by MAP Co. also involved a network of other firms including property developers, consultant planners, surveyors, landscape architects, engineers and geotechnical specialists. In effect, the value chain of this firm is more reminiscent of a complex web than a linear process.

Transfer of data is largely done using the internet from both supplier and then onto customers. However, the size of some data files (particularly those containing images) is frequently too large for easy transfer must be recorded onto CD-DVD. New software such as ECW and MrSID is now making it possible for MAP Co. to deal with large data files over the internet as they extract the key information needed for a particular project and only transfer what is needed. ECW is created by a local Perth firm ER-Mapper that is now sold world wide.

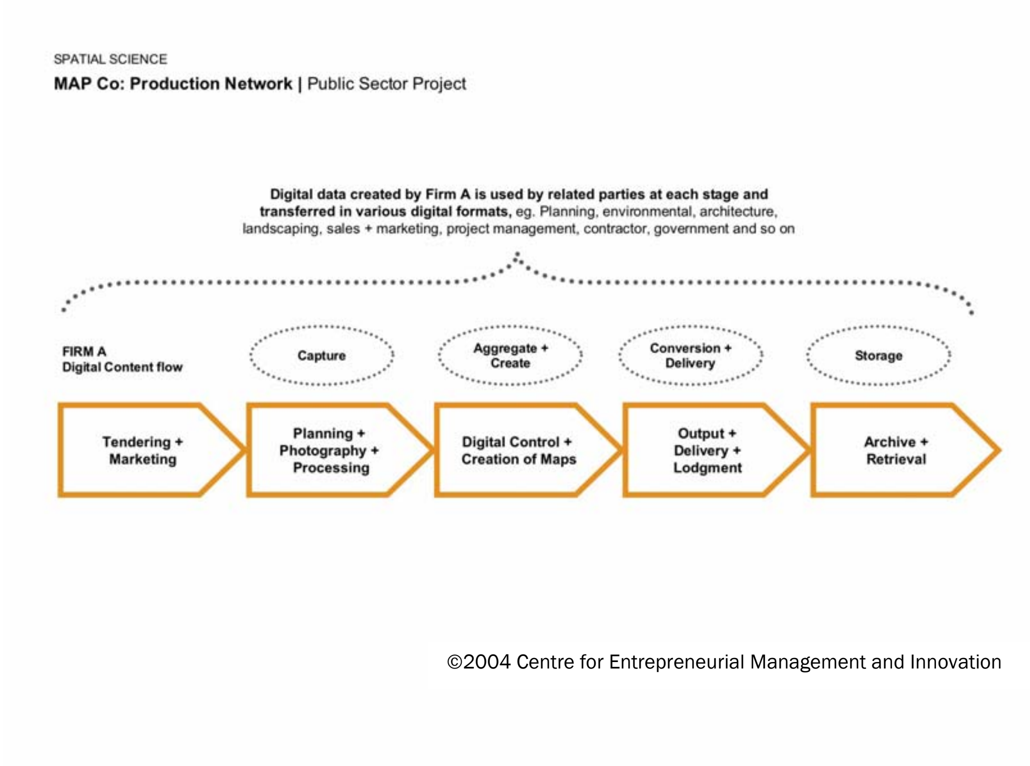


Figure 8: Production Network Layer MAP Co.

The management of MAP Co. noted that the move by DLI to have all titles work lodged in digital format (usually via PDF files) was a positive step. As they explained:

> *It's been a slow process to get the electronic lodgement up and running, but you can't complain about DLI because they've been talking to industry as well. People have to go and buy the packages and don't want to spend the money. For us, it means we can throw away some of our old equipment, particularly the old plotters that we used to create these plan. Now we are able to just create a PDF file. We think it's a good idea.*

Despite these improvements there remained the need for a universal format to make the interface between actors easier when transferring data. To address this problem DLI commissioned a company called ESRI to develop a software package that assists in solving this interface problem. Data can now be transferred in formats such as the industry standard *MicroStation* (WA specific) and CSD format that aids translation.

The introduction of GPS technology has also had a significant impact on the Spatial Science sector. Within the surveying area the number of satellites now available at any one time (usually 8 are available and 6 are needed) has changed the way this industry works. With accuracy levels at around 99 per cent and costs continuing to fall, the GPS technology offers significant enhancements for surveyors, geologists and mining exploration teams. Much of the improvement has taken place in the area of speeding up the process of locating sites and positions. Digitally recorded titles now allow surveyors to extract a CSD file and use the GPS coding to quickly identify the coordinates down to a few millimetres.

Resource and Social Networks in Spatial Science

The industry network of MAP Co. is illustrated in Figure 9 which shows the web of relationships that this organisation has with customers, suppliers and third party actors within its resource and social networks. Although the industry network of each firm within the spatial science sector is likely to be different, the case provides a useful picture of the type of interrelationships that are common within the industry.

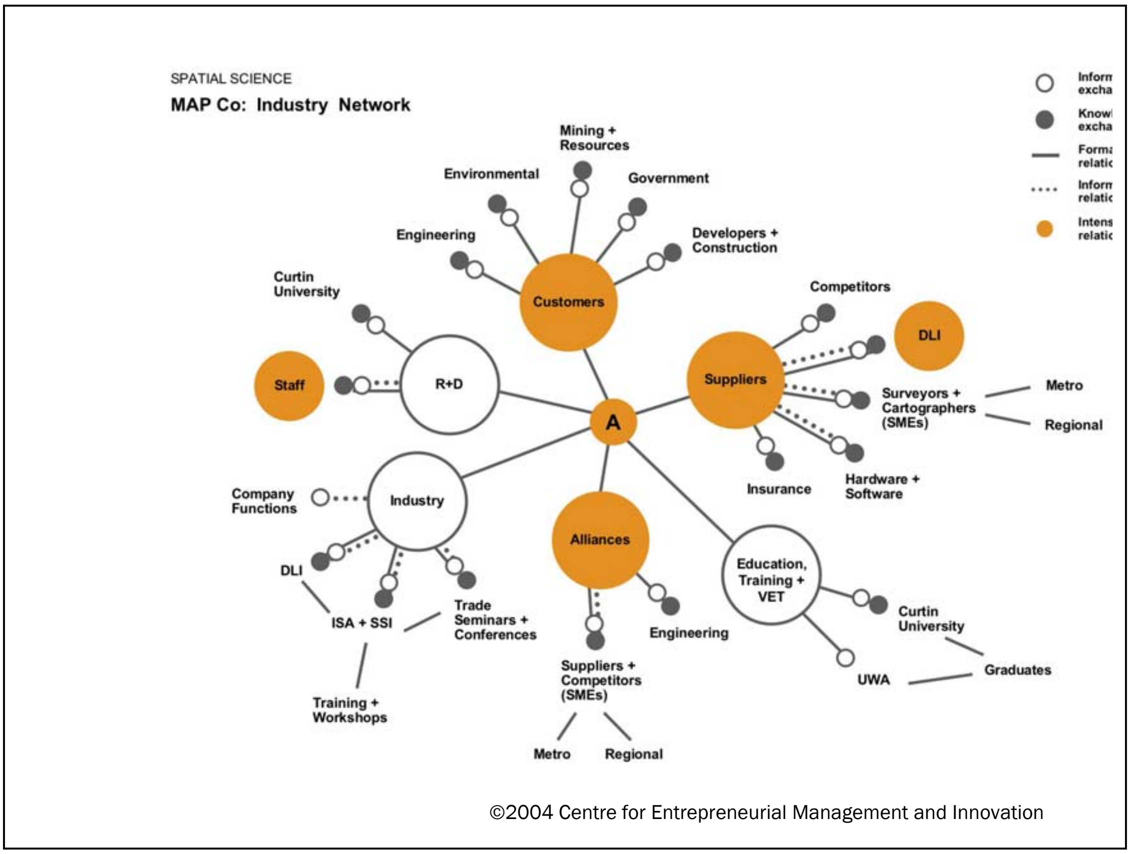


Figure 9: Industry Network for MAP Co.

As shown in Figure 9, the industry network of MAP Co. involves a range of customers in such sectors as engineering, environmental science, mining and resources, property and construction and the government sector (including transport and planning). Supplying to MAP Co. is a range of actors including DLI, who provide data, and locally-based surveyors and cartographers who tend to be small firms or independent sub-contractors. MAP Co. also obtains its computer hardware and software from both local and international suppliers and such services as insurance.

MAP Co. was frequently engaged in R&D projects focusing on GPS systems and new technologies. However, much of this research was undertaken internally or in conjunction with its industry network. The company had engaged in a research project with Curtin University of Technology that was funded by the Australian Research Council (ARC), but the outcome of this was apparently indecisive and the major benefit appeared to lie with the university rather than MAP Co.

The role of DLI in this network is worth noting. As the key regulator of spatial data in Western Australia, DLI has significant influence over the industry. MAP Co. had quite an intense relationship with DLI as both a key supplier of data, government regulator and source of information. While the relationship between MAP Co. and DLI was described as "formal" in nature, it appeared to be a positive one. As one of the managers from MAP Co. expressed it:

> *In terms of regulating the industry, DLI deals with the licensing. Any work to do with title boundaries is all covered under the broad regulations by DLI. If we lodge a survey, it generally goes through their checking processes and becomes a title. In the mining industry, you'd be protecting your bit of area, mining tenements. We are occasionally involved in that. DLI generally set the rules for how we do things, but they always consult with industry before changes are made. With electronic lodgement they did big studies and included all the major players in the industry, so there are no surprises at all.*

Interestingly the view from DLI was that they could do more to make themselves customer friendly. According to one DLI spokesperson the organisation was now seeking to work with clients "from the very beginning" to tailor services to their needs. The future would see DLI being more client oriented rather than information oriented.

The role of Curtin University of Technology in the spatial science industry in WA should be noted. Most of the surveying graduates employed within the sector came from Curtin. MAP Co. for example took most of its staff from among the Curtin graduates. Each graduate had to undergo a further 18 months to two years of applied work and training within the company before being eligible to become a licensed surveyor. Many of the management positions were held by licensed surveyors. At the time MAP Co. was interviewed for this study there was a shortage of surveyors in the State. The licensing of surveyors is the responsibility of DLI.

The TAFE sector provides diploma graduates who became engineering surveyors and do much of the technical work and field work. Other skilled employees in the spatial sector include photogrammetry specialists who manipulate digital data to generate the 3-D models needed for contour analysis.

Social interaction within the industry is channelled via the various professional associations. Western Australia has seen the amalgamation of the Cartographers Association, Photogrammetrists Association, Geographers Association, Engineering

Surveyors and Licensed Surveyors Institutes into the Spatial Sciences Institute (SSI). This professional body is active in the holding of conferences, professional development education and other functions. All surveyors must complete a certain amount of professional education each year to maintain their supplier status. The role of SSI within the social network layer is significant. As a manager from MAP Co. described it:

> *The CPD (continuous professional development) nights, in my opinion, are the best thing that has ever happened in surveying. If you go back years ago, you had your professional evenings and a few people would rock up. Now you can't get in the door!*

However, the view from DLI was that the profession of surveying had taken a turn for the worse since the 1970s. While surveyors were once highly influential people in the State with significant political power, this had changed. To become a licensed surveyor takes 4-5 years of formal education and involves heavy regulation and also responsibility. However, as professionals they no longer hold the same level of public esteem that is still the case for doctors, lawyers and engineers.

Production Networks in the Construction and Engineering Sectors

Within the construction and engineering concentrations two cases were examined. The first of these CIVILENG Co. is large civil engineering and construction firm that operates in the spatial sciences sector as well as using 3-D modelling for design and engineering tasks. For the purposes of this case analysis attention was focused on the spatial activities undertaken within CIVILENG Co. The second case, ARCHITEK Co. is based in Perth, and is part of a large global umbrella organization that has offices in other Australian capital cities and in key cities in Europe, Asia and the Middle East. The company's internal and external networks make extensive use of a sophisticated intranet system and third party digital management tools that allow them to coordinate extensive amounts of digital information with their customers and collaborators worldwide.

Much of the work undertaken by CIVILENG Co. involved the manipulation of digital data to produce 3-D models from 2-D information supplied by groups such as DLI. Accuracy was critical to future engineering projects and the firm used specialist modelling software for such work. A major problem was the comparability of data. It was a constant problem to have to match various data sources together to build the end result. CIVILENG Co. outsourced around 30 percent of its work in this area, but was always more confident of the integrity of the modelling undertaken in-house due to the knowledge the internal team had developed in determining how best to code data sets. The majority of its work was within Western Australia.

This problem of industry standardisation for data formats was created by the competition among different providers of software application. CIVILENG Co. sought to use formats that were demanded by customers. For example, the Department of Main Roads required information to be supplied in MOSS Studio format. This often meant that CIVILENG Co. designers and engineers had to convert data across from another format to MOSS Studio before working on it. A key issue therefore in the industry was accessing “clean data” that could provide ease of transfer to different platforms.

Leading customers for CIVILENG Co. tended to be WA Government Departments and major construction firms needing survey and design work. Key suppliers were DLI for digital land data and also some suppliers of CAD programs and modelling software. The firm was an active user of the online land data base provided by DLI and pays an annual fee to secure access to what they described as a most valuable resource:

> *With the digital cadastral data, the accuracy, you can zoom in and out and get more information. Then we overlay the photography. From the photography we can how much detail we are likely to have to survey, how much vegetation cover, how many trees, etc. That has a big impact on how much data we can capture and how quickly. This is all aerial photography and all off the website. We can fade the photography into the background so that we can see where the boundaries are in relation to the land parcel. So that is a really useful tool for us in pricing. In a lot of cases we don’t have to go into the field to price stuff. We don’t have to modify it or anything. It’s just digitalisation doing screen dumps.*

This access to online digital information means that CIVILENG Co. can examine a site in detail without having to physically visit it in the way that they had to do previously. This has assisted in reducing costs of operations as time is the key cost factor for a professional services firm. DLI was considered to be a “good innovator” and their data was accurate.

According to CIVILENG Co. it was currently difficult for firms such as it to source some of the specialist skills that they required for their projects. They stated there was a shortage of accredited people who could do some of the survey and design work. This was identified as particularly the case for underground facilities, with a lack of good digital information on underground services. Telstra was singled out as not being easy to obtain information from. This could be costly if projects were not able to easily locate below ground cables or other infrastructure.

Other key suppliers to CIVILENG Co. included firms that provided aerial survey and photography that supplied photogrammetric data. This work was outsourced to a number of sub-contractors (e.g. one to do the aerial photography, another to do the photogrammetry). CIVILENG Co. would coordinate the project with photo targeting to ensure that the correct data was eventually supplied. This supplier network had grown over time from experience and was based on past history, common knowledge of the industry and a competitive pricing structure. In addition to photogrammetry, CIVILENG Co. also outsourced its work in traffic management and underground services modelling.

Many of the firm’s sub-contractors were located physically close to the CIVILENG Co. office and while it was not felt that distance was a critical factor in how they worked together, it was acknowledged that this geographic proximity made collaboration easy. According to one of the senior managers from CIVILENG Co., if these sub-contractors were more distant, the level of face-to-face contact would most likely diminish and greater use would have to be made of emails and telephone contact.

The social exchange process that flows from the face-to-face contact was viewed as reinforcing for the more formal side of these business relationships.

Main activities in WA for ARCHITEK Co. include projects for education (private schools and universities), science and technology sectors. In addition, they have completed a handful of other developments such as commercial offices, residential apartments and Commonwealth Government buildings. In view of the complex nature and scale of architectural projects, its production network requires explicit communication and knowledge exchange between key actors that generate a clear paper trail in the documentation process. 3D modelling and other digital visualisation techniques are mainly developed as marketing tools to communicate to project stakeholders, in addition to assisting designers in simulating building spaces.

In terms of lead customers, ARCHITEK Co. is primarily focused on subcontracted work from its internal clients based in Asia and the Middle East, which is atypical compared to most firms in WA. But plans are underway to expand its local presence by gaining more State Government and other local projects in the future. Some of ARCHITEK Co.'s local customers have national offices and maintain existing relationships with the firm's interstate and international cohorts. This provides ARCHITEK Co with a direct link to the customer, therefore bypassing the usual market gatekeepers.

ARCHITEK Co. considers the main market gatekeepers of the industry to be the State Government, project managers and property consultants. According to ARCHITEK Co. most larger firms in WA rely on State Government (eg. local council contracts, public buildings) to even out the "peaks and troughs" of the WA small market. From experience, ARCHITEK Co. notes that access to State Government projects is based on proof of performance, and unless firms have done work with the WA State Government in the past, it is a difficult to win the tender, even with a previous track record in having done work in a similar sector interstate or overseas. Understanding the complex and exhaustive tendering process involves considerable investment in resources that are difficult to recoup and justify if a submission is not successful.

Key suppliers for ARCHITEK Co. include the customer's subcontractors (eg. engineers, project managers and consultants), internal and third party IT consultants. IT functions including the company's intranet, are centralised in their head office in the eastern states due to higher concentrations of personnel and proximity of offices. According to ARCHITEK Co. centralised processes provides them with negotiating power and the economies of scale and scope to purchase or update critical software and hardware. The costs of replicating IT, human resource and financial functions in all offices are also diminished. ARCHITEK Co.'s internal processes are standardised and constantly refined in conjunction with a comprehensive knowledge database that spans their extensive network and many years of experience in the industry. Whereas, other firms without appropriate resources to set up such knowledge management systems may end up reinventing policies when different circumstances arise.

Resource and Social Networks in Construction and Engineering

In terms of a resource network CIVILENG Co. maintained some links with the School of Spatial Sciences at Curtin University. This had involved gaining access to the University's research information in the use of laser scanners as well as workshops on the application of GPS. This relationship was not particularly intense but CIVILENG Co. acknowledged that it was useful and could allow them to access specialist information not easily available via other sources. For example, if CIVILENG Co. did work overseas, it could sometimes seek geometric parameters for that country via Curtin's research networks.

The recruitment of staff by CIVILENG Co. also brought them into contact with the local education and training sector. Curtin University School of Spatial Sciences was one source of graduates; another was Central TAFE for engineering surveyors from Leederville. While the quality of these graduates was viewed as good, they required at least six months of work experience supervision before being fully ready to work.

CIVILENG Co. was also associated through its staff with a wider social network of professional associations in the spatial science and engineering areas. This was often a useful way to identify who was who and what people were doing. The professional circuits in Perth were viewed as small.

ARCHITEK Co. has a global network of offices that is involved with diverse industry sectors from aviation, defence, health and science, to residential and corporate interiors. As seen in Figure 10, ARCHITEK Co. has intense relationships with all resource and social networks, as most of these actors exist within their internal network. Constant communication and knowledge exchange is a prerequisite for collaboration in this industry due to the involvement of multiple actors and complex coordination of building projects.

Because of its geographical distance from most of its main customers, ARCHITEK Co.'s documentation processes are produced in 2D formats, digitised and transmitted via the internet. This also includes a reliable system for storage and retrieval of information. ARCHITEK Co. has an in-house AutoCAD expert (previously a subcontractor) who generates 2D and 3D digital drawings and models.

Contact with customers and suppliers outside of WA is almost exclusively conducted through the intranet and third party project management tools. However, face-to-face contact is critical for Perth-based projects as ARCHITEK Co. deals mainly with external specialists and consultants (eg. structural engineers, quantity surveyors, acoustic and air-conditioning specialists etc) that require regular team meetings either daily or fortnightly to go over complex problem solving issues.

ARCHITEK Co. has links to UWA and Curtin through their schools of architecture and planning. A few senior architects at ARCHITEK Co. also lecture in the universities. An annual scholarship sponsored by ARCHITEK Co. and the Royal Australian Institute of Architects is offered to outstanding architecture students part way through their course and to one at the end of the degree. This scholarship aims to aid a candidate through their transition from student to professional. Part of the scholarship involves a 6-month paid work with ARCHITEK Co. which is also partly funded by the universities. This process also allows ARCHITEK Co. to access the top dozen graduates in Perth each year.

Ongoing in-house training on the company's extensive intranet system and project management software is available for new recruits and existing employees. Manuals and procedures and drawings are all managed via digital technology.

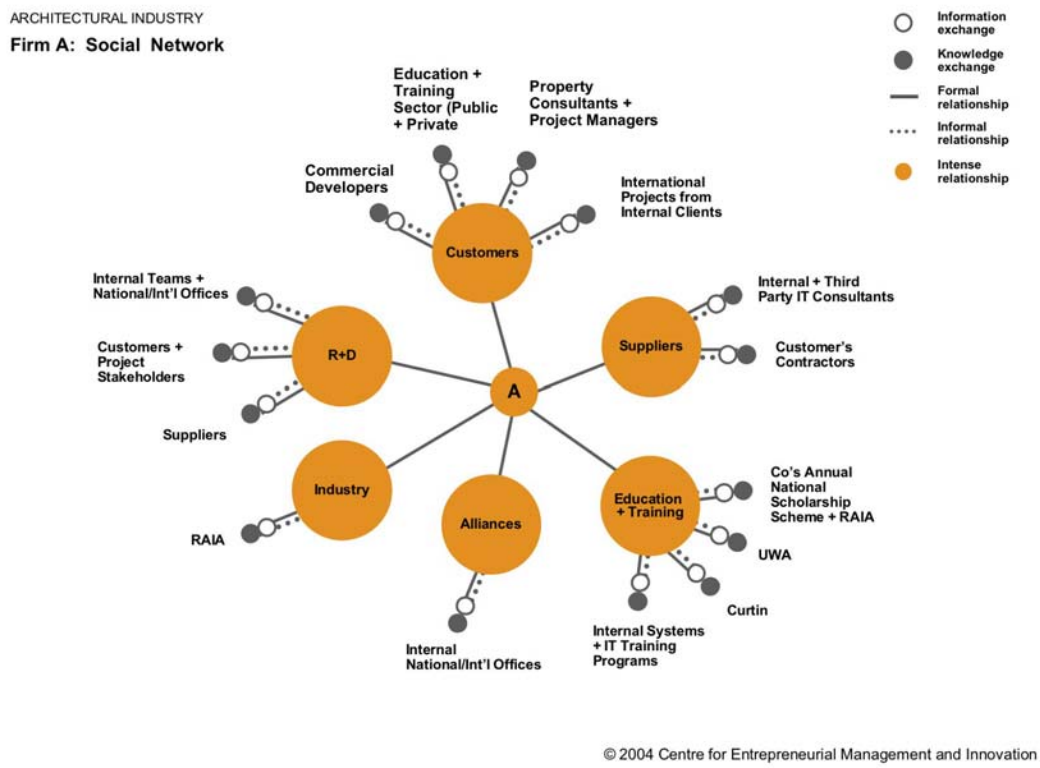


Figure 10: Industry Network for ARCHITEK Co.

The Medical and Scientific Sector

Although the medical and scientific sector of the WA digital economy is only small it remains another possible area for future development with medical imaging and the use of digital 2-D and 3-D modelling for medical diagnostic and training processes. For the purposes of this study a case study was prepared on MEDI Co. a small medical technology firm that has developed a virtual reality training product for use in the medical education sector.

Medical training around the world is dependent on students getting access to cadavers for surgery skills training. Increasingly there are problems with finding sufficient suitable cadavers for the demand. Many cadavers are now aged over 70 years and their physiology is often different from that of younger aged people.

Healthy, young specimens are simply hard to acquire leaving trainee surgeons to make do with mannequins and models. At the same time there is increasing pressure on doctors to be error free and to undertake continuous training to learn new techniques. The products produced by MEDI Co. provide virtual reality training for surgeons and other medical staff that allows realistic skills development without the need for real human subjects.

MEDI Co. is a spin-out from the University of Western Australia (UWA) and is based on research undertaken in telemedicine and communications systems in hospitals. The firm is now privately owned and has national and international networks that provide it with a combination of expertise, technology and background IP for incorporation into its systems. These strategic alliance partners include the CSIRO and medical colleges and schools in Australia and the United States. The senior management of MEDI Co. spends a lot of time travelling inter-state or overseas to meet clients and strategic alliance partners. Every two to four weeks a trip is made.

By focusing on strategic partnering and the alignment of its products to the needs of the end user, it has been possible for MEDI Co. to secure a growing international market. The firm holds a highly differentiated position in terms of its knowledge base and is frequently able to collaborate with potential competitors because it has unique skills and experience.

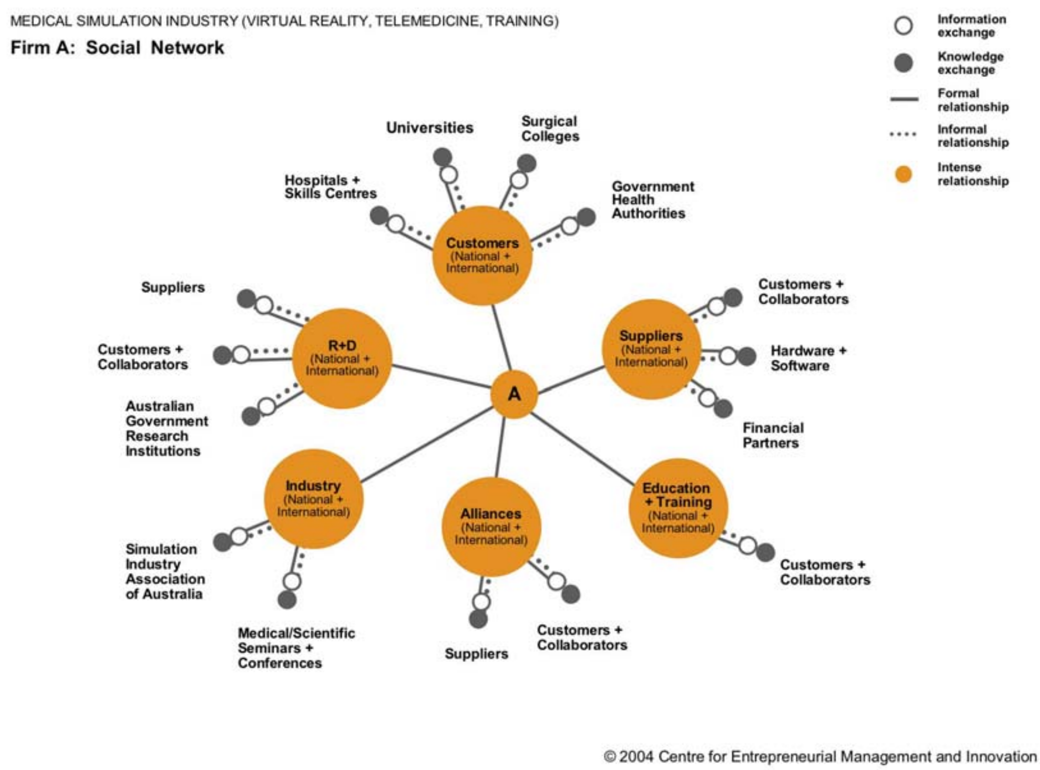


Figure 11: Industry Network for MEDI Co.

The industry network of MEDI Co is illustrated in Figure 11, showing the fairly large and intensive nature of these relationships. According to the senior management of MEDI Co. the social relationships between its key staff and those in the medical colleges and schools is critical to its success. Only by being viewed as 'credible' can they hope to secure contracts. Further, they must configure their products to meet the specific needs of each client. It is a highly specialised niche industry.

In addition to networking in the medical community, MEDI Co. senior management also makes regular trips to the United States to attend annual industry conferences in their field. A key example is the Medicine Meets Virtual Reality (MMVR) Conference that takes place annually. This is a scientific conference not a trade conference but it still offers an opportunity for networking. While small MEDI Co. retains a significant network of strategic partners and is a firm that has a high level of digital intensity.

Curtin University – Department of Spatial Sciences

As shown in the case studies outlined in this section, the role of Curtin University of Technology's Department of Spatial Sciences (DSS) within any digital spatial industries cluster is quite important. The University has assumed a strong position within WA as a centre for learning in the area of surveying and spatial information. The Department offers bachelors degree programs in several key areas. These include a B.A. Surveying, B.Sc. Cartography and a B.Sc. GIS. The courses are well supported by industry and make use of digital applications to the maximum extent that existing resources will allow. The Department has a strong Industry Advisory Board and is guided in its curriculum development by such input. It also uses many adjunct teaching staff drawn from industry.

In the area of research the Curtin DSS is engaged in collaboration with local industry for applied research projects. For example, survey and mapping firm AAM Hatch has collaborated with the Department to undertake a project designed to enhance aspects of that firm's production work. This project was funded under an Australian Research Council *Linkage* grant. Curtin DSS has also collaborated with a smaller firm Oracle Surveys who assisted the University with aspects of its teaching program. This allows students' access to industry experts who bring to the classroom experience that complements the more theoretical approach of the core academic staff.

Curtin DSS has sought to develop its research into a complementary niche that does not compete with the mainstream industry. The Department has research links to other universities such as the UWA Geology and Physics Departments, the University of Melbourne and University of New South Wales (UNSW) spatial sciences faculties. To a lesser extent this included researchers at Murdoch University. Such alliances were most informal and based on academic collegial links and a mutual respect and understanding.

A problem facing the Curtin DSS was finding suitable doctoral students who might eventually become future academics. Demand for graduates in industry was good and starting salaries were sufficiently attractive to make postgraduate study a much less desirable career path. According to the academic staff at the Curtin DSS the combination of heavy workloads and poor academic salaries made it difficult to recruit and retain good teaching and research staff. Only those who found research to be their real passion could be enticed to take up the opportunities. However, even these individuals, if really good, were frequently lost to overseas institutions. The example of a PhD student who left Curtin to work for NASA was given. Australian dollar exchange rates were also not attractive for foreign applicants who would prefer to work in the United Kingdom or United States. As result the Curtin DSS was working to groom its own people and hopefully retain them.

To compensate for the low salaries the Curtin DSS was attempting to acquire state of art technology and use this to attract researchers who wanted to work with such equipment. However, this meant that the process of raising money for the latest technologies was always a challenge. The Department felt that it had secured a reputation for being the best place to study or research geodesy in Australia. It had developed online learning programs for its courses and had benchmarked its quality against leading centres in both Australia and the UK.

Intellectual Property Ownership in the Spatial Sciences

The issue of intellectual property ownership in the spatial sciences sector is complex with a lack of clarity over copyright. By its nature the work undertaken within the sector involves a high degree of collaboration between different actors, with data being regularly exchanged between organisations. The need to lodge all land data with DLI following its production tends to blur the lines of ownership. As explained by DLI even if a surveyor seeks to claim copyright over a particular plan they are legally bound to lodge it with DLI who can then provide it (at a fee) to anyone who needs to see it for subsequent analysis.

DLI was engaged in a series of collaborative projects designed to add value to their data sets and provide potentially commercial applications. However, they were also bound to lodge all their data on the State with the national land data bank held by PSMA Australia Limited (www.psma.com.au) once a Commonwealth agency.

While much of the business activity of DLI was protected by government regulation it was part of the organisation's plan to build on its existing land data bank with a range of value added products combining cadastral, topographic, photographic and road centre line (RCL) and property street address (PSA) information. This was already a highly valuable information product. According to one DLI manager:

> *For something like a combination of RCL with PSA in combination with topography for the data base that people would like to put together for routing and logistics, people like CocaCola, anyone who delivers large quantities of goods over large distances swear by this stuff. They will spend a lot of money to be provided with so much efficiency. If you send something by Australia Post or an international express delivery company, you can go to their website, type in your consignment number and they will inform you, via GPS attached to the transportation, the exact location of your parcel. These people will pay big money to have that information.*

The future could also see a move into what was described as geodemographics that combined human demographic data with spatial information. As the DLI explained:

> *At the moment we are concentrating on land and property information, but in the future for someone else may be to add the people component. So you get the ABS information with the land information, start combining that and have actual geodemographics. Where do potential customers live and where is transport to commerce located? There is so much more information people want to start considering as part of business development, whether it's a small business, a franchise or a multinational chain.*

Findings from the Industry Workshop Process

The findings from this study were shown to a cross-section of representatives from industries within the construction, engineering and spatial sciences sectors and their related education sectors two of four industry workshops held on 16 and 25 August 2004. As noted in Section 1, the purpose of these workshops was to both report the findings and to seek feedback from potential participants in future cluster initiatives.

These workshops involved a facilitated group discussion in which the attention was given to the opportunity to create a future cluster. Key issues around which the discussions were focused included how concentrated the industries in the potential cluster were and the strength of local production networks. Also examined were the role of local research and education centres, the general level of innovation in the main industries comprising the cluster, and availability of skilled workers, investment capital and access to technologies. Finally, the role of government was examined.

A number of factors was identified from these workshops that might serve to restrict the development of the cluster. The first was a need for more broadband access within WA for the transmission of large amounts of data. Second was the need for an agreed set of standards for digital data formatting and coding to facilitate ease of data transfer and matching. There was also recognition of the need to develop an enhanced website portal architecture that could make local and state government databases more open and accessible.

It was also suggested that there is a lack of awareness within the community of the potential of digital content as a business and educational tool, as indicated by the following quote:

> *I went to a seminar a couple months ago and a guy stood up and said it is now believed that 10% of all transactions in America are being conducted online. We know from historical examples that what happens in America happens here with a short time delay. But most of the small business people don't seem to be aware of what is happening. You make an assumption that other people know what is going on if we do, but I found that they don't.*

Possible responses to this problem involved the creation of more primary demand for digital content by making potential users, such as small businesses, more aware of the potential benefits of using digital content as a business tool. In addition to this, it was suggested that the Government, via the Education Department, could stimulate local activity by supporting the local development of on-line education tools and digital content for use in schools. Related to this was the suggestion that the Government might also provide support by initiating other large scale projects that would attract large investors and create opportunities for local producers to feed off these projects.

Industry Concentration into a few Specialised Areas

WA was seen as having a strong local capacity in terms of design skills, however, the construction and engineering sectors were dominated by a few large firms (e.g. Multiplex, BCG, Clough, Transfield-Worley) and these tended to seek competitive tenders from outside the State. Much of the work that was undertaken in the mining engineering and offshore oil and gas sectors that related to the digital content sector or in terms of spatial sciences and surveying was acknowledged as being highly concentrated in WA. However, of the major architecture and construction engineering firms, it was noted that while many maintained offices in Perth, they were also part of larger national or even international organisations.

During the workshop criticism was levelled at the State Government for allowing a lot of in-house capability within its own agencies to be lost as a result of a series of out sourcing strategies undertaken in past decades. As explained:

> *From our industry point of view, when the Government decided that they were going to outsource for their architecture and engineering and do none of it in-house, part of the problem was that they had a core of expertise, which they have now basically lost, which could have been marketed – you know, the expertise in building hospitals, building schools and whatever. Now, that by and large rests in the private sector. It doesn't rest in the Government sector any more. There was an opportunity, I think, for the Government to actually retain some of that expertise and partner that with private firms out into the Middle East. They have missed it. It's gone.*

Effective Local Production Networks

Within the construction sector it was noted that there was a general lack of local production of materials, with many suppliers based on the east coast. It was felt that more could be done to promote the use of local firms. A lack of funding for major projects was not a problem for those firms that were engaged in the mainstream civil engineering, architecture or construction fields. The WA economy was buoyant and these firms followed the fortunes of the core industries in the mining, resources and property sectors. This was not the case for those firms in more atypical industries. For example, firms seeking to develop new electronic or computer engineering products or leading-edge technologies that might employ digital content, the availability of venture capital financing were viewed as a problem.

A problem for many within the spatial, construction and engineering sectors was the need for 'clean data' or the ability to match one data set with another to generate 2-D or 3-D models and plans. A lot of time was often spent cleaning up data and developing protocols to allow various data sets to be matched. Other issues were the type of modelling platforms used by the industry and the ownership of copyright for data. This also translated into the ease of accessing digital information from government storage sites. The example of Land Gate aside, it was widely acknowledged that most local and state government agencies did not offer a particularly user friendly environment for industry groups seeking to access information from their records.

It also seems that there are often difficulties in identifying local digital content producers, with work being outsourced to other states and overseas as a consequence. A suggested solution to this problem was for the creation of a government sponsored web site, with links to local producers, which could serve as a focal point for the industry in the State and act as a forum for interaction between local producers.

The Role and Importance of Research Centres and Educational Institutions

In relation to the formation of collaborative links between industry and educational institutions, several issues emerged that seem to represent barriers to the formation of such links. First, it was suggested that there was often a gap between academia and industry because both tended to have a different focus, due to the nature of the environments in which they operate. More specifically, it was suggested that while universities often focus on longer term fundamental research projects, industry often lacked the resources to become involved in such projects and therefore tended to be involved more in shorter term applied research projects, often in collaboration with lead suppliers and lead customers. A second, and related issue, was a lack of awareness in industry of the opportunities to access university expertise via government funded grants such as ARC linkage grants.

It was suggested that these problems might be alleviated by the formation of dedicated offices within relevant government departments to make industry more aware of potential funding opportunities and to facilitate research interaction between industry, government, and educational institutions. It was also suggested that industry might be encouraged to take a more active role in initiating and driving research grant applications that have more of an industry relevant focus.

The need for enhanced collaboration between the university sector and industry in the field of applied research and development was recognised in the workshops. It was also acknowledged that universities and industry were not always able to find common ground given their often different agendas.

A distinction was drawn between fundamental research that might take years to complete and have little immediate commercial benefit, and more applied research. Smaller firms were usually unable to support fundamental research, and the universities were often not interested in the applied research. As one group member explained:

> *The other side is the operational research that is very close and we see when we look at the cases. Not much involvement of the universities in that. The firms often work closely with customers and sometimes suppliers. They bring a product out, maybe a software program. The version goes to market, it is tested, it comes back and in some cases they are actually building it with their customer as the relationship goes along.*
>
> *Universities can get involved in that but it doesn't help them academically because it's not pushing the boundaries. So the professors who are doing the research are going to be saying – I'm not learning anything new here. I really need to work on something that is going to break new ground.*
>
> *So that is what we are saying. There are sort of two levels of research and I think if we are going to have a healthy, vibrant industry we have to be doing both. Where we have a problem is if the gap between the fundamental research and the actual market is too great. There is a number of disconnects. It is partly the lack of accessibility by industry to universities and the fact that a lot of universities are focused on the publishing of results and getting academic credit for what they are doing.*

However, it was also felt that the education and training sector needed to be able to complement the role of industry rather than becoming a direct competitor which some felt it had become:

> *In our business you have TAFE competing against us on production work. They will go and create a training video for a private enterprise company and we will just miss out because it doesn't cost them anything to do it. They already have the funds on-hand to produce because they have the students, the equipment, the editing and production cameras. They have the staff on to advise and support the students and if private enterprise quotes them a job; we might quote $3,000.00 for example. TAFE goes in there and gets the whole job and gets paid about $1,200.00 for the same job. So we miss out. This happens so frequently and has done for years.*

However, this was contested by some from the education sector who argued that they did not compete directly with industry:

> *In our university we would never tender for a project and we would only ever do a project within the context of one semester student exercise. So maybe it's different in the TAFE sector, but I don't think the universities are out there competing.*

Levels of Innovation within the Local Industries

With respect to the level of innovation within the local WA industries in this area, it was felt that a lot of local expertise existed that might be considered of world class standard. Australian engineers, architects and designers were felt to be of a quality that was as good or even superior to many overseas. Specific mention was made of the planning system employed, and it was the view of participants that this could have export potential:

> *Our planning system here is recognised as being one of the best planning systems in the world. We could be exporting that to other countries as well. We are not taking advantage of it now. If you have individual firms going out and doing it, it's very difficult. But if you get some partnerships going on with Government to go out and try to sell that expertise and information overseas, that is the way to go.*

Availability of a Skilled and Productive Workforce

In relation to the ability of industry being able to gain access to skilled labour, several issues emerged. It was suggested that educational institutions are not keeping up with the developments in new software packages, or with the need for frequent retraining in the industry. For example:

> *Especially with the architectural field I feel that there are quite a few different types of programs that you can use for your drafting and your design work. A lot of the TAFE, uni, aren't keeping up with the times. Because there is so much change, all the time.*

It was acknowledged that the shift in technologies has meant that many within these industries are under pressure to keep up to date with the latest techniques. The most important issue was the need to have access to continuous professional education programs to keep the industry up with the world's best practices. As one participant explained:

> *I think our industry has gone from no involvement with computers 15 years ago to almost total involvement. There are very few people who still work manually. There is an older workforce that by and large taught themselves or was paid to do a few courses at TAFE. But the issue is that most of them need to be re-skilled over their work lifetime several times. That is an area where there is not much emphasis at the moment.*

Access to Sources of Financing

It was widely acknowledged that funding for major engineering and construction projects within WA was driven by forces completely separate from the digital content sector. For projects within the digital content industry it was often difficult to secure finance and venture capital was not seen as readily available for the smaller firms. However, the participants from the construction industries felt that some funding might be secured from something like the Building and Construction Industry Training Fund of WA (BCITF).

Established in 1990 via a levy on all construction projects in the State, the BCITF funds are used to enhance industry skills development. This scheme places a levy of 0.182 percent on the total contract price (inclusive of GST) of all projects over $20,000 in value. The BCITF is used to support the training of apprentices, and other training or skills development specifically focused on the construction sector. While the BCTIF is narrowly defined, the concept of an industry level of this kind to assist in generation of a pool of funds for investment in the digital content sector was seen as worthy of consideration.

In addition, there seems to be a lack of entrepreneurial and business skills among industry participants that could be inhibiting the growth and development of the sector, particularly into larger overseas markets, which are essential to provide economies of scale:

> *What I see in the industry I'm involved in is we have a lot of technically creative, capable people. But what we are often lacking is the entrepreneurship people who can go out and find the clients, sell to clients. I know most people in the multimedia and web development industry certainly don't fall into that category.*

Cooperation between Industry Actors and Linkages to other Sectors

The level of cooperation within the spatial, engineering and construction sectors was seen to vary from sector to sector. Discussions over government tendering policy that might serve to encourage collaboration among local firms were viewed with a degree of cynicism based on past experiences of such strategies, as some of the following comments attest:

> *It needs to be truly competitive. To take away some of the impediments to smaller firms, actually tendering on stuff.*

> *But also the issue there is that there was a time when, in order to supply the Government you had to have QA for small firms, $20,000.00 a year was too much money. It ruled a lot of people out. But also in that in the architecture side where there is a process where you have to get accredited, it's very much a closed shop. It's very difficult to break into that.*

> *With architectural housing works, there is a panel system where you have to buy to get onto the panels for the different scale of jobs. It's very difficult for new players to get into the system. They limit the numbers. The whole process of how jobs are divvied up is a little bit suss as well.*

Big Project Ideas

When asked about ideas for major projects that might serve to stimulate local industry a variety of things emerged. The need for enhanced marketing of the State's capabilities in the areas of construction, engineering and spatial sciences was seen as an important project. However, the need for funding to enable such an initiative to get off the ground was viewed as a bottleneck.

Online WA for Tourism

One suggestion was to use digital spatial data to enhance the WA tourism and real estate industries. The idea of using digital information to provide tourists, investors and general public with maps and related promotional material was raised.

> *The businessman comes to town. What we should be able to do is develop a system that allows this palmtop to log on to Perth Airport wireless network or Bluetooth network and you should be able to go to that booth, push a button and download to these all the maps, all the clubs, nightclubs, whatever you want to do onto one of those. Instead of having just the booth you can take it away with you. That is moving digital. That is a tourism opportunity and a business opportunity.*

However, caution was expressed over allowing too much responsibility to be held by government agencies:

> *The problem I see in putting that sort of thing with a government agency is you end up with something like the Tourism Commission and their current website westaustralia.com, which I understand they spent over $1 million on. A lot of people in the tourism industry tell me it doesn't produce results. There are a hundred people out there around the State trying to develop similar things. It should be not a government department developing this but private enterprise being encouraged to develop these types of websites or other entities.*

> *Normally, if the government starts something and it's not done well, private enterprise should then see an opportunity and pick it up and do it better. If, say a government-run website is not doing the job, then there will be private ones to take its place*

> *Instead of spending $1 million, particularly the Tourism Commission developing that site, they should have got groups of private developers together and encouraged the private developers to go for it. It isn't the job of the government department to develop websites.*

Government Tendering Policies

The need for government agencies, both local and state, to make their information databases easier to access was also discussed. It was felt that government agencies were not sufficiently proactive in driving change and tended to "sit behind the tender process" rather than:

> *They are basically not going beyond the tender process, finding out what is going on in that particular industry and who the people who are really innovating are. They sit behind the tender process and write tenders that are sort of two years out of date and never proactively go out there and look at what is going on. Is that the experience of other people here?*

There was a perceived need for government agencies to open up more and engage with industry to learn about industry needs and challenges.

Satellite Data Processing Services

Another big project idea that had direct relevance to the spatial science sector was the ability for WA industry to service the needs of northern hemisphere clients with value adding to satellite imagery data stored onboard the satellites. The new range of advanced satellites possessed the capacity for data storage and retrieval. As a result, it was deemed to be possible for data capture in the northern hemisphere to be downloaded, processed and uploaded within the southern hemisphere as the satellite passed over Australia.

> *The surveillance satellite systems store the data on board and they download it over one part of the world. Based on satellites going over Baghdad they would download their data. You download this data in WA, it then gives you figures at the beginning of the value chain and that is sort of basically waiting to be grabbed. You have big companies here already who in fact have the exclusive contracts on all the Indian satellites. And these are global satellites so you basically gain access to data over large chunks of the globe.*

It was noted that such a use of WA as a data processing site for satellites was already recognised by U.S. defence systems companies such as Raytheon, but would require the backing of the Australian federal and state governments to get the project accepted by the Americans.

> *If the government backs such a scheme then the people of America will sit up and listen. It is a serious investment, but it has a whole downstream set of outcomes. It is all the downstream processing and products and you are then selling image products to the international market. So it really has to occur at a higher level.*

The intervention by government to secure a contract for WA to be a processing point for NASA satellites was seen as necessary. If such agreement could be reached, it was felt that U.S. firms such as Raytheon would collaborate with local industry to locate a major receiving facility in WA. There was likely to be a lot of opportunities from such a project for small firms and sub-contractors.

SECTION 7

The Digital Creative Industries Cluster

The digital Creative industries, as defined in this study, comprise an eclectic range of activities largely focused around the development of multimedia products. It includes interactive films and games, special effects and 2-D and 3-D animation, as well as graphic design and visualisation, website and creative advertising content production. The sector is poorly defined and existing industry classifications (e.g. ANZSIC codes) are frequently of limited value due to the convergence of activities that is being driven by the digital technologies. It can include multimedia and graphic design firms, computer games developers, film and TV producers, cartoonists and animators, the music industry and also advertising and marketing-media companies.

By contrast the Media industries include those organisations that are engaged in the dissemination and storage of digital creative content. This includes newspaper, book and magazine publishers, television and radio stations, website publishers, and libraries (particularly of photographic, image and digital content). As with the Creative sector, the introduction of digital technologies has forced a convergence on the Media sector, with text, image and sound now being carried digitally and distributed via a range of online formats. While the Media sector is engaged in the production, distribution and storage of digital creative content, it largely serves as a publisher and industry gatekeeper for the creative industry sector. The Media sector involves a number of other industry actors including journalists, cartoonists, graphic designers, photographers, film and TV producers, writers, pre and post production firms and printers.

Five cases were examined for these two sectors. In the Creative industries sector these consisted of a medium sized multimedia and interactive graphics design company we will name as MULTIMEDIA Co., a small graphics design firm engaged in 2-D and 3-D format production to be known as DESIGN Co., and a community of practice PORT 80. Two other firms AD Co., a large marketing and advertising company, and FILM Co., a media production group involved in the development and distribution of digital film and TV content, comprised examples from the Media sector but with a high level of creative content origination.

Industry Value Chains in the Creative/Media Sectors

The nature of production activities in the Creative and Media sectors is complex and may vary depending on the nature of project being developed. Figure 12 illustrates the generic value chain for the marketing and communications (Media) sector.

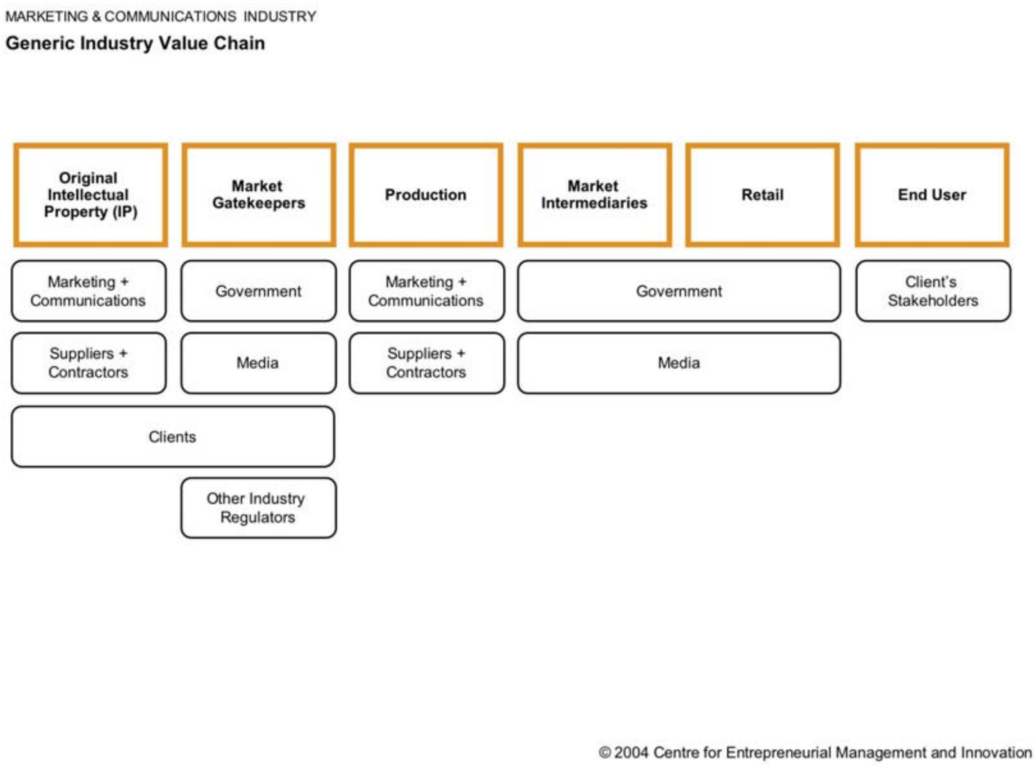


Figure 12: Generic Value Chain Media Sector

Original content is usually created by the firms in the media sector or sub-contractors working for them. Ownership of IP right to this content may or may not be retained by the content originator. Production is also undertaken within the creative/media firms or by their sub-contractors. However, the key actors in the value chain are the market gatekeepers and market intermediaries. These key gatekeepers are typically the media publishers (e.g. newspapers, TV Stations), but can also include the Government, which acts as a gatekeeper for media content through its role as a customer and regulator. By comparison the generic value chain for the web-multimedia development (Creative) sector is shown in Figure 13.

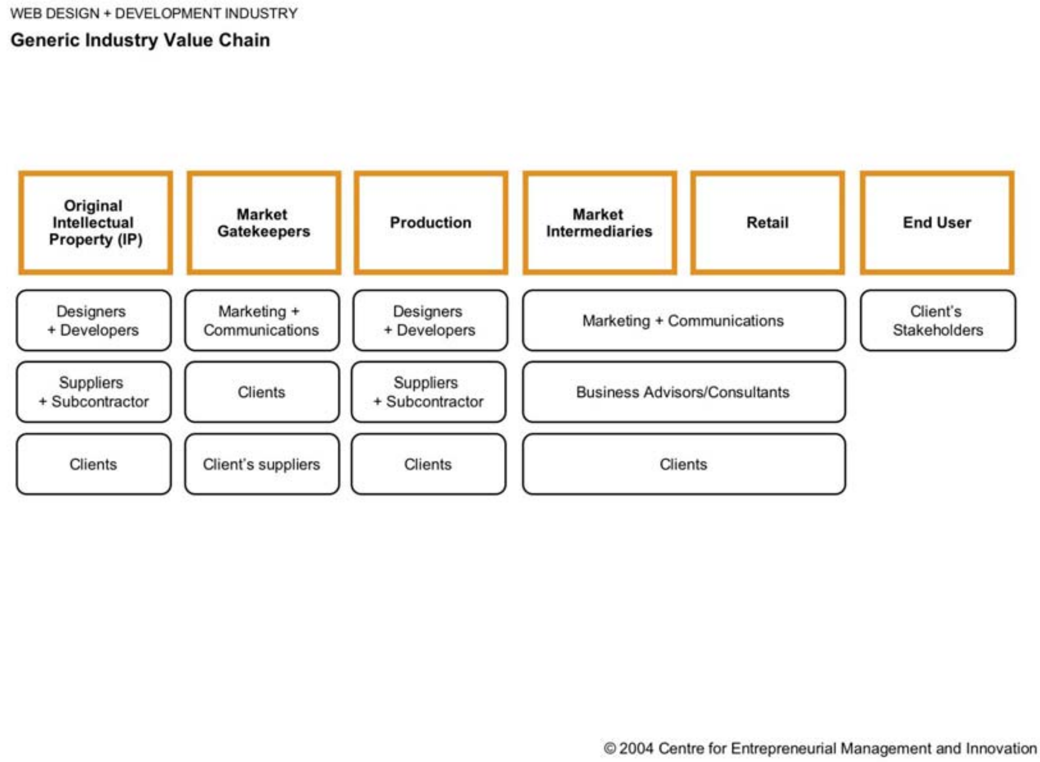


Figure 13: Generic Value Chain Creative Sector

The original content is generated by designers and developers, some of whom are sub-contracted to larger firms that serve as market gatekeepers. Within the web and multimedia Creative sector, the creation of original content may be undertaken in-house by some industry actors, or it may be sub-contracted. In terms of ownership of IP, the convention in this sector is for the client to own the IP. Major production of creative digital content is usually undertaken by a collaborative team of specialists who are funded by either an end-user client who will eventually own the IP relating to the product, or content publishers who will seek to hold the copyright. As with the media sector, the key points of bottleneck are at the market gatekeeper or market intermediaries.

Production Networks in the Creative/Media Sectors

Of the five case studies undertaken within these two sectors most were engaged in marketing and communications activities with emphasis on website development and advertising content. This was the case for MULTIMEDIA Co., DESIGN Co. and AD Co. All three firms were largely focused on the local Perth or Western Australian market, even though they had undertaken work at national or international levels. By comparison FILM Co. was engaged more in export markets with creative content that could be sold to mass media or film distribution companies. PORT 80 is not a company but a community of practice and is focused more on knowledge and skills exchange. As such it will be examined within the resource and social network section.

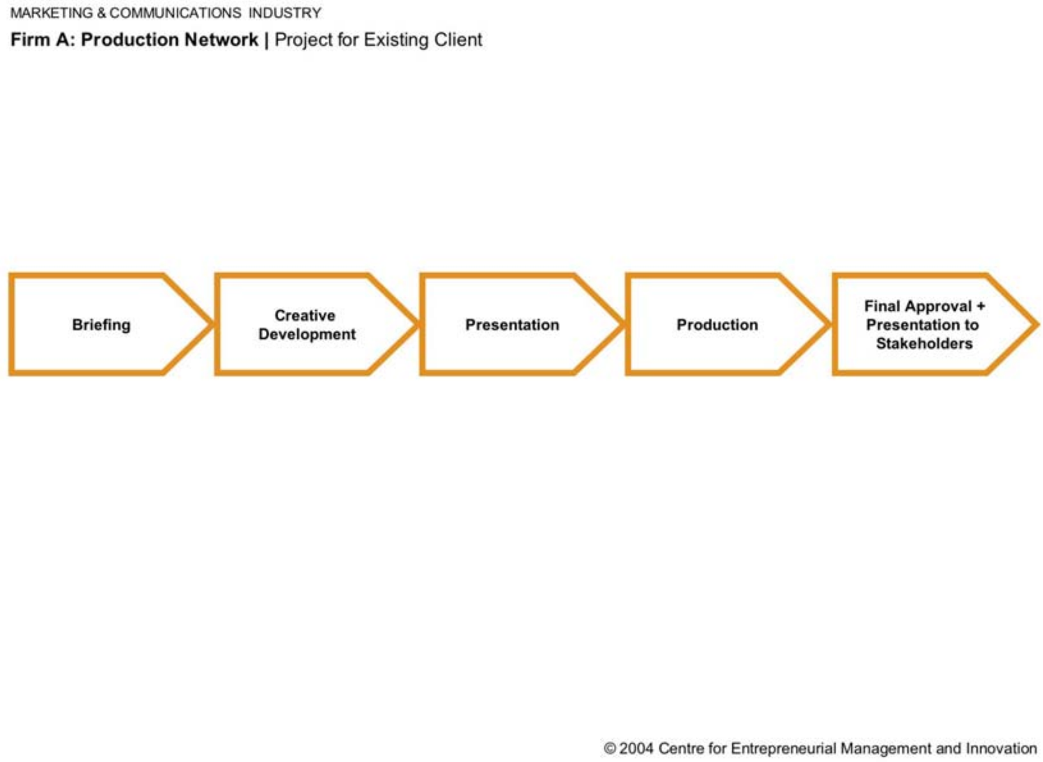


Figure 14: Production Network for Media Sector

The production network for the Media sector is illustrated in Figure 14. This is typical of the process through which a firm such as AD Co. might move through during its production cycle. Initial briefings are taken from the client prior to the creative development process that outlines the general concept, message and media strategies to be followed. A presentation of this creative work is then made to the client and following approval, a process of production will take place to develop the original concepts into a series of messages that will be disseminated via a wide range of media channels. Company-client relationships in this production process are generally very close and partnership-like and are durable over time.

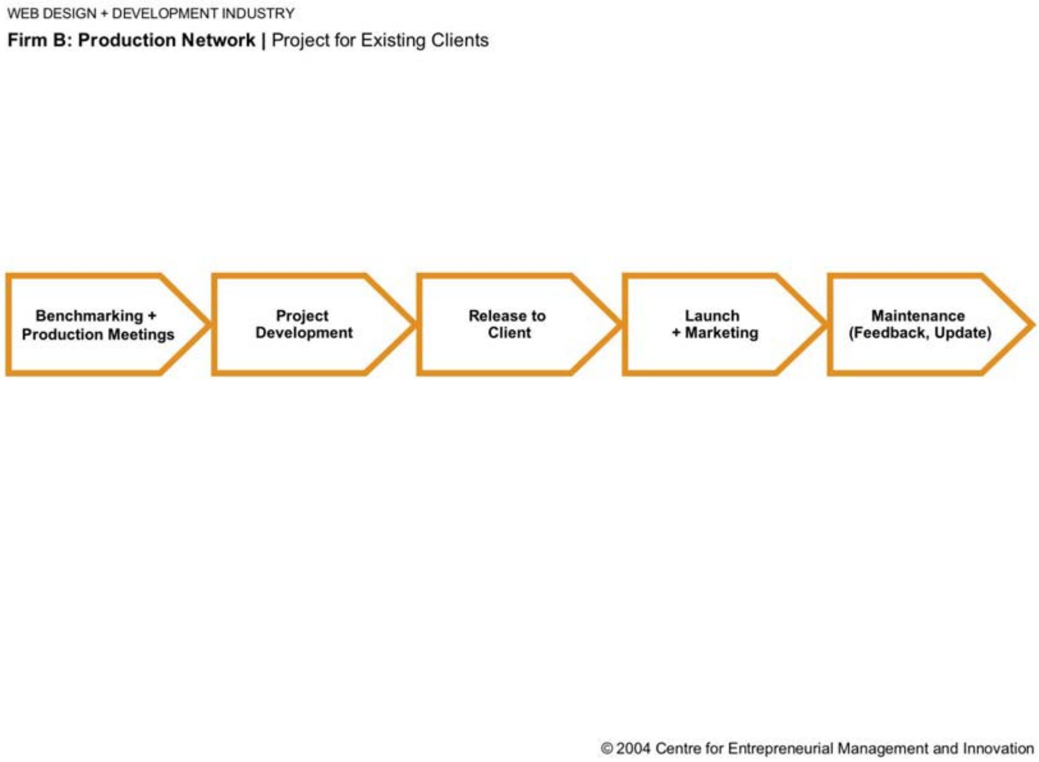


Figure 15: Production Network for Creative Sector

By comparison with the Media sector production process shown in Figure 14 the production network for the Creative sector is illustrated in Figure 15. This follows a similar pattern to the first, but frequently involves a higher level of innovation and ongoing product development. For example, a company such as DESIGN Co. that is tasked to develop an interactive website or intranet system for a client is likely to have to undertake a much greater level of original technical development and move the product through alpha and beta test prototypes over several cycles prior to full launch. This creates a high level of innovation within the sector, and also a strong partnership with clients. Ongoing maintenance and future development of such systems is a pattern of this production process.

MULTIMEDIA Co. Production Network

MULTIMEDIA Co. is headquartered in Perth and has a highly diversified customer base with over 350 clients in sectors such as automotive, retailing, wholesaling and manufacturing. Projects undertaken include the production of CD-ROM, brochures, websites and intranet management systems. The company undertakes all digital production in-house due to a desire to ensure that they maintain adequate quality control. While operating in a competitive environment, MULTIMEDIA Co. also found itself regularly collaborating with former competitors to assist them to complete projects that required specialist expertise. According to the management at MULTIMEDIA Co., the company was a "one stop shop". Customers were located mainly in Perth, but also in Sydney and Melbourne, as well as overseas. This interstate work was being generated via word of mouth, but the company did not seek to expand its work outside Western Australia due to the amount of work that was already being undertaken with local customers.

DESIGN Co. Production Network

DESIGN Co. is a small graphics design firm based in Perth that lists among its clients a number of the major mining and resource firms headquartered in Western Australia, as well as several of the prominent service firms that support the core industries of the State's economy. The company was involved in developing websites and the web-based content for a human resource management client, serving as a key sub-contractor for internet systems. Typical of this work was the creation of online human resource management systems that enabled these clients to source employees from throughout the world. Such product was a sophisticated recruitment and selection tool that enabled the applicant to be screened and interviewed online, with a two-way transmission of information to facilitate candidate selection and matching. Essentially, DESIGN Co. collaborated with their leading customer to create an online recruitment and selection system for use by the lead customers own clients who were in the local mining and resources sector. The company was also engaged in the development of intranet and website systems for other clients in the non-profit sector that involved interactive technologies. The majority (90-95%) of the firm's clients were based in WA with most enjoying a long-term relationship with DESIGN Co. These leading customers were assisting DESIGN Co. to develop new products and capabilities that subsequently could be transferred to new clients in other industry sectors.

AD Co. Production Network

AD Co. is a large marketing and advertising company headquartered in Perth, but with national reach. They constitute a "one-stop-shop" for clients seeking advertising and marketing communications services. This includes the capability to deliver the full range of creative services, recruitment placement, and media or print production, online and direct marketing, 2-D and 3-D design, media buying and strategic brand development and planning. Like many large marketing and advertising firms, AD Co. has the capacity to a lot of these things in-house, but also makes use of a large network of strategic partners who sub-contract some of this work. According to the management of AD Co. the WA media sector is very small in total size and is driven by a range of network relationships with a few large firms and many smaller ones that both collaborate and compete for the few corporate accounts that exist locally. Large firms in the sector such as AD Co. might bill around $150-$160 million per annum, while the smaller firms operate in niches with some firms being little more than 1 or 2 person boutiques. Digital content production within AD Co. is significant with all creative material being produced for print or electronic media initially created in a digital format. This allows for easier transmission and storage of the content. For example, radio advertising is recorded onto MP3 files, while television advertising is not currently produced in digital format, although they are prepared for transmission by satellite. Of concern to AD Co. was the slow diffusion rate of pay and digital TV within Western Australia that impacted the market for digital content.

FILM Co. Production Network

While the other case study organisations in the creative and media sectors were focused largely on servicing the local Western Australian market, FILM Co. is mainly involved in servicing an international customer network. The firm's main clients or leading customers are located in the United States and United Kingdom who purchase locally produced documentary film and television product from FILM Co. The company exports around 98 percent of its product to customers in 60 different countries. While some product has been sold to local Australian television networks the management at FILM Co. expressed the view that it was easier to do business with overseas clients than local ones:

> *It's easier to sell overseas than it is to Australia. It is as simple as that. They are easier to work with. They are more receptive.*

By comparison the local Australian media networks were viewed as having restrictive views on what content they would purchase and a series of "agendas" that made it difficult to sell locally produced products:

> *They have blinkers. They have agendas that need to be politically correct. Primarily there are personalities within the ABC that want to maintain the status quo....It is that they have agendas that they are pursuing. They won't venture outside those agendas.*

FILM Co. deals through an overseas agent to prepare a "treatment" or concept that is initially sold to customers prior to the actual production of the creative work. An initial "Promo" is prepared in digital format, usually Windows Media Player, and is placed onto a DVD or live pack. This provides the firm with a sales tool that can be displayed to prospective customers. The typical "Promo" would run for approximately two and a half minutes and might cost the company $25,000 to create. If successful the contract to produce a television series for a major client might be worth around $3.5 million. Each "deal" might take six months to complete from initial pitch to contract signing, and then a further 18 months of production work. Actual production involves a team of specialists (e.g. writers, camera crew, sound engineers), most of whom are sub-contracted to FILM Co. for a specific project. Most sub-contractors in the technical and creative areas are independent operators principally based in Perth. However, the production crew will frequently travel overseas during the work. FILM Co. management followed a policy of hiring local Western Australian sub-contractors, but acknowledged that the local talent was of a high calibre.

What is evident from the production network activity of FILM Co., DESIGN Co. and MULTIMEDIA Co. is the importance of local production networks (LPN) within their value chain. While customers may be either local, national or international, these firms rely strongly on local sub-contractor/key suppliers that provide them with a range of essential skills and technical competencies. While AD Co. was the most vertically integrated organisation of the four companies, it also relied upon an LPN of sub-contractors supplying everything from multimedia, website design, printing, film and TV production and public relations to service many of its customers. As noted in Section 3 of this report, the existence of LPN within an industry cluster is usually most important in the sustainability of the industries that form it.

Resource and Social Networks in the Creative & Media Sectors

The resource and social networks of each of these organisations were quite complex and largely built around personal or social network relationships that worked in synergy with the production and resource network activities. Figure 16 illustrates the industry network of DESIGN Co. It can be seen that customer and supplier relationships within the production network were highly intense and involved both formal and informal level interaction. This enables a steady information and knowledge exchange process that enhances the firm's ability to improve its products and generate new innovative responses to market trends.

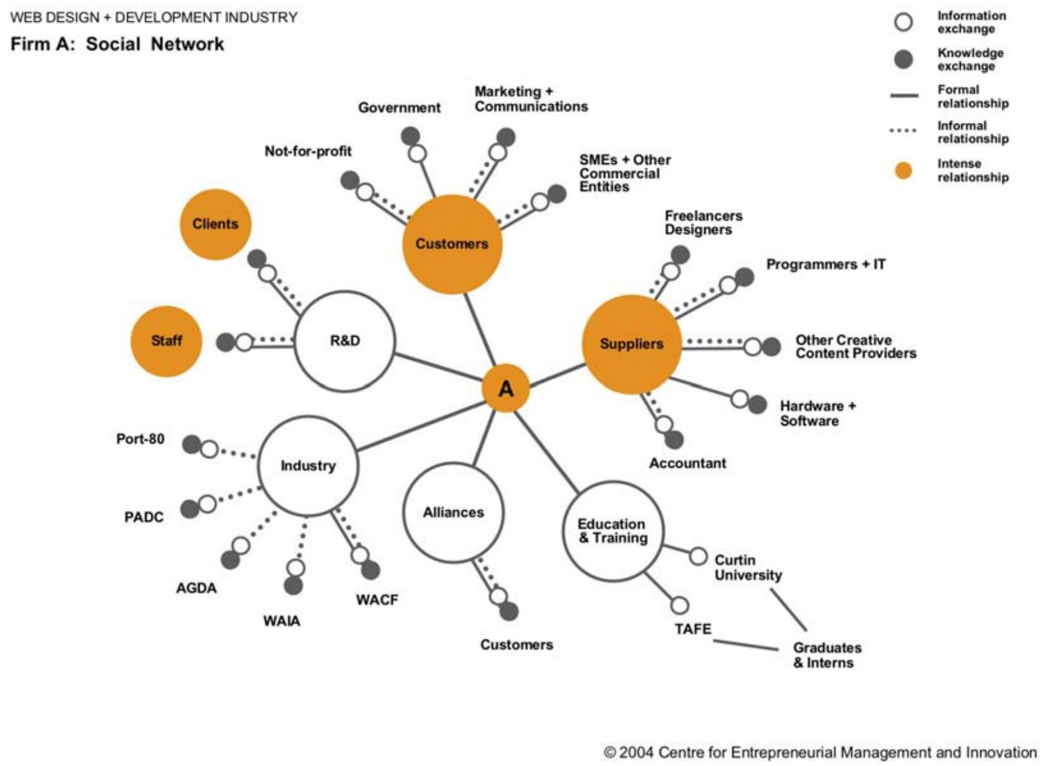


Figure 16: Industry Network for DESIGN Co.

DESIGN Co. Industry Network

The industry network of DESIGN Co. was shaped by the professional and social networks of its directors. Work is undertaken on a project basis with different skills sets required depending on the nature of the project's objectives. DESIGN Co. has formed close working relationships with a few leading customers that have willingly collaborated to generate innovative solutions; and a network of key suppliers that provide specialist skills not held within the core competencies of the firm. Contact with customers and suppliers takes place via telephone and email, but also through face-to-face meetings. It is not uncommon for the management of DESIGN Co. to deal with 40 to 50 emails a day and attend five or six face-to-face meetings per week with clients. While some customers continued to want to maintain direct personal contact with the firm's management, there was a trend toward dealing via emails and voice mails.

Most of the firm's network was informal in nature. DESIGN Co. sub-contracted to a number of firms in the marketing and communications (Media) sector. Many of these relationships were built around personal or social links held by the firm's owner-managers. A number of other design agencies were now using the services of DESIGN Co. to undertake specialist work and while these were potential competitors, there was no sense of competition in the projects that were being dealt with collaboratively. These alliances were not underwritten by formal legal agreements. Rather, they were built around trust and ethical behaviour with a recognition that one firm will not seek to disadvantage another or encroach onto its clients.

In addition to these production network activities, DESIGN Co. was active in the area of industry associations and professional circles. Its senior management was a strong supporter of PORT 80 and devoted volunteer time to assist in the development of this community of practice. Other industry associations were viewed as important forums for the company's management and staff to network through. Such linkages were viewed as informal professional circles that the management of DESIGN Co. should be a part of for the benefits of profile raising and knowledge exchange.

Research undertaken by DESIGN Co. was not conducted with universities or other formal R&D communities. This was usually conducted through normal operations with DESIGN Co. staff collaborating with leading customers and other alliance partners to develop innovative products or processes that could benefit specific projects and customers.

MULTIMEDIA Co. Industry Network

Figure 17 illustrates the industry network of MULTIMEDIA Co. A comparison with the network shown for DESIGN Co in Figure 16 suggests a similar pattern of linkages and activities. As shown in Figure 17, MULTIMEDA Co. also maintains a network that includes various industry associations and support groups such as PORT 80 and the Australian Graphics Design Academy (AGDA). It also sources graduates from the education and training sector, primarily TAFE for technical skills and Curtin University for designers. The management of MULTIMEDIA Co. expressed concern over what they feel has been a declining standard in graduates trained and educated within the State in recent years. They described how, in their view, the standard of the work shown each year at Curtin University's graduate exhibitions has declined. It was also felt that some of the technologies and techniques being taught to graduates in WA were no longer leading-edge.

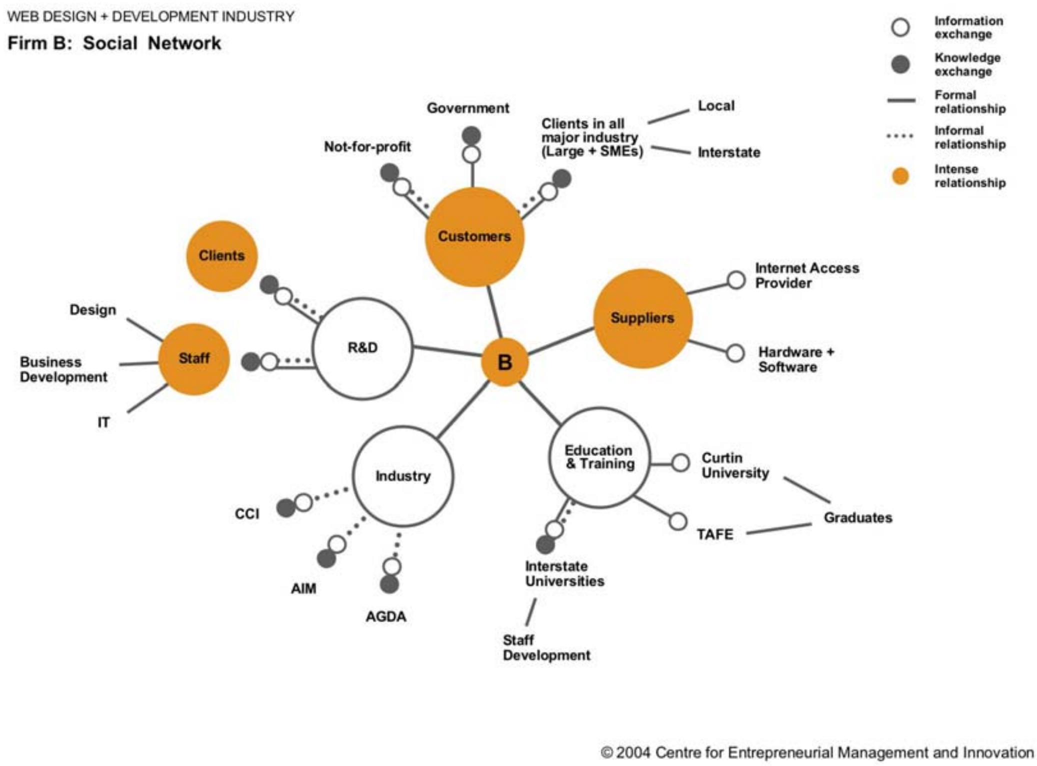


Figure 17: Industry Network for MULTIMEDIA Co.

By comparison they pointed to Victoria where Monash University, Swinburne University of Technology and the Royal Melbourne Institute of Technology (RMIT) where all considered to be superior in their programs. This was also felt to be the case for some of the Victorian TAFE Colleges that specialise in design and multimedia courses. As explained:

> *In computer science I would say WA is producing graduates that do meet industry requirements. In design I would say WA is not producing graduates that do meet industry requirements. The population in Melbourne and Sydney is so much larger. In Melbourne there are three universities that do design degrees, two TAFE that are superb. In Perth we judge the end of year exhibitions in Perth and they are not great. I find it really frustrating because they have amazing facilities and they were trying to teach students coding and stuff like that. In an organisation like this, you need to be aware of that stuff it is very valuable. But they ended up learning old programmes.*

> *The essence of typography is not pursued as relentlessly as when I went to university. That knowledge is lacking in graduates. If you go to Monash graduate exhibition or Swinburne or RMIT, they are really superb and the students have been encouraged to understand the core of design elements. I felt like technology took over and they were just encouraged to fiddle with these things and make things look flash, rather than learn the core aspects of design. A degree needs be more theory based. As it is relatively easy to learn those production techniques once you enter the company, it is more crucial to know what the essence of good design is. The TAFE role is to focus on the practical skills and even there I find them quite lacking.*

With respect to R&D, MULTIMEDIA Co. did not engage actively with third parties such as universities for this. Instead, the company collaborated closely with its leading customers or clients and undertook the development of new products or processes. This evidence of collaboration with leading customers to generate new innovation is typically found in other small firms that use their production network to enhance their product development.

AD Co. Industry Network

The industry network of AD Co. is illustrated in Figure 18 where it can be seen that the firm has an extensive local production network (LPN) drawing upon a range of key suppliers including those engaged in television and broadcast media production. Digital content was supplied to the company primarily from an LPN based in Perth. However, AD Co. has a national and international network that allows it to source material from outside of the State. For example, the company is able to source digital content photography from around the world and secure it via the internet. The same is true for music soundtracks and voice overs for radio and television productions. This material is frequently sourced from interstate with data streamed via satellite or via MP3.

The importance of social networking as a complement to the production and resource networks of AD Co. were highlighted by one of its managers. He pointed out that the long-term relationships that had been developed between the firm and its industry network was often an essential element in the company's ability to achieve its goals. For example, he described an imagined scenario in which a major client in the food manufacturing sector might discover that one of their employees had poisoned a batch of product. As he explained the story:

> *Then he tips someone off, they find out and it could be 1.00 a.m. and we get the phone calls at home – we are in crisis, come in. We all converge and we sit down and this process starts. Then we require our relationships with our suppliers to kick in because if I need to do something on the web. My web-supplier, with whom I have a 4-year relationship, I can call in the middle of the night and say – we have to get something online now. If I didn't have a relationship with him, I wouldn't have his phone number, I wouldn't be able to call him at home and he would say piss off it's 2.00 a.m.*

> *Again, it is the same with our television producers, our external directors, our production companies, the media, etc. It doesn't matter how full a station is, there can be no air time available and I can call someone and say – we are in crisis, this has to happen, we need air time and we need it now. They will go and create space. It can be done within hours if needed. It is a pretty impressive engine.*

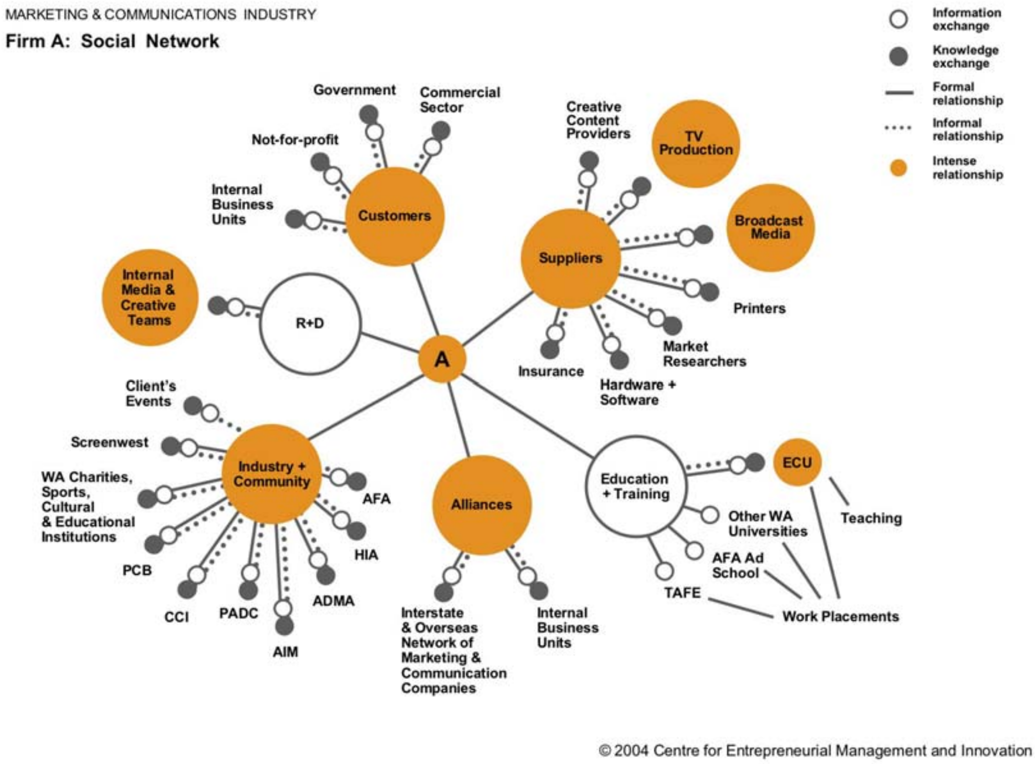


Figure 18: Industry Network for AD Co.

With respect to the role of education and training in the media and communications sector AD Co. expressed mixed views. The company was active in working with local universities and VET colleges to secure graduates and offer industry or work experience. However, they considered that many graduates from universities were not sufficiently well prepared to enter the work force. Within the advertising industry it was necessary to be "a go-getter, to be hungry, to think laterally", and they implied that these things were not or could not be taught at school. AD Co. remained committed to providing university students with opportunities for internships as part of their courses. This enables the company to spot future talent. AD Co. had a strong link to Edith Cowan University (ECU) via its senior management and there were a series of social links between the management at AD Co. and the academic staff in the local university marketing schools. This included some AD Co. staff teaching on a part-time basis at ECU.

PORT 80 Creative Community of Practice

The PORT 80 group is not a company and therefore does not have a conventional production network layer. It can be best described as a community of practice, or an association of mostly freelance creative specialists who have been drawn together for mutual support. The group was founded in 2002 by a freelance multimedia and graphics designer who was seeking mutual support and networking from peers in the same sector. Via social links a group of freelance creative designers met to establish the network. Common interest and a need to exchange views with fellow creative spirits were the principal driving forces for the establishment of PORT 80. As one of the founders explained:

> *Unless you work for a firm where you have other people in the same industry in the business with you, the rest of the people were out in the suburbs by themselves. That is when I thought it would be good to share the knowledge and find out what is going on and keep up with your competitors and that sort of thing, as well as a good excuse to go to the pub once a month and socialise. That was a big part of it. That is really where it began. I never had intentions of having forums at that point. It was literally just a once a month at the pub. That was July 2002.... I e-mailed 10 people whom I knew and I thought would be interested. Out of those, most came, but we had another 10 or 15 from two of the large companies that came along. Staff from both those companies came along to find out what was going on. In the early days we had two or three recruiters in the IT recruitment sector, but mostly just web developers. The recruiters went along to socialise, but more for recruiting purposes.*

The PORT 80 group now has over 300 members attending its forums with a core group of 50 and a regular face-to-face meeting of 25-30 people at monthly functions. Meetings take place both on and off line. The forums are used mainly for social and knowledge exchange, however, more recently PORT 80 has engaged in collaborative projects with commercial outcomes. For example, on member has a particular skill in the area of software code writing and has established a reputation as a trouble shooter who can solve difficult code problems. This individual is now sourcing much of his work via PORT 80 through the social network.

While PORT 80 remains a largely informal community of practice it has begun to develop a profile within Western Australia as a potential source of talent. State Government departments have now begun to contact the PORT 80 network and use it to circulate tenders. Companies within the local industry are also now using it to source employees with specific skills. In addition, PORT 80 and its members are also linked via formal membership and informal association with other communities of practice such as the Film and Television Institute (FTI), Siggraph, Macromedia, the Digital Labours Federation (DLF) and AGDA. Collaboration with other organisations that may overlap with its constituency is encouraged by PORT 80. This openness and desire for collaboration has been seen as a hallmark of the group. Also notable is the age profile. While many of the more established groups (e.g. AGDA, PADC) have an age profile in the post-35 age range, PORT 80 is mostly people aged in their mid-20s.

FILM Co. Industry Network

The nature of the production process at FILM Co. means that this firm is the centre of a relatively large network of sub-contractor/suppliers, clients and third party resource network actors. Each production of a film was a discreet project with its own life, team and budget. However, completed digital content was usually streamed via optic fibre cable directly to clients. This use of optic fibre and digital streaming is not widely used in Western Australia, but is appreciated by some clients in the United State and United Kingdom. Although some overseas customers continued to need video tapes as the main format. FILM Co. felt that it was making best practice use of digital technology in order to remain competitive in the global market. This was seen as necessary for a little company in isolated Perth.

Outside its direct production network, FILM Co. was an active participant in such organisations as the Screen Producers Association, the Australian Film Institute (AFI), West Australian Documentary Directors Association (WADDA) and the Film and TV Institute (FTI). ScreenWest was also seen as a key actor in the resource network of FILM Co. As the State Government's primary agent of film production financing they were a key source of film grants. FILM Co. had received funding from ScreenWest for large projects and in this case dealt with them as an investor, which required acknowledgement in the film credits as well as regular sales reports and a return of the initial investment. The management of FILM Co. also made regular trips overseas to attend industry conferences and events that enabled them to meet and network with senior executives from the international film and television community. The Chief Executive Officer (CEO) of FILM Co. estimated that he took an overseas trip every six to eight weeks visiting such destinations as London, Paris, Washington and Los Angeles. Such travel was often related to the negotiation of future deals, although it might also involve filming on location.

FILM Co. undertook all is research using the internet and internal resources and did not engage with local universities or other R&D centres. The internet was viewed as a highly valuable tool for research. As a FILM Co. manager explained:

> *I mean it is so much easier. A couple of people on the internet can do in a day, that if we didn't have the internet would take a month to do; going to libraries and looking up research, etc. We don't subscribe to any specific database. We just use general search engines like Google.*

However, the company did enjoy support from the Federal Government in the form of export assistance. FILM Co. had benefited from export market development grants from AUSTRADE and found them important to securing access to overseas markets. Unfortunately the scheme only lasted for eight years and then companies were ineligible.

Interactive Television Research Institute, Murdoch University

To illustrate the role of the education sector in this potential cluster a case study was prepared on the Interactive Television Research Institute (ITRI) at Murdoch University. This centre has links to a number of international corporations such as NIKE, Foxtel and the BBC. Many of the students who work via ITRI are undergraduates that complete honours dissertations, although the centre also has doctoral research students, several of whom are on scholarships funded under ARC research grants. At time of interview ITRI reported having around seven doctoral students, three masters students and three honours students working through its research programs.

It was felt that ITRI has significant potential to expand its operations and that there were more opportunities within industry for research than could be currently exploited with the existing staffing resources. ITRI lacked sufficient post-doctoral research fellows to expand its research activities. Academic staffing positions within Murdoch were being filled against teaching requirements rather than research opportunities and this did not always lead to sufficient concentration of expertise within the University in the areas needed by a centre such as ITRI.

According to ITRI its lack of resources meant that it was required to be selective about the type of projects and clients that it took on. Despite being offered a series of opportunities to collaborate with a number of major organisations overseas, ITRI had sought to screen partners on the basis of whether they were likely to enhance the centre’s learning. To this end they had selected to work with the BBC because they considered them to be best practice in documentaries and Nickelodeon due to their competencies in children’s television. Other partners were BSkyB, as they were a major interactive TV (iTV) platform and the American Broadcasting Corporation as they could help ITRI learn more about the U.S. market.

A problem for ITRI was that seeking to secure research contracts from major clients in the United States while based in Perth was a disadvantage. The example was given of Unilever, who questioned why they should pay for research to take place in WA and not the U.S.? The isolation of Perth was viewed by ITRI as a ‘massive disadvantage’ for organisations seeking to operate on a global stage. Nevertheless, ITRI had managed to secure a research project from the American Broadcasting Corporation, which had gone well and a second had now followed. This suggested that working from Perth for global clients was not impossible.

ITRI also felt that it was relatively poorly funded in comparison with other similar centres such as Queensland University of Technology (QUT), which had just recently obtained a grant of $70 million from the Queensland State Government. There was also the Cooperative Research Centre (CRC) for Interactive Design, based at QUT that had received $21 million in funding.

Another concern for ITRI was the way Australian Federal Government policy on telecommunications had dealt with the digital television systems. Rather than seeking to develop the boundaries of the technology, the networks had been allowed to reinforce the status quo, with the major networks continuing to hold dominance in what content becomes distributed and when. This forced content originators of digital interactive TV products to go overseas in search of suitable markets.

The debate of the creation of a fourth and digital television network was cited as an example of the problem with Federal Government policies:

> *As a direct outcome of those Government policies you end up with an environment where the broadcasters really are not embracing it, but they are doing the minimum necessary to comply with the Government to such extent that the Government would not open the door and allow others to come into the space. Others would be NewsCorp; that is the biggest one that everyone would fear.*
>
> *Right now there is a huge debate raging around the country because the legislation that the Government gave protected free to air broadcasters from the operation of the fourth network, which would only be digital. It wouldn't be analogue. It would be a digital network so you would have to buy a digital set top box to see that network. But that moratorium comes up at the end of 2006, so the government is now starting a review to see whether it should have a fourth network.*
>
> *So that is an example. If there was a fourth network that was digital, of course that would be a driver that would get people to want to get set top boxes that would buy in to the profit margin of the existing commercial networks. So the networks will do what they have to, to make sure that the Government protects them and doesn't allow other competitors to come into the mix, but at the same time they are not actually going to drive the change because it is an uncertain future. It is a change in their business model. Nobody wants a change in their business model. The existing business model works just fine*

According to ITRI there was an opportunity for WA industry to do more in the field of interactive television (iTV). It offers the potential for numerous spin offs for local content originators supplying to major international customers such as the BBC or Nickelodeon. As a niche area the field of iTV offers an opening as many of the larger national networks appear not be strongly focused on this area at present.

The example of the multimedia sector in was given to illustrate the need for WA to avoid past mistakes. This was illustrated with the failure of IMAGO as a multimedia development centre:

> *When you look back at that multimedia era, there was IMAGO. IMAGO had all the funding that was there. Now imagine if that funding had been used effectively in some way to position – not trying to do all things and not trying to do too much, but if it was about working with Q, Max and Pretzel, Method and Madness, Eclipse, they were the big ones. They left early.*

Rather than collaborate the multimedia sector in WA sought to compete for a small local market and did not take advantage of the opportunities to work via IMAGO to target large international projects. The failure of IMAGO was viewed as a lesson for WA in the development of any future digital cluster project.

Intellectual Property Ownership in the Creative and Media Sectors

Intellectual property was treated differently in each of the case study organisations. The policy and convention followed by AD Co. was that all material produced for a client remained the property of that client. Creative material developed by AD Co. or any of its sub contractors was owned by the client with IP ownership transferring at the time of purchase. While AD Co. might retain the digital master files, if the client were to shift its business to another marketing agency, AD Co. would be obliged to hand over these files to the client or their new agency.

Due to the nature its production operations FILM Co. had to deal with a large amount of copyright, particularly as it related to sound tracks and scripts. The policy used at FILM Co. was that everyone who works on a project has to sign a contract that transfers intellectual property to the company. This gave FILM Co. exclusive rights to the creative content used in each production unless otherwise agreed.

DESIGN Co. had a policy that was moving toward the prospect of sharing IP with clients. Recent collaborative product development between DESIGN Co. and major client had generated a potential opportunity for commercialisation of a new interactive online product. At time of interview the idea had not been formalised and only tentative discussions had taken place.

For PORT 80 the issue of IP was not something that the group had spent much time considering. As a community of practice the need to control IP within the group was not considered appropriate. This was explained by the PORT 80 respondent as follows:

> *I really see the forum as a public domain. Once you have posted something on the forum it essentially belongs to the public. At the end of the day you are the author of it, but by posting it in such a public place, you really expect other people to run with the ideas. I haven't seen anyone to date post something and say – never use this. There have been great concepts that have come out of snippets of things. People have posted them for the greater good of other people.*

However, PORT 80 had given consideration to the creation of an incubator centre where freelance content originators and teams could work in serviced offices. At the time of interview this idea had not progressed beyond early stage discussions.

In general the treatment of IP within the cases suggests that while most participants in these sectors recognise that intellectual property was important, they did not treat it in a formal or systematic way within the production network. Only FILM Co. had any requirement for the signing of copyright agreements, the other organisations were more likely to work on industry convention, trust and mutual agreements.

Lessons from the Creative and Media Sector Cases

The creative and media sectors are not highly concentrated within Western Australia although they do employ a large number of people and offer growth potential for a fairly large number of small firms. Within the Creative sector is what might be described as "mainstream" service group of firms that generate websites, digital graphic and multimedia content for clients who take ownership of the IP and thereby secure little more than a service fee for their time in production. This mainstream group is the most common and describes much of the work undertaken in the sector.

A second, albeit smaller group, is engaged in the generation of original content and is seeking to leverage their IP for future commercial benefit. Of the cases examined, the work of FILM Co., DESIGN Co. and some of the members of PORT 80 best illustrate this, although it must be noted that only FILM Co. demonstrated any formal and systematic approach to this.

As shown in Figure 5 of Section 4, the Creative sector offers good potential for growth within the WA digital content industry. Of importance will be the ability of the sector to secure IP rights and leverage these to yield the most returns to local industry as the product is developed along the commercialisation pathway. It is in this regard that the Media sector has a critical role to play. While the Creative sector may be the originators of digital content, it is the Media sector that is mainly responsible for the publishing and distribution of this content.

The example of FILM Co. demonstrated the problem of securing access to local publishers and distributors for locally produced content. According to FILM Co. it was most difficult getting their product into local media distribution channels. They felt that the Australian national media was "blinkered" and would not readily purchase home grown content with the ABC especially singled out for criticism. FILM Co had found international markets more open and willing to buy their product leading to a strong export performance.

It is likely that other firms in the Creative sector will find the experience of FILM Co. is not uncommon. The importance of ScreenWest as a financier for FILM Co. product, and the value the company secured from AUSTRADE export grants points to the need for the local Creative sector to have access to seed funding while also looking abroad for market growth. However, while export activity is likely to be inevitable for firms seeking to grow out of the local WA market, the need for enhanced local purchasing should not be ruled out. The existence of a vibrant local market within the State is required to assist micro-firms and freelance content originators such as found within PORT 80 to develop skills and accumulate financial resources.

Findings from the Industry Workshop Process

On 19 August and 2 September 2004 two industry workshops were held that focused on the digital creative industries. A number of issues emerged from these workshops that were similar to those identified during the spatial industries workshops. Specifically, it was suggested again that there are difficulties in identifying local expertise in order to form suitable project teams for local production. This was explained in terms of there being a lack of a local forum through which skilled talent could be readily sourced. Many of the individuals that comprise the Creative (A) community are not officially registered as being in business and work largely as independent sub-contractors. As one participant explained:

> *Animators are out there. They are looking for people to work for. There is a disconnection there. You can't quite find them. There aren't any obvious forums where these two groups of people can come together.*

This is akin to the pool of artists, musicians, writers and actors within the State. Such creative people are frequently working in other industries in order to earn a living and undertake their creative activities on a part time basis. Within the digital creative sector there is no well formed industry association or forum through which such talent can be found other than such communities of practice as PORT-80.

Broadband Access

The problem of limited access to broadband internet services was also raised as a key problem within the digital creative sectors as it was in the spatial industries. This was identified as being an inhibitor to local production of digital content: As one participant explained:

> *Broadband. To push it as far as you can, you have to have bigger and bigger bandwidth to push newer forms of digital content around the place. Everyone in the industry needs it.*

Market Access and Distribution Issues

Gaining access to markets was identified as a further major problem and related to this were concerns about the lack of opportunities for local producers to interact with key market players, or gatekeepers. As the following comments attest, the need to create a framework to attract top level producers to WA or allow local content originators to travel overseas were viewed as key issues.

> *I think if any sort of development that could occur that we would benefit from, it would be getting right in the face of the market makers and having access to those markets.*

> *We have one event on the annual agenda called Small Screen Big Picture TV Conference. That brings a whole lot of TV producers here and I know that production has flowed as a result of all those people coming together, sitting down for a week. They are few and far between, those opportunities here. It costs money for people to get out and go to those markets and attend them regularly.*

In terms of how to deal with this distribution problem, it was suggested that there is a need for government support to develop initiatives to encourage people to come to the State, and to assist local producers to attend these events.

> *The State Government or the Australian Government or both have to get involved and they have to set down a basis, a foundation for people to be able to present their wares and then they have to market the convention worldwide.*

Government Support

Concerns were also raised about the degree of government support for local producers, as evidenced by the following comments:

> *We make e-learning products for primary school children. Trying to get them into WA schools becomes a really difficult marketing exercise.*

> *The Government support is very small, isn't it? I mean, we have to acknowledge that. Last year the WA film industry produced 59 hours of commercial film product, whether it was drama, children's television or documentary. The Government itself put about one million dollars into producing those hours. Another 3 million came from the Lotteries Commission. That says a lot for the lack of support of the government for this very labour intensive industry that employs hundreds of people when it's pumping. So I think that is where we have to start. We have to start targeting the State Government to support the digital industry in a much greater way and also the Federal Government…not just for film, but into games and into the whole digital area.*

> *I thought of a national thing…the learning federation, where all the State Governments are contributing to the money and they are supposed to be creating large amounts of online content. Most of that money seems to have gone into infrastructure and most of development contracting has been in the eastern states. Tasmania has one or two, mostly in Victoria and QLD. Now why isn't more effort made by people here?*

Linkages between Industry and the Education and Training Sectors

A number of factors were identified as inhibitors to the development of collaborative links between industry and the education and training sectors. As was found in the spatial industry workshops, there was a perceived gap between the goals of industry and educational institutions:

> *The disconnection between university and industry… Industry doesn't want to put up a bunch of money to get the student to do the research. They want to get distributed. There just doesn't seem to be a focus from the university.*

Perhaps as a consequence of this perceived gap between the two groups, it seems that educational institutions have difficulties in identifying good industry partners:

> *An example from our university: They are involved in multimedia, filming and photo media. They are doing a whole bunch of stuff that they can use to collaborate with. But they have trouble actually finding good industry partners.*

As with the spatial industries workshops, there was a perceived break down in the education system, in terms of its ability to provide graduates with essential business and entrepreneurial skills:

> *I've actually just come out of sort of the meat grinder of TAFE and university and have sort of been spat out and from that view; myself, I've actually just been thrown into the environment and going – well, I'm not even business savvy at all.*

> *Largely speaking, with all the creative industry and education that I've personally been in contact with in Perth, any courses that have to do with business behaviour or practices have little or no relevance to actually being in a business or behaving in a businesslike manner. It's too disassociated from actual business circumstance. So part of what you are saying here seems to be that part of actually making the digital creative industries grow is making sure that people in it know how to behave like business people.*

Availability of Skilled Graduates

Related to this were concerns about the lack of opportunities for local graduates to gain the necessary practical experience, and of the associated risk of losing that talent overseas as a consequence:

> *I think also one of the things that I've seen around in the creative lower level area is that there are not enough places to actually earn your experience. In order to get your industry experience where a lot of the jobs that you are looking to apply for – minimum two to three years of industry experience is pretty much necessary to start making your way in there…A lot of people who I know that go through the courses here in WA, the first thing that they are thinking of as soon as they get out of their course is to go somewhere to get their experience.*

One suggested solution to these problems was the creation of an incubator in which local producers could gain valuable practical experience, as well as having access to resources to assist in the development and commercialisation of business concepts.

SECTION 8

Future Directions for the WA Digital Content Industry

The purpose of this study was to examine the opportunities for the formation of a digital content industry cluster in Western Australia. As shown in this report, the findings of the research suggest that the basic industry foundations within the State provide the opportunity for the creation of at least two potential digital content clusters, one focusing on the spatial industries and the other on the digital creative industries.

The spatial industries cluster is formed around important growth sectors in the economy with relatively high growth and above average concentration in comparison with other states. The spatial industries cluster is based around businesses that are mainly involved in the surveying, construction and engineering industry sectors and as such has substantial links into the core mining, resources and property industries that underpin the WA economy.

Most of the digital content generated by this spatial cluster is associated with data derived from the land; to which industry participants add value through various methods of data processing, analysis and graphic presentation. Individuals working in the spatial digital content cluster can be loosely classified as Creative (T) in nature, with a principal focus on scientific and engineering disciplines.

By comparison, the digital creative industries cluster is formed around potential emerging industry sectors, which have only average employment or industry concentrations, but have experienced relatively high growth in the last three years. The businesses that comprise this potential cluster are mainly associated with traditional creative industries such as graphic design and film and television production, new media creative industries such as web development, computer games and multimedia and the media industries such as TV and press.

These industries are experiencing considerable convergence due to rapidly evolving technology. Much of the work produced by this sector is based on fee for service, and therefore much of the IP (although creative) is not particularly valuable because it is generally sold in its entirety to the client. Exceptions to this situation are mainly found in the film and TV, games and simulation sectors, where the owners commercialise their IP through a range of intermediaries and retain some portion of their original property. A similar pattern of activity is also found in many parts of the spatial industries cluster, where many firms in the construction and spatial sectors also largely work on a fee for service basis and hold relatively weak controls over their IP.

Competitive Industry Dynamics for a Spatial Industries Cluster

As shown in Sections 4 and 5 of this report, the spatial science sector in Western Australia is strongly concentrated in both business and employment in relation to other states. These spatial science case studies suggest that this sector is highly innovative and has good growth potential. The transformation of DLI from a State Government agency into a statutory authority offers an opportunity for the creation of an important focal firm within the local spatial science sector. However, its role as an industry regulator and potential competitor needs to be addressed.

The spatial science sector impacts a wide cross-section of other industries that are already of key importance to the State's economy. As noted in the case studies, this includes the mining and resource sector, property and construction sector, agriculture and the transport industries. By nature, the industry is collaborative and displays a high level of innovation. The spatial science sector is research intensive and predominately a Creative (T) rather than Creative (A) oriented community. It has the potential for significant growth particularly in the application of photogrammetry 3-D modelling, information interface and satellite imaging technologies.

Figure 19 applies the findings from this potential spatial industry cluster in Western Australia to an industry "Diamond Model" (Porter, 1990). This is offered by way of mapping the key forces that may determine the industry dynamics of a future cluster.

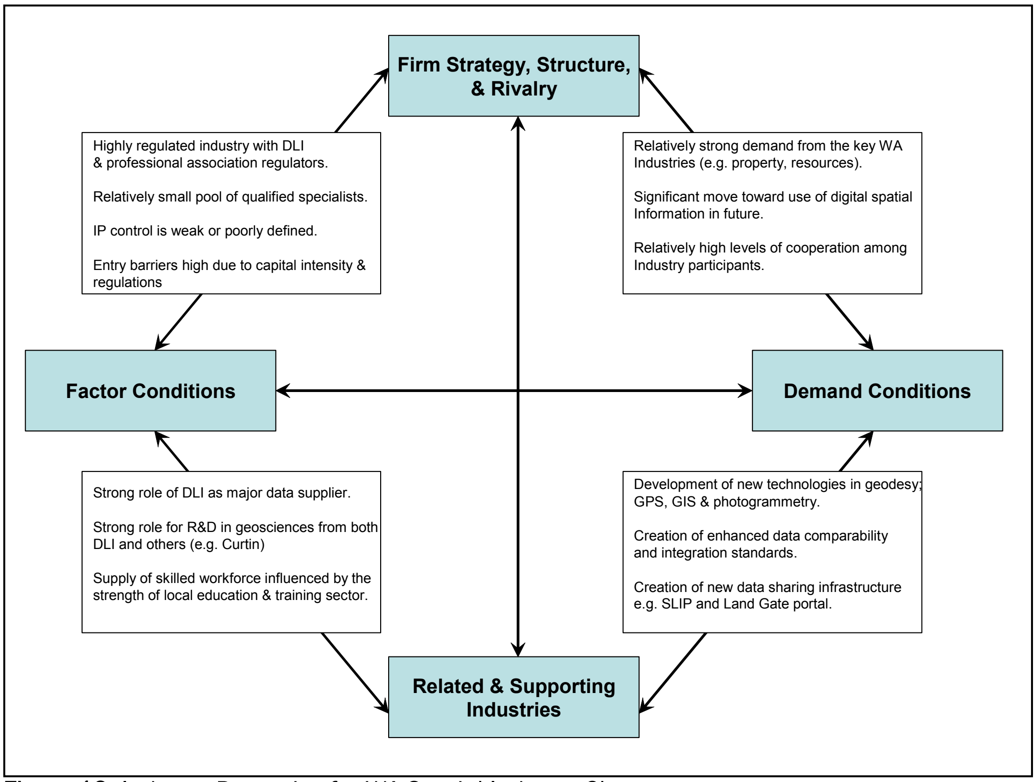


Figure 19: Industry Dynamics for WA Spatial Industry Cluster

Demand Conditions

In terms of local demand conditions the opportunities for long term growth appear good. As shown in the case studies, a wide range of industries is now making significant use of digital spatial information. These are mostly core industry sectors in the State (e.g. mining and resources, agriculture, property and construction, transportation and logistics,) and can offer a process of long-term sustainable demand for products and services that might be developed by local industry.

The evidence gathered from this study suggests that the trend toward greater use of GIS applications, photogrammetry technologies and 3-D modelling will provide good opportunities for sustainable growth in any future cluster. Government agencies such as the Department of Main Roads, Department of Agriculture, and Department of Planning and Infrastructure all serve as key customers for this cluster offering the opportunity for the State Government to shape the nature of local demand.

Factor Conditions

A key aspect of the factor conditions that exist in this spatial industries cluster is the high level of regulation. As noted earlier in this section, DLI serves as major regulator and gatekeeper for both data and skilled labour (via its licensing of surveyors). While the overall supply of skilled operators, surveyors, cartographers and other spatial science specialists within WA was not found to be critically short, there was evidence of some skills gaps that might serve as barriers to future growth.

The long term growth of this industry cluster may be partially contingent on the ability of local production networks to agree on data sharing and data compatibility issues. A common issue raise by the case studies was the need to reach agreement on a set of industry standards for the coding of digital spatial data to facilitate data matching, transfer and sharing. Given the high level of industry regulation and significant role of Government agencies as customers, it would seem possible for attention to be given to this problem.

Related to this issue is the need for greater local generation of proprietary products and systems that can be used within the spatial sciences industries. There was some evidence generated within the case studies that R&D was taking place within specific businesses and government agencies to generate software applications and data sets that could enable local industry to secure IP rights to future product or process technologies. However, the pattern of IP ownership within the sector was found to be relatively weak or at least poorly defined and appeared to be due to the high level of data and information sharing required across the sector.

Industry Strategy, Structure and Rivalry

While competition within this cluster's industry sectors can be intense at times, there appears to be more collaboration among industry actors than is typical of other industries. The high level of industry regulation and propensity for sub-contracting, information sharing and collaboration over projects, suggests that competitive rivalry in this cluster is modest.

There also appear to be fairly high barriers to market entry within the cluster's industry sectors with a combination of high capital investment costs and specialist expertise for the spatial, construction, engineering and medical scientific industries. Although technology was offering a range of potential substitutions to existing methods of operation, the general pattern that emerged from the cases was for firms to develop niche strategies. This serves to encourage greater cooperation among the industry actors as they collaborate to take advantage of each others resources and skills.

The long term development of a digital spatial industries cluster in WA is likely to be dependent on the capacity of local firms to generate new products and services that have protected IP and that can be commercialised and diffused within the State and beyond. During the research study several examples of this type of activity were found with both small and larger firms (often working in conjunction with publicly funded research centres) to generate products and services. These included such technologies as farm management tools that enable satellite imagery and other data to be applied to wool and crop production and digital data coding to enhance the use of 3-D modelling in the engineering and construction sectors.

Related and Supporting Industries

The education and research sector has a strong role to play in this cluster, with such actors as Curtin University, DLI, the CSIRO and TAFE offering a range of inputs including R&D and skills development training that are critical to future growth. The Government's decision to create an information supply portal such as Land Gate has had a significant impact on firms operating in this cluster. Discussions with DLI and such groups as ISA Technologies Pty Ltd (who operate a high performance computer facility in Technology Precinct, Bentley), suggest that the State's infrastructure is generally good, although it may possess some areas of weakness.

Over future years the spatial industries in WA will be in a position to access a series of enhanced NASA satellites with the capacity to provide increasing levels of data on a frequent basis. The State also has satellite collection infrastructure that is currently underutilised. Within the defence sector there is an increasing use of spatial data for a range of military and intelligence applications. Raytheon, the U.S. defence systems giant has now based part of its operations in WA and has identified the application of satellite imaging as a future area of development.

A common concern from many of the respondents interviewed for this study was the lack of adequate bandwidth in Western Australia. Another potential bottleneck might be access to suitable computer processing and storage power, although this may be overcome with the development of such initiatives as the ISA Technologies-IBM high performance computing facilities.

Competitive Industry Dynamics for a Creative Industries Cluster

The industry dynamics of the digital creative industries cluster are outlined in the following sections with Figure 20 illustrating these within the "Diamond" model framework. It should be noted that this potential cluster comprises two complementary but generally quite different industry sectors in the form of the media and creative industries.

Demand Conditions

The demand conditions facing the digital creative industries cluster is characterised by a very small local and domestic market, dominated by the government sector. While there are well established media businesses in Western Australia, the evidence from this study suggests that any long term growth in the cluster is likely to be through export of locally produced content. The small domestic market makes exporting necessary over time, but the relatively poor adoption rate by Australian media networks of local content requires this. There is likely to be a role for government – as a major customer – to help fill local market failures.

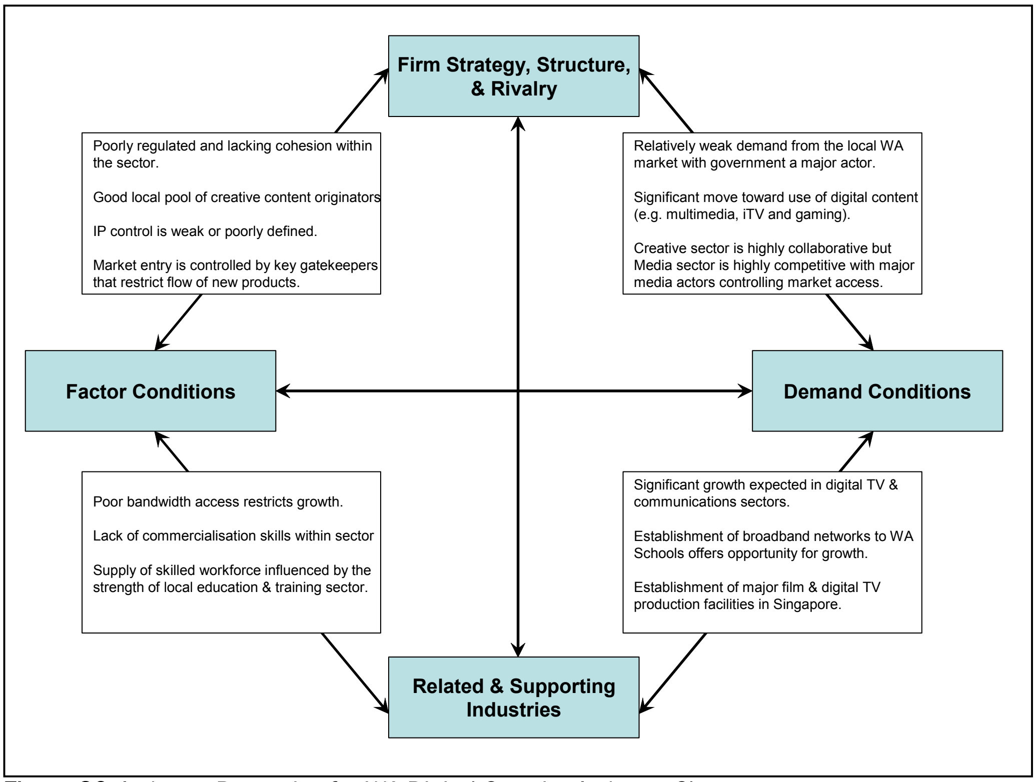


Figure 20: Industry Dynamics for WA Digital Creative Industry Cluster

Factor Conditions

The supply of skilled operators, creative designers, writers, musicians, and film and audio technicians within Western Australia is generally good. There also appears to be good infrastructure in terms of production facilities for all but the most advanced projects. However, there is a recognised shortage of competent producers able to assist in the development of creative product into commercial outcomes. Funding is also a problem, with ScreenWest acknowledging that many digital projects cannot be easily financed by them due to the narrowness of their charter. A lack of bandwidth has also been identified as key constraint as well as ready financing sources for major productions.

Industry Strategy, Structure and Rivalry

While competitive rivalry within the media industry appears to be quite intense, the opposite was found within the creative sector. As the example of PORT 80 shows there is a strong level of collaboration and cooperative engagement between firms and individuals within the content originators. However, many of those within the creative sector lack commercialisation skills and there will be a need for enhancing the level of business management and development within the sector if it is to fulfil its potential.

Within the potential cluster there are no readily identifiable large organisations that can serve as focal firms. This compares with the spatial industries cluster that has DLI as a potential focal firm, plus a number of large industry participants. For the future development of the digital creative industries cluster it may be necessary for the creation of a new entity to serve as such a focal point.

Related and Supporting Industries

The education and media sectors have a role here, particularly in assisting with both the development of future industry skills and the provision of infrastructure to assist local demand environments. It is understood that the WA Government will be linking all schools across the State with high-speed broadband communications networks. This will create a potential market for digital content originators to provide multimedia and iTV learning programs that can address the needs of WA students from early childhood education through to post-secondary levels. Ideally, there should be a role for local media industries to participate in the building of the digital content cluster. However, the past track record of collaboration between the electronic and print media organisations, working in conjunction with education and training institutions (e.g. ITRI, FTI) has not been good.

Opportunities also exist for related technologies from other areas to be configured into the support of a local digital creative industries cluster. One example that was raised in this study was providing access for digital animators to the human motion capture databases and technology held by the sports and human movement faculties at UWA and Edith Cowan University (ECU). There may also be benefits in widening the scope and access of computer facilities currently used for the scientific and engineering fields to the more creative industries (e.g. high performance computer application to digital animation projects).

Barriers to Cluster Formation and Growth

Four major barriers to the growth of spatial and digital creative industries clusters were identified in this study. The first of these is the **lack of major projects**, of either creative or technical nature, that require significant investment in innovation and serve to facilitate the development of valuable platform IP that can be used as a building block for future industry growth.[1]

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[1] Platform IP relates to innovations that can be applied across a range of products rather than a single product outcome.

The predominantly fee for service nature of contracts in both the spatial and creative industries has created an environment where innovation is piecemeal and is sold to clients who, for various reasons, do not wish to commercialise the IP further. If more valuable contracts were available, that required strategic or platform IP, producers would use the surplus resources generated by larger contracts to extend the IP beyond their client's requirement; and retain this IP to grow their business. As a general rule, venture capital investors are more attracted to platform IP innovations as they offer greater opportunities for business development.

Lack of Access to Venture Capital and Commercialisation Support

This leads to the second major barrier to cluster growth, which is the lack of access to venture capital for the commercialisation of IP. A common problem identified in this study was the situation in which predominately small businesses in the spatial and creative industries having developed valuable IP, experienced trouble accessing capital to commercialise their product. While each case involved different factors the general pattern that emerged was that lack of venture capital funding can be attributed to at least four things:

- Lack of business investment readiness among firms within these sectors – a typical situation found was a creative or technical expert with a prototype product and an embryonic micro-enterprise, but without sufficient expertise in business management or commercialisation processes.

- Difficulty identifying and connecting with commercialisation support – for many of these micro-enterprises and nascent entrepreneurs, knowing who to turn to for assistance with the future commercialisation of their product was a problem. This was particularly noticeable within the creative industries and the Creative (A) communities.

- Lack of venture capital investors willing to support the sector – the process of venture capital typically involves a series of stages with different levels of investor, each with their own specific characteristics and needs. Within WA there is a relative paucity of early stage or seed capital investment funds that can assist ventures to move from initial prototype to market. This problem is particularly noticeable within the creative industries arena, where IP is less easy to protect by patent. Existing funding sources were also found to be rather restrictive in their nature. For example, the EiR information technology incubator and seed capital investor has been unwilling to fund some digital creative ventures as they did not fit their investment parameters, and many similar projects fall outside the investment guidelines of ScreenWest.

- The lack of appropriate investment deals – as noted above, the majority of mainly micro-enterprises within these emerging clusters is poorly prepared from a venture capital investment perspective. There is a need for greater focus on the design and development of highly innovative product with sufficient platform IP to make such deals more attractive to investors.

Lack of Appropriate Common User Infrastructure

A third major barrier to future cluster development is a lack of appropriate common user infrastructure within the State. The findings from this study suggest that there is a common problem within both the spatial and digital creative sectors with inadequate access to high-speed broadband Internet access, high-end modelling and digital rendering animation effects software and high performance computing. While it was not possible to investigate each of these issued in depth, the feedback from case studies and industry workshops suggests that these are common problems across a wide range of industry sectors within both emerging clusters.

Coupled with this is the need for common industry standards for the formatting, coding and storage of data. Mention has been made in Section 6 of this report of the need for "clean data" within the spatial, engineering and construction sectors. Even these highly regulated industries appear to suffer from a lack of common industry standards. The situation among the creative and media sectors is even worse. Varying standards in format used by local media networks create difficulties for small firms that must invest heavily in capital equipment in order to supply a particular type of format. Evidence was gathered during this study that suggests Australian television networks are technically behind their counterparts in the major overseas markets. This does not assist in the development of world's best practice in the local digital creative industry.

Lack of Consumer Awareness

Finally, a fourth problem is the lack of consumer awareness of the depth of creative and scientific talent that exists in Western Australia within the industries that comprise these potential clusters. While the State has considerable and in many cases proven creative talent in the digital content sector, most companies contacted through the workgroups or in the case studies suggested that a major barrier to growth was low consumer awareness of their products and services.

This applied both within these industries among firms that might support each other within a local production network and between these industries and major customer industries. Local architects and designers were as likely to express the view that their talents and experience were largely unrecognised within the construction sector, as were those seeking to commercialise computer games and digital interactive television programs.

Economic Framework of Forces Influencing Cluster Growth

The following recommendations have also been made within the overall context of the report. Consideration has been given to the nature of the potential industry clusters identified in the study and what has been learned from previous cluster studies with regard to creating favourable conditions to facilitate successful cluster formation and growth. Attention has been given to cluster development strategies that have been implemented in Australia and elsewhere in the world, which appear to have fostered success in industries that are accommodated within the definition of creative digital content described elsewhere in this report.

In formulating these recommendations the study team involved the participants from the industry workshops and used these as an opportunity to seek feedback and criticism of both the proposed strategies and the methodologies upon which the study was founded. In all cases these recommendations were accepted as offering a way forward and received a high degree of support from the workshop participants.

The recommendations made in this report have been developed within an integrated framework, where the success of each recommendation is to a greater or lesser degree co-dependent on the implementation of the other recommendations. It is also recognised that the development of regional economic clusters is influenced by what have been identified in previous studies as **catalytic factors** and **drivers** (DLRG, 2003). The first of these deals with factors present within the local regional economy that can serve as a platform for sustaining the growth of local industry. An example is common user infrastructure, education and skills development training programs and the existence of research centres. The second refers to those forces that promote economic growth, such as investment, market expansion and the availability of local human and physical resources. Table 11 illustrates a framework for the development of digital content clusters that has been adapted from work originally proposed by the Department of Local Government and Regional Development (DLGRD, 2003), with respect to economic development within the State's regions.

Table 11: Framework of Forces Influencing the Development of WA Digital Clusters

Influencing Factors	Potential Indicators
Goal: growing viable industry clusters.	▪ Increased business & employment activities in digital industries ▪ Increased export of digital products & services from WA ▪ Digital industries make net contribution to wider State economy
Catalytic factors: resources available in the local economy that sustain future growth.	▪ Investment in R&D within the digital sectors ▪ Local purchasing of WA digital content ▪ Common user infrastructure & broadband access ▪ Direct government support for digital industry projects ▪ Skills development in creative & technical areas associated with digital industries
Drivers: external and internal factors that promote industry growth.	▪ Expansion of local, national & global digital markets through technology diffusion ▪ Investment in digital projects by private sector ▪ Development of local focal firms with capacity for industry leadership

Source: adapted from DLRG (2003)

Many of the catalytic factors outlined in Table 11 remain under developed in WA within the digital creative industries, although they are better established in the spatial industries. Western Australia has a good economic, political and social environment within which potential digital clusters may be grown. The geographic proximity to major East Asian centres offers some potential to leverage the growth of digital industries in these areas. This is likely in the case of Singapore's move into the creative digital sector and India's move into spatial industries. Perth is also a highly attractive physical location for many of the Creative (A) and (T) communities that will form the entrepreneurial management teams needed to build future business ventures. However, Perth will have to overcome its geographic isolation from other parts of the country and to compete with the rise of digital industries in other cities that have secured significant support from State Governments.

Technology is the key driver for these future industry clusters and it will be crucial for WA industry to remain on par with or in advance of the latest global trends in digital technologies and techniques. Ongoing investment in R&D within the sector will be needed, as will international benchmarking of local products and services. This will require the local industry to be opened up to international competition and see its future in the development of highly differentiated products and services made for a global market and underpinned by innovation as the key source of competitive advantage.

Securing such a future will require the development of commercially valuable platform IP that can serve as the basis for the future growth of locally based business ventures. While the long term development of home grown WA companies may see their headquarters move offshore, it will be necessary to keep the overall stock of such ventures flowing through the commercialisation pipeline high. There is little sustainable growth likely to be achieved within any digital content industry clusters from offering fee for service business models based on low labour costs.

Overall Concept - WA – "State of Digital Innovation"

For a significant digital content industry cluster to develop within Western Australia it will be necessary for the State Government to make a strong and sustained commitment to its future. As outlined in Section 3, the participation of government in the growth of most prominent industry clusters has been an essential feature. Even if the private sector must ultimately carry the long-term responsibility for the cluster's growth, government support is vital.

This study has identified the opportunity to grow two interrelated digital content clusters focusing respectively on the spatial and creative industries. A priority for future State Government policy should be the formulation of an action plan, which plots out the various strategic initiatives required to make these industries successful. This plan should provide an overall strategic focus for the range of activities needed to facilitate the growth of future industry clusters and should address the gaps that exist in the catalytic factors and drivers outlined in Table 11.

It is suggested that this strategy should be built around a branding process designed to raise awareness within local industry and the wider community to the cluster development process and to promote the state's digital industries both nationally and internationally. Our suggestion for this branding strategy is:

"WA the State of Digital Innovation"

This branding strategy is proposed in order to differentiate Western Australia from other states and regions that are actively promoting themselves as centres for the production of creative digital content. The branding concept deliberately does not make specific reference to spatial or creative sectors. As noted elsewhere in this report the digital content industries are very broad in their scope and by defining the focus too narrowly there is the risk that it will alienate some of the more important actors.

The focus is however placed on "innovation" as this seeks to emphasise the need for the local industries to lead rather than follow within their respective sectors and to devote resources to the development of valuable IP that can be leveraged. That is, IP which is retained by the developer to a greater extent and has the advantage of providing recurring revenues at much lower cost than the alternative fee for service contracts.

Placing the emphasis on innovation requires local industry to seek alternative and original ways to secure a place in national and international markets. While the digital content industry may be viewed as highly innovative by nature, this is not always the case. As with the film or music industries there are many new movies or sound tracks being generated around the world each year, but only a few cities are recognised as being major centres for highly original material. The success of *The Lord of the Rings* trilogy from New Zealand is evidence from the movie industry that innovation can be driven from relatively isolated regions.

A similar dynamic is at work in the digital content industries. For example, the level of innovation in the overall concept for a computer game based on a team sport is in itself very low, as there are many similar products on the market. The producers of such a game will therefore need to engage in higher levels of innovation in order to differentiate their product in the market. They may, for example, create truly original 3-D characters, which can perform unique actions, within a highly original game strategy that involves unheard of levels of user customisation. Each of these product features represents a higher level of innovation and will not only help differentiate the product in the market, will also create IP which can be used in other products.

Throughout the spatial and creative digital content industries there are opportunities for product innovations that if exploited have the potential to create valuable IP on which a successful industry cluster can evolve. Furthermore, by focusing on innovation a number of other benefits should eventuate. The first of these is a drawing together of the Creative (A) and Creative (T) communities that currently tend to operate in separate spheres.

Innovation requires high levels of creativity and benefits from multi-disciplinary groups joining together to address common problems through collaborative projects. A cluster development strategy focusing on innovation as a central theme has the potential to draw together various communities of practice and establish links to other innovative milieux at the national and international levels. Further, if the focus for such innovation is placed on the creation of commercially valuable IP, the long term outcome should be the development of business ventures with the ability to attract venture capital investment. Federal Government industry policies have focused strongly on innovation with a range of initiatives and commercialisation support grants (e.g. COMET, R&D Start) that may provide additional funding for digital content projects with protected IP. The development of an industry strategy that places emphasis on innovation within the digital content industries is also likely to attract or retain highly talented creative individuals (of high profile) looking for opportunities to explore the 'outer limits' of their creative or technical profession.

Recommendation 1:

That an action plan (digital innovation strategy) be developed for the creation of digital content industries clusters focusing on the spatial and creative sectors. These should be built around the concept of "WA the State of Digital Innovation" and aimed at the development of local business ventures that possess commercially valuable IP that is predominately owned within the State.

The Need for Leadership

The development of a digital content industry cluster in either the spatial or creative sectors will require strong leadership from both government and industry, as well as a long term vision for the future. Political leadership at the highest level is viewed as critical to success. It is recognised that digital content clusters focusing on the spatial and creative industries are likely to encompass multiple government agencies and therefore several ministerial portfolios. However, it is felt that there should be a focal point for such activities assisted by the creation of an **"Office of the Digital Economy"** comprising a cross-departmental team that is designed to support the development and implementation of the State "Digital Innovation Strategy".

Recommendation 2:

Establish a WA Office of the Digital Economy to be staffed with representatives drawn from a cross-section of government agencies and tasked with the responsibility to develop and implement the State Digital Innovation Strategy. Ideally, this agency should be brought under the Department of Industry and Resources.

In addition to the creation of appropriate Ministerial and Government support frameworks as outlined above, it is also recommended that two **Digital Cluster Development Task Forces** be created with the responsibility to formulate specific strategies for the spatial and creative industries clusters. The work of these cluster task forces should be coordinated through the **WA Office of the Digital Economy** described in the previous section. These industry cluster task forces should comprised representatives from relevant industry actors, education and training institutions and government agencies. Management would be undertaken through Industry Advisory Boards, an Executive Director recruited from industry and a small secretariat. Part of the work of these task forces would be to make recommendations to the State Government, via the Office of the Digital Economy, for such initiatives as government tendering policies and common user infrastructure designed to provide impetus to the digital content industry. However, these task forces should not be mere industry advisory bodies. They should be viewed as a point of industry coordination and could be involved in the distribution of targeted industry development grants provided by government.

Recommendation 3:

That two Digital Cluster Development Task Forces are established to provide a focal and coordination point for activities designed to facilitate the growth of industries in the local spatial and digital creative sectors. These cluster task forces would be led by Industry Advisory Boards comprising representatives from relevant industries as well as education and training institutions and government agencies. They would need an Executive Director appointed from industry and supported by a small secretariat. These task forces would report to the Office of the Digital Economy and would have responsibility for the development of specific strategies targeting their respective clusters.

Developing a Branding and Marketing Process

To support the development of a wider strategy focused on the concept of "WA the State of Digital Innovation" it is recommended that all activities associated with the implementation of this digital innovation strategy be branded. This will require the development of an umbrella brand and appropriate sub-sector brands focusing on the spatial and creative sectors. This branding process offers the opportunity for those tasked with the facilitation of future digital clusters to raise awareness of the State as a centre for digital innovation. This branding process can incorporate such initiatives as regular annual conventions built around conferences, tradeshows or festivals designed to showcase local industry activity and talent. The new Perth Convention Centre facilities provides an ideal location for the staging of such events that should be used to attract to Perth representatives from around the world. In addition to industry showcasing via conventions, the marketing and branding process should also comprise the development of industry portals (see below), sponsored events and industry awards programs.

Recommendation 4:

That a branding and marketing process be undertaken to support the concept of "WA the State of Digital Innovation" and that this incorporates secondary brands focusing on the spatial and digital creative sectors. This process should aim to raise the overall profile of Perth as a centre for digital content generation and industry expertise making use of industry showcase activities.

The need for BIG Projects

An examination of how clusters have successfully developed elsewhere suggests the need for large-scale, commercially valuable projects that can serve to attract private investors, while also creating business and employment opportunities. Without such major projects it is unlikely that sufficient concentration of industry activity will be generated. Two major projects have been identified from this study that may provide a substantial impetus to the spatial and creative digital content industry clusters, while also providing industry and the general community with world leading digital content resources.

Project 1 – Digital Education Content

The first project seeks to take advantage of the opportunity provided by the decision of the WA Government to connect all schools within the State to broadband internet services. It is recognised that while this broadband connectivity is a major asset for the State education system, there remains a paucity of high quality interactive online educational content for distribution along this digital distribution channel.

A project targeted at the generation of suitable, high quality educational and training content for delivery via broadband internet services would provide substantial impetus for innovation and growth in the creative digital content industry. Such a project would bring together Creative (A) and (T) producers to create valuable digital content from IP originally developed by the Dept of Education and Training, while facilitating the development of products for the local and international market. It will be important to support this with a quality K-12 syllabus focusing on the digital economy, and in-service training for teachers in new media production.

It is conceivable that the range of products produced for this project could encompass everything from simple interactive educational games, to interactive training simulations and virtual reality environments. Products could be developed for students of all ages as well as trainees working in the mining, resource, agricultural, marine, tourism and engineering industries. Given the difficulties that exist in the delivery of high quality training services to regional, rural and remote parts of Western Australia, the longer term benefits to other industries within the State economy could be significant.

The project described above would also be greatly enhanced if the Government embarked on a project to digitise many of the archives in which they currently house records and information and make them available online. This process would greatly enhance the volume of digital content available to re-purpose into multimedia projects and facilitate the development of on-line educational products in WA. The current website architecture and archival systems used by both State and local government agencies remain relatively difficult to access by the community. This is of particular importance to industry groups, specifically small business and would benefit from a coordinated approach designed to link otherwise disparate databases together.

Project 2 – Spatial Industries Content

While the spatial industries sector is already well established in terms of its activities in property development, surveying and construction there remains opportunity for a further project designed to encourage the development of innovative digital content products. These could include applications in the fields of photogrammetry (both aerial and close proximity), geo-demographics and spatial asset and logistics management technologies. There are already examples of this type of activity taking place within local industry and DLI is found as key actor in many of these projects. As the main regulator and land data wholesaler, DLI is the natural focal organisation in any major spatial industries cluster. Such a project would bring together Creative (A) and (T) producers to create valuable digital content from IP originally owned by the DLI while developing product that would benefit the local mining and resources, agricultural, property and tourism industries.

Recommendation 5:

That the Government, in conjunction with industry, initiate at least two major projects focusing on the education and training sector and the creation of innovative digital spatial information products. The first of these projects would seek to generate a range of high quality interactive education and training products and programs for distribution to WA schools and colleges via the internet or DVD. The second would seek to commercialise innovative applications of spatial data held by DLI for use in other industries such as agriculture, construction, transport, logistics and asset management.

Establishment of a Digital Creative Industries Incubator

The development of such major projects as those outlined above or other major projects within the digital content sector would be enhanced if the Government also developed methods of providing the following common user facilities:

- Low cost broadband internet access for content originators seeking to create commercial products;
- Access to high performance computers, with the capacity to render high quality digital animation;
- Access to specialist software for use in computer animation and 3-D modelling.

One option for the delivery of such common user infrastructure would be to create a **WA Digital Creative Industries Incubator** incorporating business and professional development education support for individuals seeking to commercialise digital content products. The incubator should be designed around existing facilities and communities of practice and should be tasked to leverage the work currently being undertaken within existing centres of research and training at universities and VET colleges. However, its focus would be on commercialisation of creative digital content rather than education, research or skills development. Over time the production facility could become a 'centre of excellence' for innovative digital content production and should attract private investment.

This incubator would have both a physical and a virtual architecture and would seek to incorporate the existing communities of practice within the WA digital creative sector. It should provide require regular opportunities for individuals working within the industry to investigate the wider global market. The incubator would work in conjunction with the Cluster Development Task Forces to facilitate regular forums for guest producers, developers and entrepreneurs from national and international arenas to visit Perth to meet local industry participants.

Entry into the incubator should be competitive and based on the prior formation of a business venture that seeks to commercialise valuable IP. As with other incubator programs, the applicants seeking to enter the facility would need to prepare business plans and be evaluated on the basis of their abilities to commercialise the IP that underlies their business model.

Recommendation 6:

That a Creative Digital Industries incubator be established based upon existing infrastructure with a focus on the development of innovation and commercialisation in digital creative products. The incubator would provide both physical and virtual facilities and would offer both common user infrastructure and business support and commercialisation assistance. The incubator should leverage the research, education and training activities being undertaken within existing institutions. While the incubator should serve as a focal point for existing communities of practice within the WA creative digital economy, entry to the incubator should be contingent on the formation of a business venture with commercially valuable IP.

Establishment of a WA Digital Industries Fellowships Program

To further stimulate the linkage of local digital content industry communities with their equivalents in other countries, it is suggested that a **WA Digital Industries Fellowships (WADIF) Program** be established. Based on the example of the successful Churchill Fellowships scheme, the purpose of the WADIF Program would be to offer promising digital content originators the opportunity to travel abroad for a short study tour to learn about best practice within their particular field. The aim of the WADIF Program would be to expand the international profile of local digital content producers and enable them to benchmark their activities against world's best practice. Entry to the program would be competitive and based on the level of innovation demonstrated by the applicants.

Recommendation 7:

That a WA Digital Industries Fellowships Program be established with the purpose of expanding the international profile of local digital content producers and providing them with the opportunity to make short study tours to centres of best practice overseas. Applications would be competitive and evaluated on the level of innovation demonstrated by the candidate.

Investment in R&D and Commercialisation

A key finding within this study was the apparent lack of investment in the field of digital creative product from the perspective of both R&D and commercialisation. It is recognised that this is not a simple problem and that many of the concerns that were expressed by respondents from within the digital content industries are fairly typical of early stage ventures to be found throughout most other sectors of the local economy. Further, it is the considered view of this study that the key to solving the lack of available investment is to enhance the business and entrepreneurial skills of the sector. Despite the qualifications stated above, it is recommended that the Government investigate methods of encouraging private and government investment in research and development that is focused on the production of innovative creative digital IP.

Current State and Federal funding for innovation is generally based on criteria primarily developed for traditional scientific investigation, which excludes participants in the creative digital content industries who do not always meet the qualifying requirements. This is particularly the case for the Creative (A) communities who deal with IP that is largely protected by copyrights rather than patents. The weaknesses that have been noted earlier in this report over the treatment of IP by the sector have not assisted this case.

There is an opportunity for the State Government to develop a program designed to encourage R&D into innovative products that bring together participants from the Creative (A) and Creative (T) communities. A **WA Digital Industries Grants Program** should be targeted at collaborative research activities and designed to fill gaps in the existing grants schemes currently offered by the Federal and State Governments. The grants should also be targeted at commercialisation of IP rather than the generation of creative product.

A grants scheme of this kind should be linked into the Creative Digital Industries Incubator model outlined in **Recommendation 6** and should be available for supporting commercialisation strategies and business mentoring for developers of innovative digital content products, from an early stage of concept development. The concept would envisage an incremental program where developers are provided with increasing levels of resource provided they meet certain milestones. As stated, the grants would be designed to complement rather than replace programs such as the Federal Government's COMET scheme. They might be designed to provide very early stage seed funding prior to the development of a COMET application. At this stage we have not developed any firm views as to the size of such grants, but would feel that sums of up to $50,000 per applicant would be appropriate, given that COMET funding is in the range of $125,000.

Recommendation 8:

That a WA Digital Industries Grants Program be established with the purpose of providing early stage seed funding to local digital content producers and offering them business development and commercialisation support as a preparation for future applications to larger federal funding schemes. Such grants would be competitive and based on demonstrated innovation and commercialisation potential.

In addition to the provision of a **WA Digital Industries Grants Program**, it will be important for the WA Government to continue to facilitate the flow of inbound investment into the State with specific focus on investments targeting the digital industries. The existing process of in-bound investment tours, business migration attraction strategies and infrastructure investments (e.g. in broadband architecture) should be examined by the proposed **WA Office of the Digital Economy**, and facilitated via the respective **Cluster Development Task Forces.** Specific targets could be set with attention given to supporting digital content related projects of from $500,000 to $3 million. Attention should also be given via this process to working with supporting and related industries to alleviate potential problems with such things as infrastructure or skills development.

Part of this process of reviewing the investment environment for WA creative digital industries would be to re-assess the charter of ScreenWest with a view to facilitating investment in projects which may predominantly be produced for consumption on computers (and internet) or game consoles, but still require input from participants in the film & TV industry (e.g. script writers, cameramen, editors and sound engineers). This essentially would see the role of ScreenWest widen to recognise the convergence that is being driven within the industry by new technologies.

Recommendation 9:

That a WA Digital Industries investment strategy be prepared with the aim of configuring the existing range of investment activities coordinated by the State Government to specifically target the digital content sectors. This should include a review of the charter of ScreenWest to enable that agency to invest in creative digital content projects. This investment strategy should be coordinated via the proposed WA Office of the Digital Economy (see Recommendation 2), but with reference to the respective Digital Cluster Development Task Forces outlined in Recommendation 3.

Digital Content Industry Portals

As noted above, there is a need for enhanced promotion and marketing of the existing talent and capacity within the State in the field of digital content production. To assist the process of awareness raising and connecting otherwise disconnected communities it is recommended that the Government establish one or more internet portals that genuinely facilitate collaboration between different communities of practice. This study has found that the current digital content industries in WA are highly diverse and would not normally interact with each other. Most are engaged via established professional associations that were originally designed for other purposes and do not necessary feed into the process of innovation within the digital economy.

Many commercial portals do not actually facilitate true collaboration across a community and the government could play a valuable role providing the infrastructure and developing the software necessary for such a service. One of the major benefits of providing a genuine collaborative portal architecture would be that it facilitates increased regional contribution to the digital content community and provide a facility for local communities to promote the goods and services they provide to internal and external audiences. Feedback received from the industry workshops held for this study highlighted the need for micro-enterprises and sole traders to have more access to marketing opportunities. A portal architecture that enabled such individuals to register their existence and include a capabilities statement and portfolio of work would be most valuable to fostering new work and business venture opportunities. It would be important for such a portal to be viewed as secure and offering high levels of integrity. For this reason it is suggested that it be initially developed by the State Government but in conjunction with industry. This portal or portals architecture should be developed by the proposed Digital Cluster Development Task Forces (see Recommendation 3), but under the guidance of the propose WA Office of the Digital Economy (see Recommendation 2).

Recommendation 10:

That an Internet Portal Architecture be developed with the view to providing a focal point for communities of practice operating within the WA digital content industries. Such portals should make use of the latest portal technologies and offer both a secure and public site for the marketing and showcasing of local digital economy *communities, but also a focal point for ideas and information exchange among these communities. It is suggested that these portals (e.g. one focusing on the spatial and the other on the creative sectors), be coordinated via the proposed Digital Cluster Development Task Forces (see Recommendation 3) under the guidance of the proposed WA Office of the Digital Economy (see Recommendation 2).*

A Framework for Developing the WA Digital Content Sector

These recommendations should be viewed as comprising an integrated framework of mutual supporting elements that can serve to assist the long-term facilitation of the digital content industries in Western Australia. As illustrated in Figure 21 these ten recommendations comprise a central core of four strategic level initiatives designed to provide any future cluster development process with:

- **Leadership** – via the establishment of an Office of Digital Economy;
- **Strategic Vision** – as provided by a WA Digital Innovation Strategy;
- **Industry engagement** – as enabled by the Digital Cluster Development Task Forces; and
- **Public Awareness Raising** – as enabled by the proposed branding and marketing strategy focusing on WA State of Digital Innovation.

Surrounding these core strategic initiatives are the final six operational initiatives that provide a framework to support and sustain the longer-term growth of the digital industries in the state. These six initiatives are focused on addressing the needs, identified in this study, for:

- **Large scale projects** (REC 5) – able to stimulate increasing digital content production in the State.
- **Enhanced commercialisation support** (REC 6) – able to assist the creation and growth of new business ventures in the WA digital economy.
- **Enhanced international benchmarking** (REC 7) – to assist local industry actors to access best practice networks overseas;
- **Increased investment within the sector** (REC 8&9) – making early stage seed funding and longer-term business development venture financing more accessible to local firms in the WA digital economy; and
- **Enhanced local production networks** (REC 10) – assisting locally-based digital content producers to source skilled talent, identify local project partners and facilitate the flow of knowledge and creative ideas within the sector.

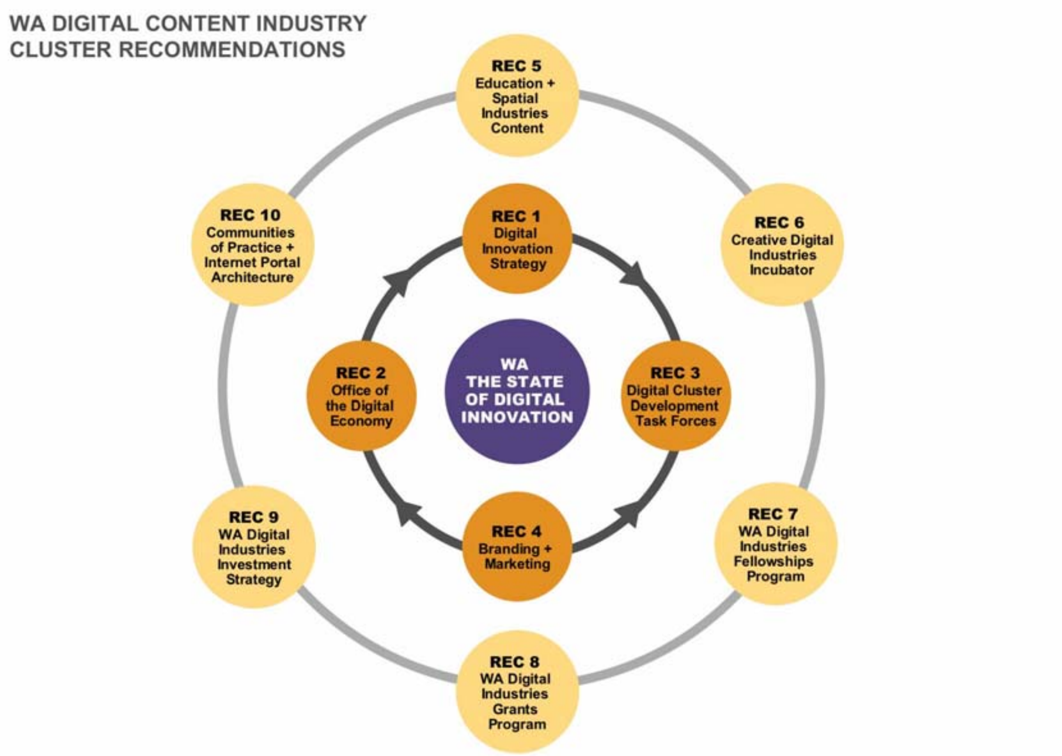

Figure 21: Framework the Digital Creative Industry Cluster

The Role of Government Agencies

This study has been undertaken on behalf of the Western Australian Departments of: i) Education and Training; ii) Industry and Resources and iii) Culture and the Arts. Each of these three Government agencies has a particular set of responsibilities within the framework outlined in this report. In the following sub-sections the role of each agency is discussed with respect each of the ten recommendations.

Department of Industry and Resources (DOIR)

The primary responsibility for the development of the State's digital innovation strategy should lie within the Department of Industry and Resources (DOIR), which will also house the Office of the Digital Economy. Both the Department of Education and Training (DET) and Department of Culture and the Arts (DCA) will have important contributions to make to this strategy development process, but cluster facilitation is related to industry enhancement. As noted above, the proposed WA Office of the Digital Economy should be located within DOIR and report through to that respective Minister. However, there should be representatives from other Government agencies, particularly DET and DCA seconded to the Office of the Digital Economy. DOIR should also be viewed as the logical lead agency for the branding and marketing strategy associated with the "WA State of Digital Innovation".

With respect to the two cluster development task forces, each will require a different mix of government agency representation. As noted earlier in this report, these Task Forces should be governed by Advisory Boards comprising representatives from both government and industry. It is considered appropriate for DOIR to have strong representation on the Spatial Industries Cluster Task Force, with equally strong involvement by the Department of Land Information (DLI). DOIR would also be the logical agency to take prime responsibility for the WA digital industries investment strategy as well as supporting DCA with the WA Digital Industries Grants Program.

Department of Culture and the Arts (DCA)

The primary responsibility for DCA within the proposed framework would be to support the work of the Digital Creative Industries Cluster Task Force and the WA Digital Industries Fellowships Program in conjunction with DOIR and DET. The creation of Digital Communities of Practice and the associated portal strategy would also seem to be a prime responsibility for DCA. This agency will also collaborate with DET and DOIR over the Creative Digital Industries Incubator.

Department of Education and Training (DET)

The primary responsibility for DET will be to develop and coordinate an education and training strategy to support the framework. Working through the two cluster development task forces and the Office of the Digital Economy, DET will be well placed to support the incubator program and the portals and communities of practice initiatives suggested within the framework.

However, the key role for DET should be the development of an education and training strategy to form part of the wider Digital Innovation Strategy. This should be designed around three tiers or levels:

1. Schools-based programs in the digital economy – the aim of any future school-based program should be to bridge the digital divide that has emerged within recent decades. Future employment and career path development will depend increasingly on the ability to possess skills and understanding of the production and use of digital content. A potential way to handle this would be to create a K-12 Curriculum for the Digital Economy that focuses on both end user awareness of the technology and production. This must include resources for teacher in-service training in the technology and hardware/software infrastructure to allow children to learn how to create websites, multimedia productions and related projects. Such learning should articulate into post-secondary education opportunities. While the final details of this strategy should be determined by DET working via the proposed Office of the Digital Economy and the respective Cluster Development Task Forces, selected high schools could be developed as digital learning hubs that concentrate teaching and infrastructure and feed into a network of other secondary and primary schools.

2. Post-Secondary training and education within the VET/TAFE and university sectors is already well-advanced although DET could provide leadership and support for fostering a breaking down of the professional and technical barriers that currently exist between different elements within the post-

secondary education and training system. Of particular importance is the need to draw together the technical and creative communities within the education and training sectors that are currently separated into their respective disciplines. The development of major projects that require multi-disciplinary collaboration – such as outlined earlier in this report – would be a potential way to address this.

3. **Professional and continuing education** – the need for enhanced professional development of the producers and future entrepreneurial directors of WA digital content industries has been identified in this study. Such education is not easily obtained via conventional education and training programs. What is required are more project-based, training and mentoring programs that allow the professional development of future producers and directors of creative digital content projects to enhance their skills and expertise. Support should be provided to appropriate courses such as those run currently by the Australian Film, Television and Radio School (AFTRS) and organisations of this kind. Such programs would ideally be linked into a future incubator program as part of the education process that is critically important for such entities.

To summarise the relationship between the recommendations and the role of these Government agencies:

Table 13: Relationship between Recommendations and Role of Government Agencies

Recommendation 1: Digital Innovation Strategy	DOIR plus DCA/DET
Recommendation 2: Office of the Digital Economy	DOIR
Recommendation 3: Digital Cluster Development Task Forces Spatial Industries Cluster Digital Creative Industries Cluster	 DOIR/DLI DET/DCA
Recommendation 4: Branding & Marketing	DOIR
Recommendation 5: Major projects Creative Digital education content Spatial industries projects	 DET/DCA DOIR/DLI
Recommendation 6: Creative Digital Industries Incubator	DCA/DET
Recommendation 7: Digital Industries Fellowships	DCA/DET
Recommendation 8: Digital Industries Grants	DCA/DOIR
Recommendation 9: Digital Industries Investment Strategy	DOIR
Recommendation 10: Communities of Practice & Internet Portal Architecture	DCA/DET

Conclusions

It is the conclusion of this study that the future development of a significant digital content industry in Western Australia based on two potential clusters (e.g. spatial and creative digital) is possible. As shown in this report, WA has existing industry and employment concentrations and sufficient business network activity to form the foundation for such clusters. However, industry clusters cannot be built within a short to medium term timeframe and they will require leadership, shared vision and significant investment in common user infrastructure. There is a significant opportunity for WA to become a significant player in the digital economy, but any sustainable clusters must be constructed on strong commercial foundations.

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APPENDIX A

WA and Perth digital content industries at Yellow Pages® level 5 and their associated business concentration ratios

Industry Category	WA in comparison to Aust		Perth in comparison to Aust capital cities	
	1999	2002	1999	2002
Medical Equipment &/or Repairs	0.88	0.84	1.03	0.90
Desktop Publishing Services	0.79	0.90	0.69	0.72
Pre-Press Production Services	0.43	0.43	0.65	0.61
Directories	1.24	1.04	1.85	1.53
Publishers Book	0.91	0.89	1.25	1.17
Newspapers Business	0.38	0.45	1.17	0.98
Newspapers Rural	1.01	1.25	0.80	1.59
Newspapers Religious	0.65	0.65	0.66	0.61
Newspapers Sporting	0.61	0.57	0.70	0.61
Newspapers General	0.94	0.87	1.07	0.92
Publishers Music	0.43	0.41	0.29	0.26
Data Preparation &/or Processing Services	0.65	0.64	0.55	0.49
Multimedia Services	0.89	0.91	0.82	0.78
Advertising Agencies	0.83	0.91	0.87	0.89
Libraries Photograph &/or Film	0.85	0.78	0.97	0.84
Artists Commercial	0.70	0.77	0.84	0.89
Designers Graphic	0.77	0.82	0.88	0.82
Media Information &/or Services	0.74	0.76	1.01	0.90
Training Films & Videos	1.19	1.01	1.65	1.22
Medical Research	1.28	1.22	1.42	1.22
House Planning Services	0.77	1.27	0.96	1.64
Drafting Services	1.22	1.49	1.31	1.50
Architects	0.86	0.86	0.90	0.84
Landscape Architects	0.79	0.97	0.85	0.99
Mining Engineers	2.60	2.89	2.97	3.25
Naval Architects	1.81	2.09	2.04	2.18
Chemical Engineers	1.38	1.30	1.34	1.21
Civil Engineers	0.99	1.21	1.05	1.24
Electronic Engineers	1.18	1.27	1.25	1.28
Designing Engineers	1.57	1.94	1.49	1.66
Combustion Engineers	1.23	1.20	1.80	1.64
Electrical Engineers	1.18	1.45	1.21	1.29
Structural Engineers	0.51	0.70	0.59	0.74
Marine Engineers	1.47	1.95	1.59	2.11
Designers Product & Industrial	1.09	1.05	0.99	0.81
Maps &/or Mapping	2.34	2.22	2.38	2.23
Sound Engineers	0.95	1.21	1.06	1.33
Photography &/or Video Schools	0.77	0.57	0.00	0.00
Radio & Television Schools	0.98	1.01	0.53	0.46

Universities & Tertiary Education Colleges	0.91	0.70	1.04	0.66
Technical & Trades Colleges	1.75	1.32	1.93	1.15
TAFE Colleges	5.14	2.16	4.66	1.90
Music Arrangers & Composers	0.70	0.75	0.73	0.74
Writers, Consultants &/or Services	0.73	0.82	0.87	0.93
Illustrators	1.11	1.19	1.12	1.13
Cartoonists & Caricaturists	0.67	0.67	0.83	0.91
Musicians &/or Musicians' Agents	0.90	1.10	0.83	0.94
Recording Services	0.72	0.79	0.78	0.82
Film Production Services	0.57	0.54	0.64	0.60
Film Production Facilities & Equipment	0.47	0.46	0.56	0.53
Theatres & Theatre Companies			1.60	1.49
Television Stations	1.36	1.17	1.67	1.37
Television Programme Producers &/or Distributors	0.53	0.53	0.78	0.68
Slides &/or Film Strips	0.63	0.67	0.50	0.50
Photographic Processing Services Professional	0.74	0.79	0.80	0.76
Photographers Scientific	0.25	0.25	0.34	0.37
Photographers Commercial & Industrial	0.95	1.09	0.98	1.11
Photograph Restorations & Retouching	1.18	1.42	1.25	1.34
Compact Discs, Records & Tapes W'salers & Mfrs	0.94	0.86	0.86	0.72
Total Digital Content	**0.93**	**0.99**	**1.00**	**0.99**

WA and Perth digital content industries at ANZSIC level 4 and their associated employment concentration ratios

Industry Category	WA in comparison to Aust	Perth in comparison to Aust capital cities
Services to Printing	0.81	0.76
Newspaper Printing or Publishing	1.04	1.11
Book and Other Publishing	0.39	0.35
Recorded Media Manufacturing and Publishing	0.34	0.31
Medical and Surgical Equipment Manufacturing	0.92	0.87
Wholesaling, nec	0.85	0.82
Scientific Research	0.93	0.82
Architectural Services	1.01	0.98
Surveying Services	1.75	1.81
Consulting Engineering Services	1.61	1.60
Technical Services, nec	1.64	1.57
Data Processing Services	0.21	0.18
Information Storage and Retrieval Services	0.64	0.72
Advertising Services	0.81	0.74
Commercial Art and Display Services	0.89	0.85
Business Services, nec	0.85	0.83
Combined Primary and Secondary Education	1.25	1.17
Higher Education	1.03	1.12
Technical and Further Education	1.07	1.10
Other Education	0.96	1.00
Film and Video Production	0.52	0.47
Motion Picture Exhibition	0.93	0.97
Television Services	0.52	0.52
Music and Theatre Productions	0.84	0.81
Creative Arts	0.84	0.83
Sound Recording Studios	0.82	0.81
Photographic Film Processing	0.97	1.00
Photographic Studios	0.89	0.94
Total Digital Content	**1.01**	**1.00**

APPENDIX B

Classification of digital content industries into seven industry categories

Yellow Pages® level 5	Creative Industries	Construction Industries	Engineering Industries	Education & Training Industries	Media Industries	Me
Medical Equipment &/or Repairs						
Desktop Publishing Services	*					
Pre-Press Production Services					*	
Directories					*	
Publishers Book					*	
Newspapers Business					*	
Newspapers Rural					*	
Newspapers Religious					*	
Newspapers Sporting					*	
Newspapers General					*	
Publishers Music					*	
Data Preparation &/or Processing Services					*	
Multimedia Services	*					
Advertising Agencies	*					
Libraries Photograph &/or Film					*	
Artists Commercial	*					
Designers Graphic	*					
Media Information &/or Services					*	
Training Films & Videos	*					
Medical Research						
House Planning Services		*				
Drafting Services		*				

Continued over page:

Yellow Pages® level 5	Creative Industries	Construction Industries	Engineering Industries	Education & Training Industries	Media Industries	Me
Architects		*				
Landscape Architects		*				
Mining Engineers			*			
Naval Architects			*			
Chemical Engineers			*			
Civil Engineers		*				
Electronic Engineers			*			
Designing Engineers			*			
Combustion Engineers			*			
Electrical Engineers			*			
Structural Engineers		*				

Marine Engineers			*			
Designers Product & Industrial	*					
Maps &/or Mapping						
Sound Engineers	*					
Photography &/or Video Schools	*					
Radio & Television Schools				*		
Universities & Tertiary Education Colleges				*		
Technical & Trades Colleges				*		
TAFE Colleges				*		
Music Arrangers & Composers	*					
Writers, Consultants &/or Services	*					
Illustrators	*					
Cartoonists & Caricaturists	*					
Musicians &/or Musicians' Agents	*					
Recording Services	*					

Continued over page:

Yellow Pages® level 5	Creative Industries	Construction Industries	Engineering Industries	Education & Training Industries	Media Industries	Me
Film Production Services	*					
Film Production Facilities & Equipment	*					
Theatres & Theatre Companies					*	
Television Stations					*	
Television Programme Producers &/or Distributors					*	
Slides &/or Film Strips					*	
Photographic Processing Services Professional					*	
Photographers Scientific	*					
Photographers Commercial & Industrial	*					
Photograph Restorations & Retouching					*	
Compact Discs, Records & Tapes W'salers & Mfrs						