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Abstract

Graphic Design is one part of the producer services sector of the modern metropolitan region. It is a sector that has experienced considerable development in terms of number of firms through demand created by the expansion of advertising and multi media. To date research has established that producer services, particularly finance related ones, agglomerate in the central city to take advantage of the agglomeration economies available in large metropolitan areas. This thesis argues that one of the key factors for the agglomeration of graphic design is the need for face-to-face communication with clients and other firms. There has been some work undertaken looking at the location of non-finance producer services, such as design, although these have been presented as snapshots at a point in time.

This thesis extends this understanding through an analysis of agglomerations of graphic design firms over a twenty year time horizon. Using details of firm location in Melbourne every five years from 1981 to 2001 the thesis uses a geospatial analytical technique to identify agglomerations and explores the change in the size, location and density of agglomerations of firms. This research shows that the initial agglomeration of 1981 was still present by 2001 and had been joined by a number of new agglomerations ringing the Melbourne CBD while at the same time there has also been a dispersal of firms to the middle suburbs. In order to provide some insight in to the agglomeration of graphic design firms this research also examines the geography of two industries allied to graphic design: advertising and printing.
This research shows that graphic designers and advertising agencies tend to locate in similar parts of inner Melbourne which may be due to the need for face-to-face contact between firms in these two industries. On the other hand, printers have become dispersed across the middle suburbs over the last 20 years. This could indicate that graphic designers communicate with this industry using means other than face-to-face contact.
Declaration

This is to certify that

(i) the thesis comprises only my original work towards the degree of Master of Planning and Design except where indicated in the preface,

(ii) due acknowledgement has been made in the text to all other material used,

(iii) the thesis is 30,000 words in length, exclusive of tables, maps, bibliographies and appendices.

Signed

Peter Vincent Elliott

/ /2005
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I have been assisted on this journey by a number of people who, without their help, this thesis would never have been finished.

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And finally thanks to my daughter Anika whose arrival spurred me to finish this thesis so I could spend more time with her.

While I have received much assistance, this work is mine and mine alone, any errors are solely my responsibility.
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Chapter 1

Introduction

The roles of cities and the distribution of uses within them has changed over time as, Lewis Mumford’s (1966) classic work “The City in History” has shown. Dramatic changes in the economies of developed nations particularly the movement of manufacturing firms offshore, the rise of the service sector and the development of the internet have maintained that process of change in recent years. These changes have a spatial dimension that are reflected in the economic development of cities.

This thesis is an examination of one small part of these changes. It looks at the location, particularly the agglomeration, of a producer service in a metropolitan setting over 20 years. The research uses graphic design and metropolitan Melbourne as its case study.

The agglomeration of firms is not a new phenomenon in economic geography although much interest in this phenomenon has been focused on manufacturing firms. This research uses producer services firms to explore the degree of concentration or agglomeration and how it evolves over time.

Pitted against the idea of agglomeration is the notion that with the development of Information and Communication Technologies (ICT),
particularly the internet, the need for people or businesses to be located near one another, or even within the same metropolitan area, has been greatly diminished. This thesis argues that while ICT has and is changing the ways businesses communicate and do business it is not the only or most important form of communication. It is proposed that face-to-face communication is still of great importance for some forms of information exchange or decision making that cannot be replicated by the use of ICT.

It is this need to communicate on a face-to-face basis that is a key determinate for the location of advanced producer services. Face-to-face communication has a spatial manifestation; the concentration or agglomeration of firms.

To this end the specific aims of the research are:

- Do agglomerations of a design intensive producer service exist in metropolitan Melbourne?

- How do these agglomerations change geographically over time?

In order to explore these questions, the following research uses the actual location of graphic design firms coupled with a spatial analytical technique to produce maps of agglomerations of firms. Repeating the process over a twenty year time period from 1981 to 2001 makes it possible to see any change that may have occurred to the agglomerations.
Structure of the thesis

This thesis is broken up into eight chapters, including the introduction. The next chapter provides the intellectual justification for this work. A review of the relevant literature shows that there is a significant argument, based on the need for face-to-face communication, for the agglomeration of producer services firms. There is some empirical evidence to back this up although much of it is concerned with firms in the finance sector located with the Central Business Districts of cities. There have been very few studies looking at the distribution of producer services in other sectors of the economy, such as advertising, design etc, or using the actual location of firms as opposed to using data provided on established statistical boundaries. From this review it was found that that a gap exists to examine a non-finance producer services, and explore a time series of actual firm locations. The third chapter is an explanation of how the data for graphic design firms over a twenty year time period was generated as well as a description of the nearest neighbour hierarchical clustering spatial statistical technique used to identify agglomerations of graphic design firms in metropolitan Melbourne. This chapter also provides a discussion and justification of the settings used to identify the agglomerations. Chapter four defines graphic design as both an occupation and industry and demonstrates that it is a producer service. This chapter also sketches out the characteristics of the industry and highlights the significance of metropolitan Melbourne as a location for graphic design. This chapter also provides a basic geography of graphic design firms within the metropolitan area. The fifth chapter commences the analysis of the
agglomerations of graphic design firms by providing an analysis of the spatial characteristics of the agglomerations for 2001, such as the location, size, density and land use zoning characteristics. The sixth chapter extends this analysis by providing a time series analysis for 1981, 1986, 1991, 1996 and 2001 and comments on the conception, growth and change of the agglomerations. This chapter also examines three of the agglomerations in detail to discuss their evolution and differences between the agglomerations. Chapter seven looks at the location of two allied industries, advertising and printing, to provide some insight into the reasons for the agglomeration of graphic design firms. The eighth chapter links the results of this research with the literature and makes suggestions to further this work and to strengthen its explanatory value.
Chapter 2

The Intellectual Heritage and Argument for the Agglomeration of Graphic Design Firms

The agglomeration of firms has been of interest to geographers, economists and economic development agencies for some time. Much of this work is concerned with the agglomeration of manufacturing firms although as Scott (1988) pointed out there are compelling reasons for other types of firms to agglomerate.

This chapter introduces the idea of agglomeration initially by exploring the work on industrial districts. While there has been a significant amount of work two things become clear. First there is no agreed single concept or terminology to describe the agglomeration of manufacturing firms. Second the inputs and products of manufacturing are significantly different to producer services. The next section explores the characteristics of producer services in order to clearly define the subject of study. A key feature of many producer services is that their products, unlike manufacturing or consumer services, are virtually weightless, ie electronic information, and can be delivered remotely using information and communication technologies such as the internet and email, this is the crux of the weightless economy thesis. While it is not disputed that ICT has and is still changing the way business is done the next section questions the over reliance this position places on electronic
communication as the primary source of business communication with the consequence of negating the impact of geography. This section will argue that face-to-face communication is of primary importance and the spatial outcome of this is for firms to agglomerate. The final section looks at empirical research undertaken into the location of advanced producer services and finds there is a gap in the literature regarding both the statistical identification of agglomerations of producer services and how the location of firms changes over time. These issues have been used to develop the research questions which are introduced in the final section.

Clusters, Industrial Districts and other terms

Since the mid 1980s there has been a large volume of material describing and explaining the location of innovative manufacturing sectors in particular locations such as computer manufacture along Route 128 in Massachusetts and Silicon Valley, California and textiles in Emilia-Romagna, Italy. This is further evidenced by the large number of articles published within the disciplines of geography and economics as well as special editions of *Regional Studies*, *Urban Studies* and the *Cambridge Journal of Economics* dealing with the clusters of industries, industrial districts, networks and milieux.

The term “industrial district” was coined by Marshall (1920) in the nineteenth century to explain the grouping of particular industries in specific areas. For
Marshall the location of firms depends upon access to both physical factors, such as raw materials and labour, as well as a social component, such as information. While Marshall’s work leans heavily on the physical factors, there are also two very important social factors that give firms within industrial districts distinct advantages. The first is the idea of tacit learning by workers within the industry where,

“...the mysteries of the trade become no mysteries; but are as it were in the air and children learn many of them unconsciously.” (1920: IV.X.7)

The second social factor is the dissemination of new ideas within an industrial district where

“...good work is rightly appreciated, inventions and improvements in machinery, in process and the general organization of the business have their merits promptly discussed” (1920: IV.X.7)

Here is the notion of people discussing not only new technology and innovation but also business conditions and market intelligence. These activities require proximity of people to one another as well as a long established history of work within a particular industry. However, there is little notion of geographic scale as Marshall uses terms such as “near neighbourhood” (1920: IV.X.7) and “congregate in the outskirts of large towns” (1920: IV.X.11).

Contemporary work on industrial districts is underpinned by the notion of a social division of labour described by Scott (1988). Scott argues that in some industries there has been a fundamental change in the way production is
carried out particularly in artisan/design intensive industries, high technology industries and producer services. It is a transformation from mass production techniques, also called fordist production, to the fragmentation of production into firms specialising in particular parts of a process, or post-fordist production, that has stimulated agglomeration in some sectors.

This post-Fordist production system has developed as a response on the part of firms to ameliorate the risk of being locked into a redundant technology or organisation of labour by purchasing goods and services from other firms rather than producing all inputs themselves. In turn, this division of labour means there are benefits to firms interacting intensively with other firms in order to obtain these inputs. However there is a risk with these transactions such as transport, sourcing the appropriate inputs, transferring knowledge as well as transactions involving an element of tacit knowledge or trust. The risks and cost associated with these transactions can be lowered by regular contact between client and supplier which is facilitated by proximity to one another (Scott 1988).

The ideas outlined above are a small part of the material examining the agglomeration of manufacturing firms, however, less attention has been paid to agglomerations of producer services firms other than to observe concentrations in Central Business Districts. Scott suggests producer services as one of the sectors that would be expected to agglomerate. This research will apply a technique to identify agglomerations of firms to test the notion that producer services firms agglomerate.
Researching Producer Services

It has been recognised since the 1980s that services have been of increasing importance to the developed economies in both terms of employment and generating wealth, ie increasing Gross Domestic Product (Dicken 1992). The term “service industries” encompasses a wide range of economic activities. These activities range from low value added and low paid personal services, such as hamburger making, to high value and high paid producer services, such as an expert in intellectual property law.

From the discussion above it can be seen that service industries as an umbrella term includes a wide range of different industries. A range of classifications produced to further define the service industries have been developed by government agencies, such as the Australian and New Zealand Standard Industry Classification developed by the Australian Bureau of Statistics and Statistics New Zealand. Academic commentators have developed other frameworks to describe the nature and impact of services (Martinelli 1991; Bryson et al 2004).

At its most basic services can be divided into 3 broad categories. First there are services that are provided to final consumers (ie the general public). These services include such things as entertainment services and retail services. Second are services that are inputs into another product such as industrial design services for car manufacturers or graphic design services for advertising campaigns. These are labelled producer services. Third, there
are mixed services that provide services to both final consumers and other businesses. For example the Finance, Insurance and Real Estate sector provide services to final consumers in the form of personal banking, home insurance and residential real estate services while also meeting the needs of businesses for complex financial dealings such as public offerings of shares, underwriting insurance and other complex transactions.

Returning to producer services, Sassen has described producer services as

“... services produced for organizations, whether private sector firms or governmental entities, rather than for final consumers; that is to say, producer services are intermediate outputs.” (2001: 91)

Using this definition, producer services firms provide inputs to other firms and are not sold directly to consumers. Good examples of producer services are industrial design, graphic design, advertising and market research to name a few.

Another key facet of producer services is they produce a specialised product embodied with some component of knowledge, judgement, skill or aesthetic element. Often the output of producer services can be packaged electronically or can be transported easily such as a piece of computer code or a set of drawings. The ability to deliver their products at a distance by telecommunication systems enables firms to have a high degree of freedom in their choice of location.
The market for producer services firms is complex as their markets can be located across a metropolitan area, state, country or even internationally (Sassen 2001). Hence producer services research has to deal with the tension between two sets of ideas, the weightless economy and its potential dispersal of firms on one hand and the concentration and agglomeration of firms on the other.

**The weightless economy thesis.**

With the increase in the range and availability of Information and Communication Technologies (ICT) a small number of writers have proposed that space, distance and geography are no longer impediments that limit economic development. Proponents of this idea have their own phrase to describe it, such as “the death of distance” (Cairncross 1998) or the “weightless economy” (Quah 1996). The term “weightless economy”, best sums up the concept of a production system that describes weightless or near weightless products.

The basic argument of the weightless economy thesis is that many nations are moving towards a situation where their wealth can be generated by exchanging ideas and data, such as the implications of stock market selling prices or a strategic analysis of the impact of increase in oil prices. In this scenario the means of producing more data and information is a powerful source of production. This type of product is dematerialised in the sense that
it exists as digital information stored on servers or some other form of storage material. In effect these products have no weight and can easily be transported from one location to another by means of communication technologies.

Information and communication technologies range from now very common and basic services such as phone and fax to more recent and sophisticated technologies such as mobile phones, short message service (SMS) and internet technologies, such as email and information searching. Figure 2.1 shows the rapid grow in the internet since the lifting of restrictions on the commercial use of the internet and the release of Hyper-Text Markup Language (HTML) in 1991 (Mowery and Simcoe 2002) and the release of the first pieces of browser software in 1993 (Mosaic) and 1994 (Netscape Navigator) (Bryson et al 2004).
Figure 2.1  Number of internet hosts, world, 1991 to 2005.

The internet is used for a myriad of business and consumer uses such as ordering goods and services (both digital and physical products), exchanging information or arranging meetings by email and securing electronic funds transfers and banking services to name a few. Internet technologies, with their global reach, high speed and flexibility enable people and businesses to access a range of services and goods from one location that would have previously been impractical or impossible. This new accessibility and mobility is central to the creation of new patterns of production in a weightless economy (Quah 1996).

The weightless character of these products and their ease of transport via the internet has led one proponent of this thesis to comment “…markets are no longer local or national, but instantaneously universal.” and “…the natural
marketplace for dematerialised objects is essentially unbounded." (Quah 1996: 9). These two quotes suggest that the limiting role that geography played in the transportation of traditional products, that is the cost of transporting raw materials and finished goods, no longer applies and, at its most extreme, predicts the “end of geography” (Cairncross 1996). Furthermore, Torre and Rallet (2005) comment that the location of firms in cities is now not necessarily based on direct functional relations between firms, but rather relies on ready access to common goods such as highways and airports.

Proponents of the weightless economy point out that large, geographically dispersed corporations operate successfully as they exploit closeness in corporate structure rather than geographical proximity (Quah 1996; Torre and Rallet 2005). Torre and Rallet (2005) place particular emphasis on formal corporate rules and advanced information and communication technologies as the drivers of success for these large firms. Where geographic proximity is required, such as negotiating new projects or developing organisational guidelines and frameworks, these can be fulfilled in a temporary manner by meetings.

There is no doubt that advances in information and communication technologies have changed, and are still changing, the way businesses and people undertake their activities and interactions. However the weightless economy thesis over-plays the role of information and communication technologies at the exclusion of other means of communication such as face-
to-face interaction. There are three flaws in the way the weightless economy thesis exaggerates the use of information and communication technologies. These flaws are the way in which information is structured and used, the uneven access to the internet and the assumption that virtual communications will replace face-to-face interaction. These flaws have serious consequences for the weightless economy’s diminution of geographical space. Each of these themes will be examined below.

The weightless economy thesis tends to view information as freely transferable, subject to purchasing access to information, and understandable to any recipient. However it has long been recognized that there are two broad types of information: one is standardized information, which is structured and easily obtained. Data contained within databases where there are specified fields and variables are an example of this type of information. For instance the number of housing approvals in Australian cities published by the Australian Bureau of Statistics is freely available (at a nominal cost) and can be understood by all users. The other type of information is non-standard information (Sassen 2001) or tacit knowledge which is made up of rules, codes of behaviour, judgment, skill, experience that cannot be codified or easily replicated (Howells 2002; Gertler 2003). The non-standard information is a complex mixture of standardised data, information, rules, mores and judgment stored in people’s heads that cannot be reproduced in a database. So non-standardised information has elements that are both technical and tacit. The tacit element relies on social networks made up of people with specific knowledge. The recognition that some information is made up of
complex non-standard information reinforces the likelihood that producer services will concentrate in places where their social networks can be organised (Sassen 2001).

The weightless economy thesis also rests on the assumption that use of and access to infrastructure that supports ICT, such as fibre optic networks, is free and unencumbered. However access to ICT is not evenly distributed across space. Within cities there are areas with high levels of accessibility to ICT infrastructure while other areas are relatively devoid of this infrastructure (Walcott and Wheeler 2001). An example of the uneven distribution of communication networks can be seen in New York (Figure 2.2) where optic fibre routes (the red, orange and yellow lines) are highly concentrated in the business areas such as Mid Town and the Financial District while in Brooklyn, Queens and Harlem there are few optic fibre routes. This outcome is based on the capacity of consumers to pay for access or the propensity on the part of telecommunication companies to supply areas where there will be a high degree of use and a return on their investment (Graham 2002). The location of optic fibre infrastructure has a marked effect on the location patterns of industries that require access to high speed and high capacity infrastructure and so firms relying on information transfer can be expected to agglomerate where this infrastructure is most readily available (Walcott and Wheeler 2001).
The weightless economy thesis has also been criticised for being too technologically deterministic by suggesting that many face-to-face interactions that would have taken place prior to the introduction of ICT are now replaced by electronic means (Pratt 1996). The weightless economy thesis places too great an emphasis on ICT and does not really take into account the range of ways people and businesses meet their requirements for information. There is empirical evidence that information and communication technologies actually facilitate face-to-face communications rather than replace them (Goddard 1975; Hall 1998; Pratt 2002; Hall 2003).
From the discussion above it can be seen that the relationship between users and information and communication technologies is complex and not as simple as the proponents of the weightless economy make it appear. This throws into question their assertion that the power of geography to shape the location of information-based activity has been negated.

Geographers have been investigating the geography of producer services since the early 1980s, although some work was undertaken earlier than this, particularly Goddard’s (1975) examination of office work in London. There are a number of streams within this work (Coffey 2000) although two are of interest for the current research. The first area examines the reasons producer services firms have for requiring proximity to each other. The second body of work is concerned with the actual geography and resulting patterns of distribution of producer services within metropolitan areas. These two areas will be examined in detail below.

**The business requirements of producer services firms**

While the output of some producer services exhibit the characteristics of a weightless product, there are elements of their production process that are enhanced by spatial proximity to their clients and other producer services firms. (Sassen 2000). In short it is the process of creating outputs, not necessarily the transport of the products themselves, that promotes the agglomeration of producer services firms in cities. These agglomeration
factors include traditional elements such as access to infrastructure and a skilled workforce as well as to less tangible elements such as the amenity of a city, its reputation and, most importantly, face-to-face communication. These factors are discussed in detail below.

Producer services firms require access to high speed information infrastructure to collect and disseminate some forms of information. As discussed above, access to this type of infrastructure is geographically constrained and tends to be found in the central business district of cities such as Atlanta (Walcott and Wheeler 2001) and the Financial District and Mid Town areas in New York (TeleGeography 2004).

Producer services require access to a skilled workforce (Scott 1999), such as designers, software engineers, marketing professionals among many other occupations. This type of worker is attracted to places based not solely on the location of work but also places that have high amenity (Sassen 2001), creative and diverse cultures, within both the work and social environments (Florida 2002). These lifestyle elements are distributed unevenly and tend to be concentrated in some cities more than others (Sassen 2001; Florida 2002).

The types and quality of outputs created by producer services are difficult to measure. One indication of the quality of products can be related to the general reputation of a particular place (Clark 2002). In order to be recognised an important player in a particular industry, firms need to be located in a particular space. This branding of space is illustrated by one of
the respondents from Cook et al (2003: 6) saying “…we have an ambition to be an international bank and you can’t be an international bank unless you have something in London.”. This illustrates the branding of space and the reputation associated with that brand is a factor in the agglomeration of producer services firms.

The factors discussed above are important for the agglomeration of producer services, however there is a key theme that runs through the producer services literature that plays a central role in the agglomeration of these firms; the importance of face-to-face contact (Coffey 1996; Scott 1999; Pratt 2000; Sassen 2000; Sassen 2001; Coffey and Shearmur 2002; Pratt 2002; Cook et al 2003; Pratt 2004). Face-to-face communication provides a range of advantages that cannot be replicated and replaced by electronic means of communication.

First, the production process of producer services requires a number of inputs from a variety of suppliers. Some of this information is structured information that can be freely exchanged and is the same for each user of the information. However some inputs are not as easily used as standard codified information, some inputs are dependant on non-standard information or tacit knowledge which, as described above, cannot be easily communicated in a codified form. For instance a stop sign is a codified message that has one specific meaning and this meaning does not change from interaction to interaction. On the other hand a relatively simple verbal message, such “I love you”, is a complex interactive message intertwined with the history, trust and understanding of
the people communicating, often communicating simultaneously (Leamer and Storper 2001). In this case the words “I love you” could be used to specify a close bond between friends, a statement of feelings in the hope of the feelings being returned or said in jest based on the context of the interaction. In business, complex non-standard information is exchanged, the content of the message is laden with unwritten and context dependant meaning which necessitates the use of face-to-face communication (Coffey and Shearmur 2002).

Second, face-to-face communication provides participants with a range of different levels of communication, principally verbal, as well as more subtle communication such as tone of voice, body language, visual cues. These subtle forms of communication enable participants to make judgements about not only understanding what is being said but also deciding to believe it or not. This element of believability or trust is communicated through these subtle channels of communication (Storper and Venables 2004; Coffey and Shearmur 2002). These subtle channels of communication cannot be replicated by a disembodied voice during a telephone conversation or an email message (Goodchild 2001; Leamer and Storper 2001).

Third, face-to-face communication enables simultaneous communication and instant feedback. This enables people to respond to each other, ask for points of clarification and build on a common understanding in an instantaneous way (Storper and Venables 2004). Simultaneous communication provides participants flexibility to alter and change their
message to add understanding and agreement. Furthermore feedback can also contribute to learning on the part of participants. Face-to-face communication during the production process can be a rich source of creativity and innovation as clients and suppliers build on each others ideas (Scott 1999; Coffey and Shearmur 2002). While on-line tools such as messenger software and video conferencing provide instant electronic feedback this is cannot not replicate the instantaneous verbal feedback and non verbal cues that take place in face-to-face contact (Pratt 2002).

The use of face-to-face communication requires a great deal of time which includes planning meetings, preparation, travel time to and from the meeting place as well as the time spent in a meeting. Face-to-face communication is a time intensive exercise (Coffey and Shearmur 2002). The time intensive nature of face-to-face communication promotes producer services firms to locate close to one another in order to minimise the time spent outside of meetings such as the time required to travel from office to meeting and from meeting to meeting. In addition to reducing time devoted to formal meetings, spatial proximity enables chance encounters to occur and the informal exchange of information, such as market conditions or employment opportunities, at professional networking functions, over lunch or coffee (Pratt 2000; Leamer and Storper 2001; Powell et al 2002, Pratt 2002; Pratt 2004). Face-to-face communication and spatial proximity are important for the production process of producer services firms, however, it is not the exclusive method firms use for communication. As noted above, the work of these firms involves a number of inputs, some of which will only be available through
face-to-face contact or a combination of face-to-face contact and electronic communication and some exclusively electronic communication. Firms require some flexibility with their communication, however, face-to-face communication is a resource intensive activity that is also spatially bound. It is the spatial nature of face-to-face communication that encourages firms, particularly producer services firms, to agglomerate in specific locations.

From the discussion above it can be seen that there is substantial argument for the agglomeration of producer services firms. The next section will examine the results of empirical research into the actual geography of producer services firms and employment in a range of metropolitan areas to test this proposition.

The geography of producer services

At a global level Sassen (2001) identified the metropolitan areas of New York, London and Tokyo as centres of global finance and the producer services required to support these functions. The metropolitan areas of New York, London and Tokyo are very large areas in themselves and this analysis does not drill down into the metropolitan area to examine the detailed geography of producer services. The sub-metropolitan location of producer services firms can provide some insight into the importance of face-to-face contact for producer services firms. If firms do not require intensive face-to-face contact with other firms or clients then firms can be located anywhere across a
metropolitan area, or even its hinterland. On the other hand if firms depend upon regular face-to-face communication then firms would locate close to one another in order minimise the cost of time spent on programmed interaction (eg meetings) and enhance the potential for unexpected and unprogrammed interaction (eg the chance meeting in the pub). It is this intra-metropolitan analysis that provides some insight into the importance of face-to-face contact to producer services firms.

Recent research has been carried out looking at the distribution of producer services at the sub-metropolitan level. This research can be categorised into two streams. The first group of papers examine the location of producer services within a metropolitan area using broad geographic units. The second stream of research uses the actual location of producer services firms within a metropolitan area to identify concentrations of activity.

The first series of papers describe the intra-metropolitan location of producer services of Sydney (Searle 1998), Montreal (Coffey and Shearmur 2002) and Paris (Shearman and Alvergne 2002; Guillain et al 2004). These studies use data based on predetermined boundaries and use a similar set of industry sectors including finance, insurance, real estate, management consulting, market research and accounting. There are some differences between the studies in the exact industries studied, however they include the same type of high order producer services, with the exception of the work on Sydney which also includes graphic designers. These studies show that in Sydney, Paris and Montreal there is a seemingly contradictory spatial pattern with
agglomeration in the Central Business District (CBD) on the one hand and dispersion on the other. In Sydney business services are starting to move out of the CBD, with the exception of high order financial services, into the inner suburbs (Searle 1998). In Paris it was found that in the finance sector, large global banks locate within the CBD area while smaller consumer branches and branches designed to service the needs of small businesses are located across the metropolitan area. Management consultancies also displayed a similar pattern with some employment located in the CBD area, particularly large global firms, with many small firms located in the greater Paris metropolitan area (Shearmur and Alvergne 2002). The work on Montreal examines the location of producer services from 1981 to 1996. This study also found a degree of suburbanisation of producer services employment although producer services employment in the CBD continued to grow in absolute terms. Coffey and Shearmur (2002) suggest that the relative decline of producer services jobs in the CBD is due to increasing specialisation of high order producer services, particularly finance and legal services, and the fact that the CBD cannot absorb all the employment growth in producer services. Coffey and Shearmur (2002) also found that the growth in non-CBD producer services employment was concentrated a small number suburban locations and is not being dispersed across the metropolitan area.

This body of work is a useful start in the intra-metropolitan location of producer services, however there are a number of shortcomings. First is the use of a mixture of pure producer services, such as management consulting, with mixed producer services, such as finance. These two services have very
different markets and inputs and so would be expected to have different locational requirements. Second, administrative boundaries, like those used for various censuses do not necessarily align with major economic activities, for example a major industrial area or employment node may be subdivided by administrative boundaries and distort the level of employment concentration. Third, this stream of research has a CBD centric view of producer services location. The CBD is seen as the primary location for producer services, however this is not true of all cities or of all producer services.

The second body of work uses the actual geographic location of producer services firms to identify concentrations of firms, free from the distorting effects of pre-determined spatial units. Within this stream of literature work has been completed for London and Vancouver.

The work on London (Taylor et al 2003) uses the location of firms in financial services, including banking, insurance, accounting, legal service as well as advertising, as the basis for study. This work, which updates the path breaking study of Goddard’s (1975), found that firms were scattered across the central London area, however, there are distinct and sharply defined geographic agglomerations of firms. Some industries are very highly concentrated with nearly 60% of insurance firms and 55% of banks within these clusters (Taylor et al 2003). Unlike the work on Paris and Montreal, different industries agglomerate in different parts of London such as insurance firms concentrating in the City of London area, banks were found to cluster in
the City of London and Mayfair while advertising firms were concentrated in Soho (Taylor et al 2003). London is a different type of city compared to Montreal or Paris as its Central Business District is spread across a comparatively wide area.

Even in a city with a clearly defined CBD, the actual geography of producer services firms is more complex matter than CBD vs the rest of the metropolitan area. Hutton (2000, 2004a) has developed a body of work looking at the location of producer services, particularly design orientated industries such as graphic design, multimedia and commercial photographers, in Vancouver.

Hutton found that design intensive producer services in Vancouver concentrate within particular parts of the inner city around the CBD, such as Yaletown, as well as parts of the CBD itself. This illustrates that there is a degree of variety in the location requirements of producer services firms and that the CBD is not necessarily the most concentrated, or desired, location for certain producer services.

The current research seeks to build on Hutton’s work in two ways and apply it to metropolitan Melbourne. To this end the first research question is:

- Do agglomerations of a design intensive producer service exist in metropolitan Melbourne?
Graphic design firms have been selected as the subject of the current research as it is an industry that has undergone rapid growth and, following from Hutton, would be expected to exhibit a different spatial behaviour compared to more traditionally studied industries such as finance. In addressing this question the thesis will break new ground by applying an agglomeration identification technique that can use readily available firm address information. If successful this approach will provide a rigorous way to identify agglomerations of producer services firms.

Agglomerations develop and change overtime. However the work undertaken by Taylor et al (2003), provides a snapshot of the clusters, frozen in time. Hutton (2000, 2004a) has built up the start of a time series for design intensive industries in Vancouver although these data have not been used to illustrate how agglomerations change over time. The change in the location of firms and agglomerations of firms is an under researched area. Hence the second research question is:

- How do these agglomerations change geographically over time?

Addressing this question ties the research back to broader issues associated with telecommunications, weightless goods and the potential dispersal of producer services. The time period that will be used in this research is from 1981 to 2001 (in 5 year increments). This time period is an interesting one to study as it straddles a time when the world was virtually untouched by the internet, through to a period of continual growth of the internet. While this
thesis cannot directly investigate the impact this growth has had on business communication, this research will provide some insight into the agglomeration or dispersal of a producer service during a time when information and communication technologies have become more common.

This chapter provided the theoretical context and justification for the investigation of agglomerations of graphic design firms. The next chapter will describe the method used for identifying geographic agglomerations of graphic design firms.
Chapter 3

Identifying Graphic Design Firms and Agglomerations

This chapter provides an overview of the method used to identify the agglomerations of graphic design firms. The data used for the identification of agglomerations is geospatial data that can be used in a Geospatial Information System (in this case MapInfo). Geospatial information enables the:

- identification of geographic patterns
- examination of the geographic relationships between different elements

At its most basic, the method used to identify agglomerations of graphic design firms was to create a geospatial dataset of graphic design firms for 1981, 1986, 1991, 1996 and 2001. In order to identify agglomerations of graphic design firms, if they could be identified at all, a spatial statistical program called CrimeStat (Levine 2002) was used. CrimeStat uses a nearest neighbour hierarchical clustering algorithm to identify significant groupings or agglomerations of points, in this case agglomerations of graphic design firms.

The remainder of this chapter will expand on this brief overview and describe each step in detail as well as the assumptions and limitations of the method. The first section describes the identification of graphic design firms and geocoding them to provide a geospatial representation of their location. The
second section describes the identification of agglomerations of graphic
design firms using the nearest neighbour hierarchical clustering routine
included in CrimeStat. The third section describes the parameters used to
identify the agglomerations of graphic design firms and the reasons for using
those parameters.

Identifying Graphic Design Firms

There are a limited number of data sources that can be used to identify
graphic design firms. For this research it is important to identify data sources
that:

- provide the greatest coverage of graphic design firms
- can be built into a consistent time series
- has detailed address data that includes street number, street name, suburband state

These criteria were applied to the data sources to determine their suitability.

The first source of this type of data are the directories produced by industry
bodies such as the Australian Graphic Design Association, Design Institute of
Australia and the National Association for the Visual Arts. These directories
have full address information for each firm as well as a brief description of the
expertise of the firms. However they have a number of limitations that make
them unsuitable for using them as a source to identify graphic design firms.
First these directories have limited coverage as the firms have to self select themselves for inclusion in the directory. This means that while the entire population of graphic design firms could list themselves in these directories many firms do not because of lack of knowledge of the directory. For example the National Association for the Visual Arts lists 11 graphic design firms in Victoria in its directory for 2004 whereas this research identified approximately 750 firms in metropolitan Melbourne for 2001.

Second these directories are undertaken on an ad hoc basis. Therefore a time series dataset using a consistent time period cannot be developed from these directories.

From this discussion it can be seen that the directories produced by the industry bodies fail the criteria of coverage and ability to build up a time series although they do provide detailed address data.

The second data source investigated was the Telecom/Telstra Yellow Pages Directory. This is the Australia wide, business phone directory of businesses. Two sources exist for this data. The first source is hard copy phone books with data from 1964 to the current day. The information in these directories consists of firm name, address and telephone number. The second source is an electronic database of the Yellow Pages called Australia on Disk. This data exists for 1993 to 2002 and consists of firm name, address, telephone
number and the Australian and New Zealand Standard Industrial Classification which provides information about the main functions of the firm.

The Yellow Pages has a greater chance of capturing all graphic design firms for three reasons:

- It is the primary business directory in Australia and most businesses list in it.
- When businesses order a telephone connection they are asked if they would like to appear in the Yellow Pages directory.
- An advertising campaign is run on an annual basis to remind business to list in the Yellow Pages or to change the amount of space they purchase.

The Yellow Pages is published annually and so a time series using a consistent period can be developed.

From the discussion above the Yellow Pages directory meets the three criteria listed above for the selection of a data source to identify graphic design firms in metropolitan Melbourne.

Using the Yellow Pages to identify graphic design firms

The Yellow Pages can be used to provide time series data over a long period of time (approximately 40 years). This research has limited the time series to a 20 year period from 1981 to 2001. 1981 was selected as the start date for the time series. This is because the category “graphic design” did not exist in
the Yellow Pages until the late 1970s. Prior to this there was a category called “designer” that included graphic designers as well as range of other design industries including house designers, garden designers etc. Data was collected for 1971 although it proved too difficult to separate graphic designers from the other types of designers. The time series data has been subdivided using 5 year periods within the total 20 year period. So data has been collected for 1981, 1986, 1991, 1996 and 2001. These years were selected to coincide with the census of population and housing undertaken every 5 years by the Australian Bureau of Statistics (ABS) to enable comparison with the industry and occupation data for graphic design from the census.

The list of graphic design firms for each year had to be cleaned to remove firms that were listed as graphic design firms even though their main function was an activity other than graphic design. Listed within the graphic design category are printers, advertising agencies, computer hardware retailers among other types of firms. These firms were removed leaving a list of firms that was made up of graphic design firms. Some non-graphic design firms probably still exist in this list although it is not possible to interrogate the data further to remove them.

Once the list of firms had been completed, the address information was used to geocode the location of the firms. The firms were geocoded using the State Digital Map Base – Address Points which is developed and maintained by the State Government of Victoria and is the authoritative source of address information for Victoria. Approximately 4% of firms could not be geocoded.
due to incomplete information (eg no street number provided), wrong information (eg the misspelling of a street) or the directory entry provided a mobile phone number and no address information. However 96% of the firms that were listed were able to be geocoded.

The 96% of firms that could be geocoded were geocoded to different levels of geographic accuracy depending on the information provided in the Yellow Pages directory or the State Digital Map Base – Address Points. There are three levels of accuracy:

- **Exact Address.** This is where the firm has been geocoded to the exact address using the State Digital Map Base – Address Points. These firms have been geocoded to the highest level of accuracy afforded by the State Digital Map Base.

- **Next Door Address.** Some addresses are provided as a range (eg 58 to 60 Smith Street). This type of address is not recognized in the State Digital Map Base – Address Points and so one of the numbers was used to geocode the firm. There is a small level of imprecision in the geographic location of these firms although the approximation in the actual location of the firms is in the range of tens of metres.

- **Approximate Address.** This is where the address of the firm does not exist in the State Digital Map Base – Address Points. This is due to addresses being changed or removed over time as development in the city occurs. For example 15 Clarke Street, Southbank no longer exists as it is now part of the multi storey car park for Crown Casino. Where this has occurred the firm has been geocoded to the most precise point using old street directories as a guide. As with the data coded to the next door address, there is a small level of imprecision in the geographic location of these firms although the approximation in the actual location of the firms is in the range of tens of metres.

From Figure 3.1 it can be seen that a very large proportion of the data was geocoded to the highest level of accuracy.
The output of this process is a point location of graphic design firms. In reality firms occupy buildings and are not points in space. It is recognized that the point locations of these firms is a representation of their location and does not take into account their actual occupation of buildings. However without further detailed information about the actual occupation of buildings this is the most accurate geographic representation of the firms. The point locations of the firms is the base data from which the agglomerations of firms are identified.
Identifying Agglomerations

Agglomerations can be identified just by looking at maps of the graphic design firms. However a systematic method has to be developed to minimise or remove subjectivity in identifying agglomerations. This research uses a piece of software called CrimeStat 2.0 (Levine 2002) (referred to here as CrimeStat). CrimeStat has the advantages of:

- providing a robust and easily understood method for identifying agglomerations of firms
- providing a detailed methodology of the technique
- providing a geospatial representation of the results that can be used with other geospatial datasets

As the name suggests, CrimeStat is a statistical package for the analysis of crime statistics, in particular, the geographic relationship and dimension of crime incidents. CrimeStat is not a standard statistical package, its utility lies in its ability to process point location data and provide a range of routines that produce geographic statistical measures. So while CrimeStat was first developed for use by law enforcement agencies for processing data related to the location of crime, some of the modules can be used for other applications such as the identification of agglomerations of firms.

One of the modules incorporated in CrimeStat is a routine to identify agglomerations of points using geospatial data. This routine is called the nearest neighbour hierarchical clustering routine. The nearest neighbour hierarchical clustering routine in CrimeStat identifies groups of firms that are
spatially closer compared to the distance between firms if there was a random
distribution of firms. This distance is called the threshold distance.

The following equation is used to calculate the threshold distance:

\[
d_{\text{ran}} = 0.5 \sqrt{\frac{A}{N}}
\]

where \( A \) is the area of the region and \( N \) is the total number of firms. An
elementary of the location of firms and the area occupied by the firms (area of
the region) is provided in Figure 3.2.

**Figure 3.2** Region rectangle and graphic design firms in metropolitan

**Source:** Australia on Disk, 2001
The algorithm then compares this threshold distance between firms. Where the distance between two firms is less than this threshold distance the firms are grouped together. The pairs of firms are then compared to each other and again where these pairs are closer together than threshold distance they are grouped together. This process of comparing larger and larger groupings of firms to the threshold distance continues until either all the firms have been grouped together into one or a number of agglomerations or the clustering algorithm eventually breaks down as it cannot agglomerate any more firms together as they are located at a distance greater than the threshold distance. Full instructions for *CrimeStat*’s nearest neighbour hierarchical clustering routine can be found in Appendix A.

*CrimeStat*’s nearest neighbour algorithm produces two outputs. These are:

1. A text report of the results including the number of firms identified in the agglomerations, co-ordinates for the centre of the agglomeration among other measures. An example of this text report can be found in Appendix B.

2. An ellipse or a number of ellipses that can be imported into a geographic information system (GIS). An example of this can be seen in Figure 3.3. The ellipses produced by *CrimeStat* are approximations of the agglomerations as the actual agglomerations identified can be irregular in shape. It is not possible to determine the actual shape of the agglomeration using *CrimeStat* Version 2.0 and so this research uses the ellipses produced by *CrimeStat* as the location of agglomerations of graphic design firms.
The text reports generated by *CrimeStat* were compared with the ellipses to determine if the ellipses provided a true representation of the results. Extensive testing found that the ellipses were a valid representation of the textual results and so the analysis of the agglomerations, such as the area or number of firms in an agglomeration, in this thesis are based on the geospatial ellipses and not the data from the text reports.

The discussion above outlines the basics of the nearest neighbour clustering technique. *CrimeStat* includes some additional parameters that enable fine tuning of the algorithm. These parameters are:
• Minimum number of firms per agglomeration
• Confidence interval
• Standard deviation of the ellipses.

Extensive testing of *CrimeStat* was undertaken, testing the each of the parameters and its effects. The results of this testing and the way the parameters change the output of *CrimeStat* can be seen in Appendix C.

*Minimum number of firms per agglomeration*

Using the nearest neighbour hierarchical clustering routine, as few as two firms could be classified as a agglomeration if the minimum number of firms in the agglomeration was not controlled. *CrimeStat* enables a minimum number of firms within an agglomeration to be set. By specifying a low minimum number of firms per agglomeration a large number of agglomerations are identified. Conversely by specifying a high minimum number of firms per agglomerations a small number of agglomerations will be identified.

*Confidence interval*

If the data for graphic design firms was randomly distributed it would be expected that half the firms would be located at or closer than the threshold distance (ie d(ran)). *CrimeStat* enables the fine tuning of the threshold
distance so that the agglomerations of firms can be selected where the firms are significantly closer to one another than the threshold distance or greater than the threshold distance. The threshold distance can be either loosened, ie the threshold distance between firms is increased and so more firms are selected or tightened which results in fewer firms are selected. This is done by calculating the upper confidence interval:

\[
ConInt = \left[ 0.5 \sqrt{\frac{A}{N}} + t \left( \frac{0.26136}{\sqrt{\frac{N^2}{A}}} \right) \right]
\]

Where A is the area of the region, N is the number of firms and t is the value associated with the tolerance selected (level of tolerance). The value of t varies from -3.719 where the probably of selecting pairs by chance is 0.001% to +3.09 where the probably of selecting pairs by chance is 99.9%. It can be seen that by using -3.719 as the value for t, then the threshold distance decreases where as if the vale of t is 3.09 then the threshold distance increases. The change in the value of t and the threshold distance is illustrated in Figure 3.4.
The confidence level, and the number of firms selected in agglomerations, can significantly effect the nearest neighbour agglomeration results (for a fuller assessment see Appendix C). These effects include:

- Number of agglomerations. The higher the level of $t$ (ie 3.09) the greater the number of agglomerations identified. While a lower level of $t$ will produce fewer agglomerations.

- The location of agglomerations. The effects on the location of the agglomerations are very complex and cannot be simply explained. One of the effects of increasing the threshold distance is the identification of large agglomerations located away from the main concentration of firms.

- The shape of agglomerations. The effects on the shape of agglomerations, like that on the location of agglomerations, is complex and cannot be simply described. However the shape of the agglomerations are markedly different as the level of $t$ is changed.
Standard deviation of the ellipses

Standard deviation relates to the size of the ellipses produced by *CrimeStat* for geospatial analysis in a GIS package such as MapInfo. *CrimeStat* provides 3 settings for the ellipse size or standard deviation; 1, 1.5 and 2. A 1 standard deviation ellipse typically contains half of the firms identified as part of the agglomeration, that is the number of firms specified in the text report generated by *CrimeStat*, while an ellipse of 1.5 standard deviations is about one and a half times greater in size and will contain about 95% of firms identified as being part of the agglomeration while the 2 standard deviation ellipse is twice the size and will contain about 99% of the firms identified as part of the agglomeration. The geospatial ellipses produced by *CrimeStat* are an approximation of the agglomerations identified by the nearest neighbour algorithm. The standard deviation setting does not affect the location or number of ellipses just the size of the geospatial representation of the ellipses.

However the size of the ellipses is important when they are analysed with other geospatial data so as not to understate or overstate the significance of these areas. For instance the 2 standard deviation ellipse will contain 99% of the firms identified within an agglomeration. However when the ellipse is overlayed with the location of graphic design firms some firms that are not part of the agglomeration will fall within the ellipse therefore overstate the number of firms that fall within the agglomeration. From extensive testing of *CrimeStat* comparing the textual output with a geospatial analysis of the ellipses and location of graphic design firms it has been found that an ellipse of 1.5
standard deviations provides a good representation of the agglomeration as it includes most of the firms that are in the agglomeration while excluding firms that are not part of the agglomeration.

Identifying agglomerations of graphic design firms in metropolitan Melbourne

The parameters within CrimeStat enable a large number of possible combinations to be used. For example there are 12 levels of confidence interval and 3 settings for standard deviation. This produces 36 different results. The minimum number of firms per agglomeration can also be varied, so if 10 different minimum number of firms per agglomeration were used there would be 360 sets of results to analyse. Furthermore using data for 5 time periods results in 1,800 different sets of results.

As discussed above, the main reason for using a systematic method to identify agglomerations was to remove or minimise subjectivity in the identification of agglomerations. The large number of combinations of parameters shows that there is an element of choice and subjective bias in the identification of agglomerations even using this method. This element of choice or subjectivity cannot be completely removed from the research process, however the reasons for selecting a particular choice should be clearly articulated in order to highlight the in built aims of the research. To this end the research is attempting to identify significant agglomerations of graphic
design firms in metropolitan Melbourne where firms have a high degree of spatial proximity.

To produce this result, particular levels of the parameters have been selected (see Table 3.1) to identify agglomerations of graphic design firms.

**Table 3.1** Parameters for the selection of agglomerations of graphic design firms in metropolitan Melbourne.

<table>
<thead>
<tr>
<th>Parameter Name</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum number of firms per agglomeration</td>
<td>15</td>
</tr>
<tr>
<td>Standard deviation of the ellipse(s)</td>
<td>1.5</td>
</tr>
<tr>
<td>Value of $t$ (level of tolerance)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

The number of firms per agglomeration is set at 15. This was selected in order to identify a few large agglomerations rather than identifying a large number of small agglomerations. By setting the minimum firms per agglomeration to 15 it is envisaged that large, well established agglomerations would be identified as well as smaller emerging agglomerations.

The standard deviation of the ellipses was set at 1.5 standard deviations. As discussed above, this provides a good representation of the agglomerations being neither too small (i.e., 1 standard deviation) and represent too few firms in the agglomeration or too large (i.e., 2 standard deviations).

The level of tolerance was set at 0.001%. This is the tightest setting for the level of tolerance. This is so that a few tight and compact agglomerations are
identified rather than identifying many loose agglomerations and devalue the notion of geographic proximity.

The methodology described here has been used to identify significant and spatially compact agglomerations of graphic design firms over a twenty year period from 1981 to 2001. Chapters 5, 6 and 7 provide an analysis of these agglomerations. However, before discussing these results the next chapter provides an overview of graphic designers and graphic design in Australia and illustrates Melbourne’s central position in this industry.
Chapter 4

Graphic Design as an Industry and Occupation and its Location in Melbourne

This chapter describes the role of graphic designers and graphic design firms as an activity within Australia. Its purpose is to show that graphic designers are highly skilled individuals working in a producer service that has a substantial and growing presence in Australia. This chapter is broken into three sections. The first section looks at the way graphic designers describe themselves and their industry and the way they are defined for statistical purposes. The second section uses simple measures such as the number graphic designers, their characteristics and the type of firms graphic designers work within. The third section provides a basic geography of graphic design in Australia and metropolitan Melbourne to provide a broad context for the finer grain geographic research that follows.

Defining Graphic Designers and Graphic Design

There is no single accepted definition of “Graphic Design” or “Graphic Designer”. The professional graphic design organisations surveyed here have their own view of the profession. The definitions vary from the abstract to definitions based on concrete examples of graphic design in everyday life.
The International Council of Graphic Design Associations (Icograda) defines Graphic Design as:

“an intellectual, technical and creative activity concerned not simply with the production of images but with the analysis, organization and methods of presentation of visual solutions to communication problems. Information and communication are the basis of world-wide interdependent living, whether in trade, cultural or social spheres. The graphic designer’s task is to provide the right answer to visual communication problems of every kind in every sector of society.” (Icograda 2001)

And the Graphic Designer as:

“One who has the artistic sensibility, skill and experience and/or training professionally to create designs or images for reproduction by any means of visual communication, and who may be concerned with illustration; typography; calligraphy; surface design for packaging; or the design of patterns, books, advertising and publicity material, or any form of visual communication.” (Icograda 2001)

On the other hand, the American Institute of Graphic Arts takes a more light-hearted and example driven approach to defining graphic design,

“Suppose you want to announce or sell something, amuse or persuade someone, explain a complicated system or demonstrate a process. In other words, you have a message you want to communicate. How do you “send” it? You could tell people one by one or broadcast by radio or loudspeaker. That’s verbal communication. But if you use any visual medium at all—if you make a poster; type a letter; create a business logo, a magazine ad, or an album cover; even make a computer printout—you are using a form of visual communication called graphic design.

Graphic designers work with drawn, painted, photographed, or computer-generated images (pictures), but they also design the letterforms that make up various typefaces found in movie credits and TV ads; in books, magazines, and menus; and even on computer screens. Designers create, choose, and organize these elements—typography, images, and the so-called “white space” around them—to communicate a message. Graphic design is a part of your daily life. From humble things like gum wrappers to huge things like billboards to the T-shirt you’re wearing,
graphic design informs, persuades, organizes, stimulates, locates, identifies, attracts attention and provides pleasure.

Graphic design is a creative process that combines art and technology to communicate ideas. The designer works with a variety of communication tools in order to convey a message from a client to a particular audience. The main tools are image and typography.” (Poggenpohl 1993)

The Australian professional bodies have developed their own definitions of graphic design. John Frostell (1999), the President of the Australian Graphic Designers Association, describes graphic design in similar abstract terms of the Icograda definition.

“Graphic design is seen by its leading practitioners as being a vehicle for visual communication, one which sees positive change as a primary reason for its existence. Further, it is the idea of harnessing this change and generating presence for defined commercial and social outcomes that provides graphic design its greatest power. The process of designing, therefore, should be seen as more than a selection of creative and technical functions - which were the origins of the profession - but a means of integrating their outcomes within the cultural fibre of clients.” (Frostell 1999)

The definition used by the Design Institute of Australia is more operative describing the mechanics of the occupation.

“Graphic designers develop and prepare information for publication with particular emphasis on clarity of communication and the matching of presentation styles to audience requirements.

The information they deal with not only requires a sound understanding of text based communication but also requires them to skilfully use the communication properties of symbols, colours and pictures.

They prepare concept layouts and mock-ups to discuss project details with clients. They prepare or subcontract diagrams, illustrations and photography. They resolve all communication elements into a final format to suit the required physical or digital media.

They select paper and other printing materials, resolve manufacturing details and produce instructions for others involved in the reproduction
process. They organise and oversee proofs and colour separations to prepare for printing and liaise with suppliers who specialise in the many forms of digital and computer based information distribution mechanisms.

Graphic designers often work as part of a project development team. While other specialists such as marketing managers and advertising specialists work on the strategies of distributing information to the market place and determining beneficial product positioning the graphic designer may be working on the image and branding that will appeal to and attract the intended customer.” (Design Institute of Australia 2002)

While the definitions provided above are all different there are a number of themes that run through them that provide a common basis for what is graphic design and who is a graphic designer.

The first theme is graphic design as a knowledge and creative activity that exercises judgement and aesthetic skill to create a product and is not a purely technical activity. Graphic designers see themselves as creators of products imbued with creative and artistic content. In this way graphic designers do not produce standard products. The products are the result of manipulating visual representations to create an innovative design to differentiate their client’s products from the products of other producers. This places them within Robert Reich’s (1992) “Symbolic Analyst” group of workers that are involved in problem solving and manipulating symbols.

The second theme is that graphic designers specialise in visual communication. This means that graphic designers use images, colour, symbols and text to communicate with an audience. Their output is not limited to one medium and the choice of media has expanded from traditional hard copy with the development of digital technologies. Digital technology has had
an impact on both the process of design (that is the use of software to create design products) and the display of design (such as display on computer monitors and in film and videos).

The third theme is that graphic design is a producer service. Graphic designers provide specialist design products to other firms in a wide array of sectors. These organisations then incorporate the design into a product or service they provide to a final consumer. Therefore the products provided by graphic designers are usually intermediate products, not final products for consumers. The intermediate nature of graphic design products places it within the producer services sector of the economy.

This summation of the way graphic designers describe themselves and their industry is one approach to defining graphic design as an activity. The Australian Bureau of Statistics also defines graphic design and graphic designers for of their collection for social and economic information.

How graphic designers and graphic design are defined for statistical purposes

The Australian Bureau of Statistics (ABS) has developed a range of standard classifications of both occupation and industry which can be used to collect information for the census and other data sources. The two standard classifications that concern the definition of graphic designers are the
Australian Standard Classification of Occupations and the Australian and New Zealand Standard Industrial Classification to define graphic design firms.

Defining graphic designers as an occupation

For the purpose of using statistical data generated from the ABS, graphic designers can be described using the Australian Standard Classification of Occupations (ASCO) (ABS catalogue number 1220.0). The ASCO is a skill based classification of all occupations within the Australian workforce. The level of distinction between occupations is quite fine with 986 separate occupations described in the ASCO.

An occupation is described as "a set of jobs with similar sets of skills. An occupation in ASCO is a collection of jobs which are sufficiently similar in their main tasks to be group together for the purposes of classification" (ASCO, 1997, 5). The ASCO uses a hierarchical classification, so all occupations can be categorized at different levels of detail. Graphic Designers are nested within ASCO as seen in Table 4.1.
Table 4.1  Graphic designer as an occupation in the ASCO hierarchy.

<table>
<thead>
<tr>
<th>Hierarchy</th>
<th>Description</th>
<th>Classification Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Group</td>
<td>Professionals</td>
<td>2</td>
</tr>
<tr>
<td>Sub-Major Group</td>
<td>Social, Arts and Miscellaneous Professionals</td>
<td>25</td>
</tr>
<tr>
<td>Minor Group</td>
<td>Artists and Related Professionals</td>
<td>253</td>
</tr>
<tr>
<td>Unit Group</td>
<td>Designers and Illustrators</td>
<td>2533</td>
</tr>
<tr>
<td>Occupation</td>
<td>Graphic Designer</td>
<td>2533-13</td>
</tr>
</tbody>
</table>

Source: ABS, ASCO, 1997

The ASCO defines the occupation of “Graphic Designer” as:

2533-13  Graphic Designer
Commercial Artist
Graphic Artist

Designs and presents information in a visual form for print, film, television, signs, video and computers.

Skill Level:
The entry requirement for this occupation is a bachelor degree or higher qualification or at least 5 years relevant experience. This occupation requires high levels of creative talent or personal commitment and interest as well as, or in place of, formal qualifications or experience.

Tasks Include:
- consults with clients to determine time frames, budgets and other objectives
- analyses clients’ needs, undertakes research and plans presentation of material
- prepares concepts and illustrations or other visual representation of final material
- submits designs to clients for approval
- prepares notes and instructions for finishing artists to assemble and prepares final artwork for printing, display or electronic use
- reviews final layout and suggests changes and improvements through proofing stages
- may advise on the photography and reproduction of illustrations or other graphics

Specialisations:
- Calligrapher
- Display Artist
- Exhibition Designer
- Film and Video Graphics Designer
- Publication Designer

This definition of graphic designers is consistent with the ideas expressed by the professional associations. It views graphic designers as visual communicators in many mediums not just specialists in printed communication and an activity with major client orientation.

Defining graphic design firms as an industry

Graphic design firms have been described by the ABS for the purposes of data collection through the Australian and New Zealand Standard Industrial Classification (ANZSIC) (ABS catalogue number 1292.0). Like the ASCO, ANZSIC uses a hierarchy to categorize. Graphic design firms are nested within ANZSIC as shown in Table 4.2.

Table 4.2  Graphic design as an industry in the ANSIC hierarchy.

<table>
<thead>
<tr>
<th>Hierarchy</th>
<th>Description</th>
<th>Classification Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Division</td>
<td>Property and Business Services</td>
<td>L</td>
</tr>
<tr>
<td>Subdivision</td>
<td>Business Services</td>
<td>78</td>
</tr>
<tr>
<td>Group</td>
<td>Marketing and Business Management Services</td>
<td>785</td>
</tr>
<tr>
<td>Class</td>
<td>Commercial Art and Display Services</td>
<td>7852</td>
</tr>
</tbody>
</table>


The industry description of graphic design firms is not as detailed as the occupational definition discussed previously. As shown below, it is an amalgam of high value producer services (graphic designers), artists (commercial artist) and trades people (sign writing and ticket writing). Below
is the full ANZSIC description for the 7852 Commercial Art and Display Services class.

7852 Commercial Art and Display Services

This class consists of units mainly engaged in providing graphic design services, or in sign writing or ticket writing on a custom or order basis

Primary Activities

Commercial art service
Graphic design service (for advertising)
Sign Writing
Ticket Writing


This definition pools into one category firms that have a range of skill levels. The variety of firm types in the definition (from that of the skilled designer to the trade based skills of a sign writer) means that some caution needs to be exercised in using the ANZSIC classification “Commercial Art and Display Services”.

Characteristics of Graphic Designers

Using the definitions outlined above a number of elements can be drawn from statistical sources to sketch out some basic characteristics of Australian graphic designers and compare them to the Australian workforce as a whole. The characteristics used here are growth in the number of graphic designers, age profile and income distribution. This section ends with an analysis of the type of firms graphic designers work within.
Number of Graphic Designers

Graphic design is a growing industry. Figure 4.1 shows a marked increase in the number of graphic designers between 1991 and 2001.

**Figure 4.1** Number of graphic designers, Australia, 1991, 1996 and 2001.


Graphic designers have grown at a rapid rate between 1991 and 2001, some 140% increase, when compared to the growth of the Australian workforce, as illustrated in Figure 4.2.
The rapid increase in the number of graphic designers indicates an increased demand for graphic design services and so more people are employed as graphic designers. An indication of this demand is the rapid growth in the internet since 1991, illustrated in Figure 2.1. While not all websites require the services of a professional graphic designer, there are a number of corporate and government websites that do require these services to maintain and create new content. On the supply side, the demand for graphic design services has probably attracted people who would otherwise enter other design or artistic occupations. The attractiveness of graphic design is enhanced by the relatively low cost of entry into the graphic design industry, particularly in terms of technology costs (Searle, 1998). Therefore people with an inclination to enter the industry are not excluded from the practice of graphic design on the basis of start-up costs.
Age

As seen in Figure 4.3, Graphic designers tends to be a youthful occupation compared to the age distribution of the Australian workforce. For the working Australian population (ie those aged between 15 and 65) the age distribution is much flatter than that of graphic designers. Where as the age distribution for graphic designers is more marked with nearly two thirds of graphic designers aged under 34 years old, with the single largest age cohort being 25 to 29 years old.

This relatively young population is influenced by the use of the internet and the need for professionally designed websites. This requires people with skills in both information technology and design. These skills would generally reside with relatively young people who have been exposed to and used this type of technology throughout their lives. The young people now entering graphic design are the first generation of graphic designers to have grown up with the internet. This accounts for the relatively young graphic design workforce.
**Figure 4.3** Age distribution of graphic designers and Australian workforce, 2001.

![Age distribution bar chart]


**Income**

Figure 4.4 shows that graphic designers tend to earn higher incomes compared to the Australian workforce. In 2001, 53% of the Australian population earned more than $300 per week while 86% of graphic designers earned more than $300 per week. The most common income range for the Australian is $300 to $499, the most common income range for graphic designers $700 to $999. This relatively high level of income indicates that the skills and knowledge of graphic designers are in demand and employers have
to attract and retain employees with higher wages compared to those paid to the rest of the Australian workforce.

**Figure 4.4** Income distribution for graphic designers and the Australian workforce, 2001.

![Income distribution for graphic designers and the Australian workforce, 2001.](image)

**Source:** ABS, Census of Housing and Population, 2001.

**Firms employing graphic designers**

Graphic designers can be found in a range of different industries such as government departments, hospitals, manufacturing and tertiary education, all of which have some need for graphic design support even although it is not their core business. However there are particular industries that graphic designers are concentrated within.
Figure 4.5 shows that the largest single industry that graphic designers work within is Commercial Art and Display Services (ie the specialist graphic design consultancies) with some 5,500 graphic designers or 28% of the total Australian graphic design workforce. Therefore a significant number of graphic designers work within specialist design firms providing producer services for other organisations.

**Figure 4.5** Proportion of graphic designers by industry class of employing firm, Australia, 2001.

![Pie chart showing industry distribution of graphic designers.]

**Source:** ABS, Census of Housing and Population, 2001.

It is interesting to note there is a relatively large number of graphic designers working within Computer Consultancy Services firms. This suggests there are a number of graphic designers working with digital media, particularly web design. The more traditional area of employment for graphic designers such as Advertising Services accounts for about 9% of employment. These three producer services account for 49% of employment.
Some graphic designers are also found in manufacturing with 8% of graphic
designers working for firms involved in printing. As mentioned above, graphic
designers can be found in almost all industries, this accounts for the large
proportion of graphic designers, 43% of them, that work in industries other
than those discussed above.

From this discussion above it can be seen that graphic design is a producer
service providing a specialised intermediate product for other businesses.
The need for these services has increased rapidly as the demand for design
services have increased due to branding and expansion of the internet.

The graphic designers themselves are typically younger than the rest of the
Australian workforce with the assumption that younger people will have both
design skills and information technology skills. They are also paid at a higher
level compared to the Australian workforce which indicates their skills are in
high demand. The definitions of graphic design illustrate the non-standard
nature and output of their work which places graphic designers within the
symbolic analyst category of Reich’s breakdown of the modern labour market.

Graphic design firms employ a significant share of all graphic designers.
These firms provide specialist graphic design services, or producer services,
to other firms. It is these knowledge intensive business services firms that are
the locus for highly skilled workers which make up the focus for the remainder
of this research.
Distribution of graphic designers and firms across Australia

While the previous sections described graphic design as an industry as well as its rapid growth in recent times, this growth has not occurred evenly across Australia. This next section provides an overview of the geography of graphic design in Australia as well as an introduction to the geography of graphic design in metropolitan Melbourne.

Distribution of graphic designers in Australia

From Figure 4.6 it can be seen that both New South Wales and Victoria have a higher proportion of graphic designers than their share of the Australian workforce. All the other states (with the exception of the Australian Capital Territory which has a small number of graphic designers compared to Victoria and New South Wales) have a lower proportion of graphic designers compared to their share of the Australian workforce. Hence, graphic designers are not distributed in proportion to shares of workforce as New South Wales and Victoria offer opportunities or advantages for businesses employing graphic designers not available elsewhere in Australia, which these cities provide for producer services generally (O’Connor, Stimson and Daly, 2001).
Figure 4.6  Proportion of graphic designers and Australian workforce by state, 2001.


Distribution of graphic design firms in Australia

That pattern observed for the distribution of graphic designers is similar distribution of graphic design firms. There has been an increase in the number of graphic design firms in Australia between 1996 and 2001 from 1,836 firms to 2,922 firms. Most firms, in both 1996 and 2001, were located in New South Wales and Victoria as seen in Figure 4.7.
Figure 4.7  Number of graphic design firms by state, Australia, 1996 and 2001.

All states experienced some increase in the number of graphic design firms between 1996 and 2001 although most of the growth has occurred in New South Wales and Victoria.

The graphic design industry in Australia is highly concentrated in the large metropolitan centres in each state. So while graphic design firms are located through out the State of Victoria, a very large majority of them are located in metropolitan Melbourne which is the geographic focus for the research.
Figure 4.8  Location of graphic design firms, metropolitan areas and the rest of State, selected States, 2001.

Source:  Australia on Disk, 2001.
Note:  The Australian Capital Territory (ACT) was excluded as the whole area of the ACT can be considered as a metropolitan area. The Northern Territory and Tasmania have been excluded due to the very small number of graphic design firms in these locations.

Number of graphic design firms in metropolitan Melbourne

As with the increase in the number of graphic designers there has been a substantial increase in the number of graphic design firms over the last 20 years. In metropolitan Melbourne the number of firms has increased from 105 in 1981 to 732 in 2001.
Like the geography of the graphic design industry in Australia, there is a distinct geography to the industry in metropolitan Melbourne which the next section will investigate.

**Distribution of graphic design firms in metropolitan Melbourne**

The following section provides an analysis of the distribution of graphic design firms in Melbourne over the past twenty years. The distance measure uses a series of concentric rings at 5 kilometre intervals from the centre of Melbourne (defined as the intersection of Elizabeth and Bourke Streets outside the old General Post Office). The rings are divided further into four sectors based on...
the cardinal compass points North, South, East and West. Figure 4.10 illustrates the distance rings and sectors used for the distribution analysis.

Figure 4.10 Metropolitan Melbourne with distance rings and sectors.
Distribution of graphic designers in metropolitan Melbourne by sector

There is a strong and long standing pattern of graphic design firms locating in the east and south of Melbourne. However the distribution of firms has been changing slowly over time. For instance, the south sector has been the primary location for graphic design firms since 1986. However, in 2001 the proportion of firms located in the South and East of Melbourne was even with 41% of graphic design firms in each of these sectors. The West and North of Melbourne have not proved popular with graphic design firms. However the north is becoming a more significant location for graphic design firms with the proportion of firms increasing from 7.6% in 1981 to 13.4% in 2001.


Source:  Australia on Disk 1996 and 2001
From the discussion above it can be seen that there is a distinct geographic bias in the location of graphic design firms with the east and south of Melbourne being the location for the vast majority of firms.

*Distribution of graphic designers in metropolitan Melbourne by distance*

From Figure 4.12 there has been an increase in the number of graphic design firms across all distance rings. However there has been a substantial increase in the number of firms located in the inner city (up to 5 kilometres from the centre of Melbourne) and middle distance suburbs (5 to 20 kilometres from the centre of Melbourne) between 1981 to 2001.

**Figure 4.12** Number of graphic design firms by distance from central Melbourne, 1981, 1991 and 2001.

*Source:*  
Australia on Disk 2001  
Telecom Yellow Pages 1981, 1991
There is a tendency to concentrate in the inner city as evidenced in Figure 4.12. Since 1981 the proportion of firms locating in the inner city has increased and reached its peak in 1991 when nearly 49% of firms were located within 5 kilometres of central Melbourne. Since 1991 the number of firms in the inner city has decreased to 42%. While the proportion of firms in the inner city has declined since 1991 there is still a significant number of firms located within this relatively small part of the metropolitan area.

Figure 4.13  Proportion of graphic design firms by distance from central Melbourne, 1981, 1991 and 2001

Source: Australia on Disk 2001
Telecom Yellow Pages 1981, 1991

The information reviewed here has established that graphic designers and graphic design firms exhibit many features common to producer services firms in that they have expanded rapidly over the past 20 years, tend to be located in major cities and employ young well paid staff. Within this broad context,
Melbourne is prominent as a graphic design employment location within Australia.

In Melbourne the focus on graphic design firms confirms an inner city concentration and a bias toward the south and east from the centre of Melbourne.

The concentration and the evidence of some dispersal towards the south and east provides an interesting context to explore the tendency of these firms to cluster near by one another. In practical terms the thesis investigates whether the inner city concentration is in fact an agglomeration or a number of agglomerations of similar firms or simply represents a general preference for inner city locations.
Chapter 5

Agglomerations of Graphic Design Firms in Metropolitan Melbourne, 2001.

The previous examination of the distribution of firms by sector and distance describes how firms are distributed in Melbourne. While it provides a useful method for describing the location of graphic design firms, and shows that the inner suburbs play a special role in their location, it does not provide an indication of how firms are spatially related to each other, which is the focus of this research. This chapter provides an analysis of agglomerations of graphic design firms in metropolitan Melbourne for 2001. The first part of the discussion focuses on the extent to which graphic design firms agglomerate in metropolitan Melbourne. The second section looks at the actual agglomerations that were identified in 2001 and will examine their characteristics including measures such as the number of firms and the density of firms inside and outside the agglomerations. This chapter also includes information from the planning scheme about the land use zoning of sites occupied by graphic design firms as a proxy measure of firm size.

Firms in Agglomerations 2001

In 2001, seven agglomerations of graphic design firms were identified in Metropolitan Melbourne. The agglomerations were located in:
• South Melbourne
• Prahran/St Kilda
• Richmond
• Collingwood/Fitzroy
• West Melbourne/Central Business District (CBD)
• South Yarra
• South Bank/CBD

These agglomerations are all located in a rough ring within the inner suburbs of Melbourne and the Central Business District (see Figure 5.1). This ring confirms the inner city focus of graphic design activity. It also suggests that some parts of the inner city are more important than others. The eastern and southern parts are the location of five of the seven agglomerations (South Melbourne, Prahran/St Kilda, Richmond, South Yarra, South Bank/CBD) where as the north and the west are the location for the remaining two agglomerations (Collingwood Fitzroy and West Melbourne/CBD). This reflects the long standing social and economic contrast between these two broad parts of the metropolitan area, where commercial and service businesses, and their professional staff, have favoured the east and south, while manufacturing and its lower skilled workers have located to the west and north.
Figure 5.1  Agglomerations of graphic design firms in metropolitan Melbourne, 2001.

Source:  Australia on Disk, 2001.

Number of graphic design firms in agglomerations 2001

Across metropolitan Melbourne in 2001, 732 graphic design firms were identified. Of these 271 (37%) were located within the 7 agglomerations shown in Figure 5.2, with the remainder scattered across the metropolitan area particularly to the eastern and southern parts. The number of firms located within the agglomerations may seem small, although as noted in the methodology, this is the result of using a narrow definition for the identification of agglomerations.
Significantly, the firms within the agglomerations are located in areas with higher office rents. From Figure 5.3 it can be seen that office rents in the CDB and inner suburbs are significantly greater than those in the middle suburbs of the metropolitan area by of 33% and 19% respectively. This suggests that the firms located within the CBD and inner suburbs are willing to offset the higher costs for space for other advantages that are gained from being located in one of the inner city agglomerations.

**Figure 5.2** Number of graphic design firms within and outside agglomerations in metropolitan Melbourne, 2001.

Source: Australia on Disk, 2001.
Density of graphic design firms in Agglomerations 2001

The firms within the agglomerations are significantly more densely packed together than those firms that lay outside the agglomerations. Within the agglomerations the average density of graphic design firms is 12.2 firms/km$^2$ (see Figure 5.4) compared to the average density of all graphic design firms in metropolitan Melbourne of 0.5 firms/km$^2$. This suggests that agglomeration advantages, such as face-to-face communication and linkages between firms, are likely to be easier to arrange within an agglomeration as opposed to a non-agglomeration location. Furthermore these agglomeration locations are small in area compared to the metropolitan area which suggests that the locational
advantages of agglomerations may exist in a tightly defined area and may not extend far beyond the agglomeration.

**Figure 5.4** Density of graphic design firms within and outside agglomerations in metropolitan Melbourne, 2001.

![Density of graphic design firms within and outside agglomerations in metropolitan Melbourne, 2001.](image)

**Source:** Australia on Disk, 2001.

In broad terms this analysis has shown how graphic design firms have located in a relatively small part of the metropolitan area with over one third of them located in highly dense agglomeration surrounding the CBD.

**Size of graphic design firms and agglomerations**

The database used to identify graphic design firms does not provide information about their size. However the land use zoning that a firm is located within can be used as a proxy indicator of the size of a firm. Land is
zoned for various uses across the metropolitan area however for the purposes of this analysis, zoning has been simplified into 5 categories:

- Business
- Industrial
- Residential
- Mixed-Use
- Other

Business and industrial zones are areas designated for productive activities. The fact that this land is set aside specifically for businesses means that larger firms are more likely to be located within these zones. Smaller firms and sole practitioners can also operate from this type of zoning.

On the other hand, land zoned for residential uses is primarily used for housing. Productive uses can occur, however there are specific provisions that limit the size of firms working within residential zones in order to protect the amenity of the neighbourhood. These limitations are based on the number of people employed, the proportion of the dwelling used for business purposes, type of equipment used. For this purposes of this analysis the critical factor is the number of employees. This can vary from one person, without council permission, up to four people with council permission.

Furthermore, it is possible some of the firms in residential zones may be operated on a part time basis and may have a different way of operating and set of linkages compared to large firms in the central city.
The Mixed-Use zone, as its title suggests, enables buildings to be used for a range of purposes including residential, business and some industrial uses. As with the Business and Industrial zones, this zone can be used by firms ranging in size from large firms to sole practitioners. Firms can be using dedicated office space, converted warehouse and industrial building as well as residential space for home occupations such as those found in Residential zones.

The Other zones are a mixture of rural and conservation zones. Firms within these zones would be similar to those within residential zones.

From Figure 5.5 it can be seen that there is a split in the structure of this industry. One part involves firms, which are located in residential zones and are scattered across the whole of the metro area. These are predominately small firms as outlined in the discussion above. The other part of the industry are probably larger, although there will be a number of sole practitioners as well, and are found in business zones. It is the firms located in the business zones that in the main make up the agglomerations. This can also be seen in the data for Figure 5.5, where a very large number of firms in business zones are located in the agglomerations. In contrast, there are relatively few firms in agglomerations on residentially zoned land. Hence in what could be typified as the commercial end of the industry, the tendency to cluster is particularly strong.
Figure 5.5  Comparison of zoning between firms within and outside agglomerations, 2001.

Source: Australia on Disk, 2001 and Department of Sustainability and Environment, 2002.

This observation reinforces the idea of the special nature of the cluster location as firms in business zones face higher costs for their accommodation than their counterparts within residential zones.

This section has provided an analysis of firms located within agglomerations and outside agglomerations for 2001. From this analysis it can be seen that while in aggregate 37% of firms are located within the identified agglomerations a large share of the commercial part of the industry are densely packed into a small part of the metropolitan area, paying higher rents and are probably larger than firms outside of the agglomerations. This suggests that there are locational advantages that attract firms to locate within specific areas. The next section is an analysis of the characteristics of the
individual agglomerations to determine if the agglomerations are relatively homogenous or different from one another.

**Number of firms by agglomerations 2001**

Before discussing the number of firms located within each agglomeration it should be noted that some of the agglomerations overlap and intersect one another (see Figure 5.6) particularly the South Bank/CBD agglomeration which overlaps with the South Melbourne, West Melbourne/CBD and Collingwood/Fitzroy agglomerations. When the agglomerations are treated in aggregate the overlap between clusters can be ignored. However, when examining agglomerations on an individual basis some allowance has to be made for overlapping. In this case, rather than double counting the firms where firms fall within the overlapping area of two agglomerations, the firms in the overlapping area are shared equally between the agglomerations. This is a compromise solution as there is no avenue in the method used for determining precisely which firms are part of which cluster. The limitation of using this solution is the number of firms in some of the clusters is expressed as a fraction (ie half a firm).
Figure 5.6  Agglomerations of graphic design firms in metropolitan Melbourne, 2001.

Source:  Australia on Disk, 2001.
From Figure 5.7 it can be seen that the agglomerations fall into two broad groups based on the number of firms. The first group consists of the South Melbourne (69.5 firms), Prahran/St Kilda (58 firms) and Collingwood/Fitzroy (52 firms) agglomerations. Approximately two thirds of graphic design firms located within the agglomerations are located within these 3 areas that ring the CBD. The second group is made up of the smaller agglomerations of Richmond, West Melbourne/CBD, South Yarra and South Bank/CBD.

The previous comments on the location of the agglomerations stressed the importance of the south east of the metro area. This data shows that the within the south east, South Melbourne stands out. This location represents an area around the CBD, providing space for service firms that may need CBD access while avoiding CBD rents and requiring proximity to other firms. As will be shown in data below, this agglomeration is the traditional heart of the graphics industry and its complementary industries. As the commercial growth of Melbourne occurred the advertising industry tended to locate in and near St Kilda Road; in addition one of the large television stations was in this area. Those two factors were likely to be significant in the shaping the development of the South Melbourne Agglomeration.
Figure 5.7  Number of firms by agglomeration, 2001.

The agglomerations in Richmond, Prahran/St Kilda, South Bank/CBD and South Yarra continue to underscore the significance of the southern and eastern side of the CBD in this industry. However, the Collingwood/Fitzroy and West Melbourne/CBD agglomerations suggest that some firms have begun to locate on the non-traditional side of the CBD. This outcome will be explored in more detail below.

Density of firms by agglomeration 2001

From Figure 5.8 it can be seen that the agglomerations in Prahran/St Kilda and South Melbourne are the most densely packed agglomerations compared
to the average density of the agglomerations with 14.8 and 14.1 firms/km² respectively. Once again the traditional core of the industry, along with a nearby agglomeration, stands out.

Significantly the non traditional locations Collingwood/Fitzroy and West Melbourne/CBD agglomerations are also densely packed with a density close to the average density of all agglomerations in metropolitan Melbourne. This suggests locations away from the traditional area to the south and east of the CBD are starting to emerge as important areas for this industry.

**Figure 5.8** Density of firms by agglomeration, 2001.

Elsewhere agglomerations are not as densely packed as in the South Melbourne and Prahran/St Kilda area. This is illustrated by comparing them with the density of the agglomerations in Richmond, South Bank/CBD and
South Yarra. These smaller agglomerations are the least densely packed (ranging from 7.4 firms/km\(^2\) to 7.9 firms/km\(^2\)). This is a significant difference, illustrating that the agglomeration behaviour is not a uniform one, and that some parts of the metropolitan area are much more attractive to these firms than others.

The difference in density may be due in part to the amount of space available for graphic design firms. Agglomerations with relatively low densities of firms may be areas where firms share, or compete, for space with a large number of other users such as industrial users in Richmond. It is also possible that the three agglomerations with the largest number of firms and the highest densities might in fact be specialist design areas.

**Land use zoning of agglomerations, 2001**

From Figure 5.5 it can be seen that most graphic design firms located in the agglomerations are within some form of commercial zoning (ie a business or industrial zone) and a small proportion in residential zones. However, it can be seen from Figure 5.9 that each agglomeration has a different pattern of land use zoning within it. Some of the agglomerations have a number of graphic design firms in residential zones, such as Richmond and South Yarra. Other agglomerations, such as West Melbourne/CBD and South Bank/CBD, all of the graphic design firms are located with some type of commercial zone. This means that the types of firms within each agglomeration, in terms of firm
size, vary across inner Melbourne. This suggests that the character of each agglomeration is significantly different from one another with some agglomerations having a large number of small firms, sole practitioners and part-time practitioners, such as Richmond, while other agglomerations have the potential to be made up of larger, full time firms. These different firms probably have different client bases as well as connections within the agglomeration. As will be shown below, some of the agglomerations have been longer established than others.

Figure 5.9  Land use zoning by agglomeration, 2001.

Source: Australia on Disk, 2001 and Department of Sustainability and Environment, 2002.

The overview presented above shows that agglomerations can be described as a whole to compare with the rest of the population of graphic design firms although a closer examination of the individual agglomerations reveals the individuality of each of the agglomerations.
The analysis carried out here provides some simple insight on the geography of these services. It shows that agglomerations do exist and they are located in the inner city. In addition agglomerations exhibit different characteristics. This has been illustrated by comparing the number of firms in each agglomeration and the density of the agglomerations. However, this analysis reflects the situation in 2001. As stated previously, the number of graphic design firms in metropolitan Melbourne increased from 105 firms in 1981 to 732 firms in 2001. As a result the spatial arrangement of the firms has changed. A key question is whether the tendency to agglomerate is a recent outcome or has a longer heritage. The next chapter will show how these agglomerations have evolved over time and provide further insight into the geography of these services.
Chapter 6

Change in Agglomerations of Graphic Design Firms, 1981 to 2001

The previous chapter established that the agglomerations were significant locations for graphic design firms in 2001. This chapter is a time series analysis of the agglomerations of graphic design firms over a twenty year time period to illustrate the growing importance of the agglomerations and their location. The first section deals with the geographic change of the agglomerations and shows that location and shape of the agglomerations has evolved over time. The second section looks at another dimension of the evolution and development of the agglomerations by examining the growth in the number of firms and the increasing density of the agglomerations. The third section examines the types of firms (new or existing firms relocating) that are driving the development of existing and new agglomerations of graphic design firms. The final section is a discussion about the distinct character of each of the agglomerations using three areas to illustrate this.


From Figure 6.1 it can be seen that the number of agglomerations of graphic design firms has increased from 1 in 1981 to 7 in 2001. However, the rate of
growth has varied over this period. Between 1981 and 1991 the number of agglomerations doubled between each time period (that is from 1 to 2 to 4) while two additional agglomerations were identified between 1991 and 1996 and one additional agglomeration was identified between 1996 and 2001 bringing the total number of agglomerations to 7.

**Figure 6.1** Number of agglomerations of graphic design firms in metropolitan Melbourne, 1981, 1986, 1991, 1996 and 2001.

![Bar chart showing the number of agglomerations from 1981 to 2001.](image)

**Source:** Australia on Disk 1996 and 2001

### The Geographic Evolution of the Agglomerations

Figures 6.2 to 6.6 show the geographic evolution of the agglomerations from 1981 to 2001. From Figures 6.2 and 6.3 it can be seen that the initial focus of the agglomerations was to the south and south east of the CBD in 1981 and 1986 with the identification of agglomerations in South Melbourne and
Prahran. As the industry continued to grow new agglomerations have appeared in different parts of the inner city, namely Collingwood/Fitzroy and Richmond (see Figure 6.4) in 1991. So up until 1991 the agglomerations of graphic design firms were located to the south and east of the CBD, confirming the importance of this location.

In 1996 an agglomeration of firms was identified in the CBD as well as an agglomeration further south in St Kilda/Elwood (see Figure 6.5). These two agglomerations were not identified in 2001. The CBD agglomeration appears to have split into two to form the South Bank/CBD agglomeration and the West Melbourne/CBD agglomeration. The St Kilda/Elwood agglomeration was absorbed into the existing and larger Prahran/St Kilda agglomeration. In 2001 a new agglomeration emerged to the south east of central Melbourne in the suburb of South Yarra (see Figure 6.6).

From Figures 6.2 to 6.6 it can be seen that the South Melbourne agglomeration is the oldest agglomeration of graphic design firms in Melbourne and, as will be shown later, is the largest agglomeration over the twenty year time period under study. Figures 6.2 to 6.6 also show that locations close by South Melbourne have been prominent since 1986 (Prahran St Kilda) and St Kilda Elwood (1996) and South Yarra in 2001. Furthermore it is only in 2001 that an agglomeration was identified to the west of the CBD. This suggests the south east corridor from the CBD has been expanding and intensifying as this industry expands, and in the process has spawned new agglomerations.
From Figures 6.2 to 6.6 it can be seen that the agglomerations change over time in terms of their shape and location. For instance from Figures 6.4 to 6.6 it can be seen that the Collingwood/Fitzroy agglomeration has become smaller in area and moved north since it was initially identified in 1996. The location and shape of the South Melbourne agglomeration has remained relatively stable since 1991, as seen in Figures 6.4 to 6.6, although this agglomeration too has changed shape and location since 1981 (as seen in Figures 6.2 and 6.3).
Figure 6.2  Agglomeration of graphic design firms in metropolitan Melbourne, 1981.

Source: Telecom Yellow Pages, 1981.
Figure 6.3  Agglomerations of graphic design firms in metropolitan Melbourne, 1986.

Source: Telecom Yellow Pages, 1986.
Figure 6.4 Agglomerations of graphic design firms in metropolitan Melbourne, 1991.

Figure 6.5  Agglomerations of graphic design firms in metropolitan Melbourne, 1996.

Source:  Australia on Disk, 1996.
Figure 6.6  Agglomerations of graphic design firms in metropolitan Melbourne, 2001.

Source: Australia on Disk, 2001.
A visual examination of the agglomerations shows change over time, however this a subjective method of measuring change in the size and location of the agglomerations. The following discussion uses two indicators to show both change in location and change in the shape of the agglomerations. The first measure is the change in the geographic location of the centre of the agglomerations, this illustrates the movement of the agglomerations over time. The second indicator is the area of the agglomeration which is way of showing the changing shape of the agglomerations.

From Figure 6.7 it can be seen that the geographic centres of most agglomerations, with the exception of the Richmond agglomeration, have moved a significant distance from their initial location. For instance the centre of the Prahran/St Kilda agglomeration has moved some 1.2 kilometres to the south since it was identified in 1986. From the maps of the agglomerations (Figures 6.2 to 6.6) and the illustration of the geographic centres of the agglomerations (Figure 6.7) it can be seen that while the agglomerations move around the inner suburbs of Melbourne there is a degree of consistency in their location.

This is best illustrated using the South Melbourne agglomeration. The centre of this agglomeration has moved little, approximately 60 metres, between 1996 and 2001. This suggests that as the agglomerations age their location may start to stabilise.
Figure 6.7  Change in the location of the centre of selected agglomerations.

Source:  Australia on Disk 1996 and 2001
The area of the agglomerations can be used as an indicator of the changing shape of the agglomerations as any change in the shape will lead to a change in its area. From Figure 6.8 it can be seen that for most agglomerations the area of the agglomeration has decreased since they were initially identified, with the exception of the Richmond agglomeration. This confirms that as the agglomerations age their shape and extent starts to stabilise.


The visual assessment as well as the analysis of the movement and area of the agglomerations suggests that the agglomerations develop over time. It is a process where an initial and somewhat diffuse agglomeration spreads and then consolidates into a more defined and stable form. It may be that firms, both existing and new, recognize a particular area and are attracted to it thus both increasing the numerical strength of the agglomeration as well as
creating a more defined location. The movement of firms with the agglomerations will be examined in a later part of this chapter.

The discussion above highlights the geographic dynamism of the agglomerations and the way they emerge, develop, and, in some cases, merge with other agglomerations over time. The next section provides an examination of the increasing importance of the agglomerations in terms of the number of firms and the changing density of the agglomerations over a twenty year time period.


From Figure 6.9 it can be seen that the number of firms locating within one of the agglomerations has been increasing since 1981 where some 15 firms were located within the one agglomeration to 271 firms in 7 agglomerations. This growth can be attributed in part to the general increase in the number of graphic design firms as seen in Figure 4.9. Of more interest is the increasing proportion of firms being located in one of the agglomerations. From Figure 6.10 it can be seen that the proportion of firms being located within one of the agglomerations has increased between 1981 and 1996. This observation confirms the notion outlined above that once a location within one of the agglomerations is attractive for graphic design firms it attracts more firms and so intensifies. However there has recently been a slight decline in the proportion of firms locating within one of the agglomerations between 1996
and 2001 as seen in Figure 6.10. This decline is due to the larger number of home based businesses located within residential neighbourhoods entering the industry during this period.

**Figure 6.9**  Number of graphic design firms within agglomerations, 1981, 1986, 1991, 1996 and 2001.

**Source:** Australia on Disk 1996 and 2001

Source:  Australia on Disk 1996 and 2001

Figure 6.11 shows the number of firms within each agglomeration over a twenty year time period. From this figure it can be seen that the South Melbourne agglomeration, which is the oldest of the seven agglomerations identified in 2001, is also the largest of the agglomerations in terms of number of firms. This illustrates that South Melbourne is the traditional core of the graphic design industry and remains the largest agglomeration of graphic design firms in metropolitan Melbourne. However, the South Melbourne agglomeration is also the only agglomeration to have experienced a decline in the number of firms. This suggests that the agglomerations reach a level where firms are unable to locate in them due to factors such as a lack of suitable premises, high rents, loss of cachet of an area or there are too many
competing firms. However it is beyond the scope of this thesis to explore the reasons for this phenomena.

The rate at which the agglomerations grow varies between agglomerations and over different time periods. The Richmond agglomeration is the smallest and slowest developing of the agglomerations that have been identified since 1991 while the Collingwood/Fitzroy agglomeration to its north west, which was also identified in 1991, has been growing rapidly particularly between 1996 and 2001. This suggests that the attractiveness of Richmond is lower than other locations such as Collingwood/Fitzroy and that there are new areas within the inner city of Melbourne, such as South Yarra where a new agglomeration was identified in 2001, that are more attractive to graphic design firms. Furthermore this attraction in turn attracts other firms so a agglomeration forms and continues to grow. The movement of new and existing firms will be discussed later in this chapter to add some insight into the growth of agglomerations.

Source:  Australia on Disk 1996 and 2001


Figure 6.12 shows the density of firms within agglomerations has risen steadily, even in the 1996-2001 period when the proportion of firms in agglomerations declined slightly (see Figure 6.10). So while the proportion of firms in agglomerations has levelled out, the number of firms in the agglomerations has been increasing and, from the density data, there are more firms willing to locate more closely to each other which is a trend that has prevailed over the last twenty years. This observation confirms the idea that at least some firms have a relatively high level proximity to one another in particular parts of the inner suburbs of the metropolitan area and this has strengthened over the last twenty years.

Source:  Australia on Disk 1996 and 2001

Figure 6.13 provides information about the density of firms within each agglomeration over a twenty year time period. As with Figure 6.12, the density of firms within all of the agglomerations has been increasing over time, with the exception of South Melbourne in 2001. From this figure it can also be seen that the largest agglomerations in terms of number of firms, South Melbourne, Prahran/St Kilda and Collingwood/Fitzroy are also the most densely packed agglomerations. The increasing density of these agglomerations is related to the growth in the number of firms in each agglomeration as well as the decreasing area occupied by the agglomerations (see Figure 6.8). This confirms the notion that the agglomerations start as diffuse collections of firms and as other firms locate within the same area the
agglomerations become more compact and defined. This discussion also confirms the idea that graphic design firms are being attracted to a limited number of specific locations within the inner area of the metropolitan area and are willing to or wanting to locate relatively close to one another.


The analysis presented above confirms that some graphic design firms in metropolitan Melbourne locate close to one another. The agglomeration of these firms is not a new occurrence and has been evolving and become more pronounced over the past twenty years. Furthermore this phenomenon occurs in quite localised areas which suggests these locations provide a high level of advantage that attracts firms to agglomeration. The next section will look at the movement of firms to provide some insight into the growth of agglomerations.
Migration of graphic design firms into and out of agglomerations

The locational choices facing firms can be simplified into two choices: either remain in their existing location or move to a new location. Table 6.1 compares the movement of established firms and whether they were located within an agglomeration in 1996 or outside one. It shows that firms within agglomerations are more willing to move than firms outside of agglomerations with about 60% of established firms in the agglomerations opting to relocate between 1996 and 2001 compared with about 40% for the firms outside of the agglomerations. The lower rate of movement of firms outside the agglomerations may be due in part to a large number of these firms being located in residential areas and so the decision to move may not be directly related to the business needs of the firms. In contrast, the firms within the agglomerations and are more likely to be located in a business zone and many will be renting premises, as a result these firms have the opportunity to review their location and maybe more able to relocate.
Table 6.1  Movement of graphic design firms, 1996 to 2001.

<table>
<thead>
<tr>
<th>Type of movement by the firm between 1996 and 2001.</th>
<th>Inside an Agglomeration in 1996</th>
<th>Outside an Agglomeration in 1996</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number</td>
<td>Proportion</td>
</tr>
<tr>
<td>Established firms that did not move ¹</td>
<td>34</td>
<td>13%</td>
</tr>
<tr>
<td>Established firms that moved ¹</td>
<td>50</td>
<td>18%</td>
</tr>
<tr>
<td>New firms*</td>
<td>187</td>
<td>69%</td>
</tr>
<tr>
<td>Total</td>
<td>271</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Australia on Disk 1996 and 2001

¹ Established firms have been identified where the same firm name is matched in the data for 1996 and 2001. Some firms may change their name in this period, these firms would not be identified as established firms and would be identified as new firms and so the number of new firms may be overstated and, conversely, the number of established firms would be understated. The degree to which this happens cannot be estimated.

* New firms are firms identified in an agglomeration or outside an agglomeration between 1996 and 2001.

What is also clear from Table 6.1 is the large number of new firms entering the industry which start up in agglomerations and outside of the agglomerations. As it was seen in Chapter 4, the industry is expanding and is driving the development of the agglomerations. However, most of the new firms in the industry start in a location outside of the agglomerations with nearly twice as many new firms starting outside of the agglomerations than within them. This suggests that agglomeration locations are not necessarily an issue for many new firms, perhaps due to higher rents and scarcity of property.

Looking at established firms, 109 established graphic design firms changed location in the metropolitan area between 1996 and 2001. A large number of these movements were associated with one of the agglomerations. From Table 6.2 it can be seen that 30 firms stayed either in their existing agglomeration (18 firms) or moved to a new agglomeration (12 firms), which
accounts for almost half of the moves. This confirms agglomeration location is regarded as an important consideration for firms within the agglomerations.

**Table 6.2** Movement of established graphic design firms within the agglomerations, 1996 to 2001.

<table>
<thead>
<tr>
<th>Number of firms that moved into the agglomerations</th>
<th>Number of firms that moved out of the agglomerations</th>
<th>Number of firms that moved to a different agglomeration</th>
<th>Number of firms that moved within the same agglomeration</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>21</td>
<td>12</td>
<td>18</td>
<td>64</td>
</tr>
</tbody>
</table>

Source: Australia on Disk 1996 and 2001

Further insight on the significance attached to agglomeration location can be obtained by a study of the distance moved by the 21 firms that moved out of a agglomeration and the 13 firms that moved into a agglomeration. These distances are shown in Figure 6.14.

**Figure 6.14** Distance moved by relocating firms, 1996 to 2001

Source: Australia on Disk 1996 and 2001
Between 1996 and 2001 about 70% of firms moving into a agglomeration were previously located more than 2 kilometres from a agglomeration (see Figure 6.14). These firms have made a substantial effort to be closer to the established agglomeration. In contrast those who have moved out of a agglomeration have moved a much shorter distance, moving less than two kilometres, suggesting that the agglomeration location remains a major attraction. Furthermore, 7 firms, or 35% of firms, moved less than a kilometre from the edge of one of the agglomerations so maintaining very close proximity. So firms moving into the agglomerations are willing to move longer distances than most of the firms moving outside the agglomeration. This suggests two things, firstly that the agglomerations are attractive to some established firms and these firms are willing to move a relatively long way to be part of a agglomeration. The second observation is that most of the firms that have moved out of a agglomeration still want to be close by and maintain the advantages they received in the agglomeration. It is as if the agglomerations have a hinterland or sphere of influence that extends beyond the borders identified previously although the exact extent of this sphere of influence cannot be determined using this data. Looked at another way, a more generous definition of the agglomerations would have included these firms within the borders.

Finally, three new agglomerations emerged between 1996 and 2001 and the majority of firms are new, particularly the West Melbourne/CBD agglomeration and the South Yarra agglomeration. This suggests that some new firms are
attracted to particular locations within inner Melbourne and either added to an existing agglomeration or formed new agglomerations.

In summary, there are four separate processes occurring associated with the agglomerations that actually strengthen them. The first process is the starting up of new firms within the agglomerations. This is the main driving force behind the continued growth of the existing agglomerations and the development of new agglomerations. The second process is the attraction of established firms into the agglomerations from relatively distant parts of the metropolitan area. The third process is the conservative behaviour of established firms, who obviously see no reason to leave agglomeration locations and either do not move from their original location or move within the existing agglomerations. The fourth process is the short distance movement of firms out of the agglomerations. While this may appear to indicate a loss of firms from the agglomerations most of these firms relocate to areas close to one of the agglomerations and possibly maintain the advantages they received from being located within the agglomeration and so in effect are still part of the agglomeration. On balance, agglomeration seems a major factor in this industry.

Character of Agglomerations

The discussion so far has focused on the evolution of the agglomerations as a whole. A limitation of this approach is that all agglomerations have the feeling
of being similar, however, the space these agglomerations occupy in Melbourne are different to one another. To this end this section looks in detail at three areas and describes their growth and character over the past twenty years. The three areas examined in this detailed way will be the South Melbourne agglomeration, the oldest and largest of the agglomerations, Collingwood/Fitzroy agglomeration, the first agglomeration to be located outside of the southern and eastern corridor, and the agglomerations in the Central Business District which is an area where a large number of producer services are located although it is an area newly colonised by graphic design firms.

The South Melbourne Agglomeration

The South Melbourne agglomeration is the oldest and largest of the eight agglomerations identified in 2001 and so is the traditional home of the graphic design industry in Melbourne. The South Melbourne area is also the traditional location of advertising agencies particularly located at the top end of St Kilda Road, this illustrates the potential for face-to-face contact between graphic design firms and advertising agencies. The built form of commercial space in the South Melbourne area is purpose built, low rise (one two three storey) office accommodation so the graphic design firms are moving into an area that has an urban form that is established for office uses.
In 1981 the agglomeration contained only 15 firms (see Figure 6.15) and most were located in two distinct parts of the area identified as a agglomeration. One was near the intersection of Albert Road and Kings Way with the second area being made up of firms scattered to the west of Ferrars Street, 1.5 kilometres to the west. It should also be noted that very few graphic design firms were located outside the agglomeration border in this part of the metropolitan area.

By 1986 (Figure 6.16) the agglomeration became larger in terms of area as well as the number of firms within it. The Albert Road/Kings Way intersection remained a significant location. As well as this area firms started to locate on and around the St Kilda Road/Toorak Road intersection, suggesting they are seeking out locations. The firms to the west of Ferrars Street agglomerated along Birdport Street and became a more defined node within the agglomeration.

Between 1991 and 2001 (Figures 6.18 and 6.19) the shape of the agglomeration changed very little although it becomes larger in terms of the number of firms and density which is apparent in the number of firms marked on the map. The Albert Road/Kings Way area remains as a significant core in the agglomeration. Beyond 1996 the number of firms remains steady, perhaps suggesting this area reached capacity, and a number of other sites in Melbourne have begun to be attractive.
One obvious alternative location was just down the road in what became the Prahran St Kilda Cluster, the second largest and second oldest agglomeration. This illustrates the manner in which a new agglomeration is spawned.
Figure 6.15  South Melbourne Agglomeration, 1981.

Source: Telecom Yellow Pages, 1981.
Figure 6.16 South Melbourne Agglomeration, 1986.

Source: Telecom Yellow Pages, 1986.
Figure 6.17 South Melbourne Agglomeration, 1991.

Figure 6.18  South Melbourne Agglomeration, 1996.

Source: Australia on Disk, 1996.
Figure 6.19  South Melbourne Agglomeration, 2001.

Source: Australia on Disk, 2001.
Collingwood/Fitzroy Agglomeration

In contrast to the steady spawning effect that seems to behave operated in the south eastern corridor, such as the development of the Prahran/St Kilda agglomeration from the South Melbourne agglomeration, the growth of the industry has also created agglomerations in entirely new directions such as firms seeking locations to the north and east of the CBD. To the north a agglomeration formed around Collingwood/Fitzroy while in the east a agglomeration formed in Richmond. Both these agglomerations were first identified in 1991.

When the Collingwood/Fitzroy agglomeration was first identified in 1991, there were 26 firms located within it. The firms were widely dispersed with some as far south as Jolimont (near the Melbourne Cricket Ground) and as far west as Exhibition Street in the Central Business District (Figure 6.20). However most of the firms were located in Collingwood and Fitzroy between Victoria Parade in the south and Alexandra Parade to the north.

By 1996 (Figure 6.21) the agglomeration consolidated with fewer firms to the south. The northern area of the agglomeration is still where most of the firms were concentrated particularly in an area bounded by Nicholson Street to the west, Johnson Street to the north, Wellington Street to the east and Gertrude Street to the south. There were some firms located in Carlton as well as on the north eastern edge of the CBD between Russell and Exhibition Streets.
In 2001 (Figure 6.22) the agglomeration contracted again to be centred on the suburbs of Collingwood, Fitzroy and, to a lesser extent, Carlton. Most of the firms are now located with the Nicholson Street, Johnson Street, Wellington Street and Gertrude Street. A small number of firms are located within Carlton, near Rathdowne Street and in Collingwood along Johnson Street east of Wellington Street. This area is a funky and youth culture orientated area and the retail and commercial activities reflect this. Brunswick Street has a funky feel to it with a range of cafés, restaurants and pubs as well specialty clothing and jewellery shops aimed at the youth market. Smith Street is less commercially orientated area than Brunswick Street and is a grungy area with a number of galleries as well as clothing and accessory shops. This reservoir of culture related activities has probably influenced graphic design firms to locate in this area although confirmation of this proposition is beyond the scope of the current research.
Figure 6.20  Fitzroy/Collingwood Agglomeration 1991

Figure 6.21  Fitzroy/Collingwood Agglomeration 1996

Source:  Australia on Disk, 1996.
Figure 6.22  Fitzroy/Collingwood Agglomeration 2001

Source:  Australia on Disk, 2001.
Central Business District Agglomerations

Up until 1996, no agglomeration had been identified in the CBD. There had always been a small number of graphic design firms in the CBD although not large enough to constitute a nearest neighbour agglomeration. The CBD agglomeration that was identified in 1996 (Figure 6.23) consisted of firms located along Flinders Lane which is away from the major commercial, financial and retail areas of the city which command high rent and probably price graphic design firms out of these locations. Conversely, graphic design firms located in the CBD may actually seek out areas that have a different mix of uses, for example parts of Flinders Lane is home to a wide variety of uses such as community/social welfare organisations, bars, clubs and other design professionals (industrial designers, fashion designers, jewellers and architects).

This choice of location away from the business and retail centre of the CBD has been reinforced with most of the firms in the South Bank/CBD and West Melbourne/CBD (Figure 6.24) locating in the area around Flinders Lane and Little Collins Street and within a number of smaller streets and laneways. Furthermore, one of the nodes of the West Melbourne/CBD agglomeration is located near Dudley Street is also the location of the Queen Victoria Market and a wide range of other uses.
This suggests that the firms that are located within the CBD area do not co-
locate with the usual users of CBD space such as large corporations,
government departments or retailers. This may be due to high rents excluding
graphic design firms from these areas or graphic design firms may be actively
pursuing a location in the non-core parts of the CBD.

Furthermore, it has taken some time for graphic design firms to locate within
the CBD in significant numbers. This suggests that the CBD has not been a
desirable location for these firms which have pursued locations in South
Melbourne and Prahran/St Kilda than to locate in the CBD. This suggests that
graphic design firms, unlike the finance, insurance, legal and government
functions require access to CBD, probably for meetings with clients, but do not
need to be located there permanently. The recent emergence of a
agglomeration in the CBD may be due to the changing cultural nature of the
CBD, such as new bars, cafes and museums as well as an alternative to the
traditional graphic design agglomeration in South Melbourne which may be
reaching capacity although exploring these ideas is beyond the scope of the
current research.
Figure 6.23  CBD Agglomeration, 1996.

Source: Australia on Disk, 1996.
Figure 6.24  West Melbourne and South Bank Agglomerations, 2001

Source:  Australia on Disk, 2001.
The description of the dynamics of the agglomerations of graphic design firms in Melbourne suggests three things.

The first suggestion is an element of a spatial stability or persistence in the location of agglomerations of graphic design firms. The advantages for firms of some particular locations seem to be recognised and maintained over a considerable period. The St Kilda/Elwood and CBD agglomerations run counter to this as they either merged with an existing agglomeration or extended into a larger agglomeration.

The second suggestion is that the agglomerations are malleable in the sense they change shape over time. That implies more firms are added to the edge of the agglomeration or more gather around existing nodes, so reinforcing the attraction of a agglomeration. However the extent and location of the agglomerations varies from agglomeration to agglomeration. For instance the shape and location of the South Melbourne agglomeration, which is the oldest of the agglomerations, has changed little since 1991 where as the Prahran/St Kilda agglomeration, which is the second oldest agglomeration, has moved further south during each time period.

The third suggestion is that graphic designer firms, unlike Finance or Insurance industries, have not found it advantageous to locate within the Central Business District in large numbers until comparatively recently. The small number of graphic design firms that have always located within the CBD tended not to locate in areas used by the large commercial, financial or head
offices, such as Collins Street, or the retail hub in streets such as Swanston Street and Bourke Street. Graphic Design firms in the CBD have tended to locate in areas such as Flinders Lane where a range of users are located. This suggests that graphic design firms in the main prefer to locate outside the CBD in the surrounding inner city area.

This chapter provided an examination of the evolution of the agglomerations. The next chapter will provide some preliminary analysis of the reasons for the agglomeration of graphic design firms.
Chapter 7

Graphic Design Agglomerations and the Location of Allied Industries

While the present research has not undertaken a survey of graphic design firms in order to determine their reasons for locating in particular areas this section provides some preliminary insight into the reasons for the agglomeration of graphic design firms by examining the location of two industries that interact with graphic design firms. This section compares the locations of graphic design firms with firms in two allied industries: Advertising Agencies and Lithographic Printers.

Advertising and lithographic printing were selected for the comparison with graphic design firms because of their close linkage with these industries, as seen in Figure 7.1. The two industries represent two points of the production chain. The roles graphic designers play can be:

- a supplier of design concepts, drawings, layouts, etc for advertising agencies.
- a client of lithographic printers who supply proofs and finished documents.
However the important element is not the where these industries sit in a supply chain but the type of information exchanged between these firms. As mentioned previously (Chapter 2), information can be classified into two groups, complex, non-codified knowledge and codified, standard information. It is suggested that graphic designers need to work closely with their clients during the design process, that is face-to-face interaction, and that this close working relationship promotes physical closeness. So graphic design firms and advertising agencies would be expected to locate in similar areas. This is not to say that all contact between advertiser and designer require face-to-face interaction, however the important decisions will require this type of

Source: Adapted from Yusuf and Nabeshima, 2005.
personal contact. In the case of lithographic printers it is suggested that the printing process is a technical one that depends on the transfer of standard information and so and requires less intense interaction between graphic designer and printer. The relationship could be one where most of the contact occurs electronically, such as emailing layouts and phoning through corrections, with periods of intense and short term face-to-face contact between graphic designer and printer, such as the graphic designer working alongside the printer to ensure that the final product is produced to the required standard. To this end most of the contact with the lithographic printer could be transacted by email and courier with some face-to-face contact at the end of the process. As a result there would be less need for graphic designers to be located close to lithographic printers.

The following analysis examines the location of advertising agencies and lithographic printers based on postcodes of firms in 1981, 1991 and 2001 and compares this with the previously identified agglomerations of graphic designers to determine if the propositions made above hold true.

**Advertising Agencies**

From Figure 7.2 to 7.4 it can be seen that the location of advertising agencies is similar to the location of agglomerations of graphic design firms in the metropolitan area. Furthermore, the major concentrations of advertising and
graphic design firms occur within a relatively small area, in a radius of about 5km from the CBD.

Figure 7.2 Location of advertising agents and graphic design firms, 1981.

Source: Telecom Yellow Pages, 1981.
Figure 7.3  Location of advertising agents and graphic design firms, 1991.


Figure 7.4  Location of advertising agents and graphic design firms, 2001.

Source: Australia on Disk, 2001.
For 1981, the agglomeration of graphic design firms falls within the major concentration of advertising firms in South Melbourne. During 1991 and 2001 some advertising firms spread out into surrounding suburbs to the south, such as Port Melbourne, and to the east in suburbs such as Richmond, South Yarra and Prahran which is similar to the development of the agglomerations of graphic design firms. However, significant concentrations of advertising firms are not located north of the CBD in Collingwood or Fitzroy, or in the south east in the suburb of St Kilda, as is the case with graphic design firms.

One reason for the relatively limited number of concentrations of advertising firms is the low level of growth in the industry from 257 firms in 1981, 408 in 1991 to 434 in 2001. This suggests that pressure on advertising firms to move out of South Melbourne and into surrounding suburbs is not as great as that on graphic design firms where the industry has experienced more substantial growth.

The similarity in the location of concentrations of advertising firms and agglomerations of graphic design firms suggests two things. First, both graphic design firms and advertising firms are attracted to the inner city, particularly east and south of the CBD. Second graphic designers and advertising firms locate close to each other as they require frequent face-to-face contact. This proposition cannot be confirmed here using this data and will require interviews of firms to confirm the significance of this spatial pattern.
Lithographic Printers

While there are many types of printers, such as general printers, card printers, screen printers etc, lithographic printers are used for large volume and high quality reproduction such as reports and posters. Lithographic printers are the type of printers graphic designers use for the reproduction of the sophisticated designs.

Lithographic printing firms are more dispersed across the central and south eastern areas of the metropolitan area compared to the concentrations of advertising firms and the agglomerations of graphic designers. In 1981 there were printers near the CBD which were the closest concentration of printers to the graphic design agglomeration in South Melbourne (see Figure 7.5). The other major concentration of printers was in Moorabbin. In 1991, Figure 7.6, the total number of lithographic printing firms decreased from 164 to 100 firms with pockets of firms spread across the north, east and south east of the metropolitan area, particularly Richmond and Moorabbin. One concentration of printers was near the agglomeration of graphic design firms in Richmond. In 2001 the number of printers had decreased to 66 with the 2 major locations with one in Brunswick and the other in Moorabbin as seen in Figure 7.7. From Figures 7.5 to 7.7 it can be seen that graphic designers and lithographic printers have very distinct and different patterns of location.

It can also be seen that for 1981 and 1991 the lithographic printers were located more closely to the agglomerations of graphic design firms than they
were in 2001. One factor is that printers are more constrained in their choice of locations as they need to be located in industrial zones. This accounts for the concentration of lithographic printers in Moorabbin and Brunswick where there are a large number of small scale industrial premises suitable for printers to use. However the period between 1991 and 2001 also coincides with the major expansion of electronic communication. The dispersal of lithographic printers compared to the major agglomerations of graphic design firms may be an indication that linkages between these two industries are changing. For 1981 and 1991 the main way of communicating between these industries would have been to courier physical drawings and proofs between printers and designers where as now it is done by files in Portable Document Format (PDF) and email. So there is a break in the physical link between printers and graphic designers which has enabled printers to leave the inner city, and the associated competition for space, for industrial areas in the middle suburbs of Melbourne.
Figure 7.5  Location of lithographic printers and graphic design firms, 1981.

Source: Telecom Yellow Pages, 1981.

Figure 7.6  Location of lithographic printers and graphic design firms, 1991.

Figure 7.7 Location of lithographic printers and graphic design firms, 2001.

The analysis above of two allied industries provides some insight into the agglomeration of graphic design firms. As expected, graphic designers and advertising firms need to locate near one another in order to share the same attributes of a particular area and for close, dense and intimate contact between the two industries for joint work such as developing ideas, scoping work and agreeing on design concepts. This type of contact requires instant feedback, both verbal and graphic, and is best performed as face-to-face contact. In contrast, there appears to be very little spatial relationship between lithographic printers and graphic designers. This suggests a difference between service to service links and service to manufacturing links and that agglomeration is significant where service to service links are more
important. It appears in these cases that the type and intensity of communication drives the locational choices of graphic design firms.

This analysis is speculative and depends upon a number of suppositions. In order to confirm the assertions made about the behaviour of graphic design firms towards advertising agencies and lithographic printers and the conclusions drawn about their locations, some form of social research would have to be undertaken. This will be discussed in the concluding chapter.
Chapter 8

Conclusion

This thesis has provided both theoretical and empirical insights into the evolving geography of a producer service in a metropolitan setting. This chapter will provide a conclusion to this thesis by providing connections between the empirical research, the theoretical framework and the broader disciplines of geography and planning. The first section will discuss the empirical results in the light of the literature reviewed in chapter two and highlight the strong linkages between the results of this research and theory. This section will also draw linkages between this research and the changing economic geography of the inner city. The work presented here sheds some light on the metropolitan dynamics of a producer service, however, there is always scope for improvement that can increase its value and explanatory power. So a second section will suggest a way forward for this research with an agenda for studying the intra-metropolitan geography of producer services.

Discussion of results and its relationship to theory

As shown in Chapter 2, there is limited research on producer services on an intra-metropolitan level. This research has sought to add a significant piece of
analysis to the body of thinking by using a method to identify agglomerations of firms and incorporating time into its perspective.

The analysis of the geography of an industry can use a multitude of different scales and boundaries for analysis, for instance describing the distribution of firms over a metropolitan area using local government areas, postcodes or a grid. This research used the actual location of firms and a geospatial analytical technique to identify marked concentrations or agglomerations and used the agglomerations as the primary spatial unit of analysis. This is an innovative step in this general area of research.

The methodology employed to identify agglomerations of graphic design firms is potentially fruitful for others engaged in producer services research. As long as a geospatial database of the location of firms exists, or can be created, and there is access to geospatial information technology to manipulate this data, maps of the distribution of firms and the identification of agglomerations can be created almost instantly. These maps can sharpen the perspective on the location of the service under review and helps to shape other research questions, some of which are explored below. The software used, CrimeStat, also has the flexibility (explored in Appendix C) to identify agglomerations using different parameters than those used in this research. By applying and refining the spatial statistical approach of CrimeStat to producer services this research has provided future producer services locational studies with a useful example to follow.
The approach, when applied to graphic design firms, showed they are not distributed evenly across metropolitan Melbourne but exhibit a distinct geography. This geography has two distinct types of distribution. The first type of distribution consists of firms that are located within relatively densely packed clusters or agglomerations within the inner suburbs that surround the Central Business District. The second distribution consists of firms scattered across the middle and outer parts of the metropolitan area, primarily to the east and south the central city.

The agglomeration of graphic design firms within the inner suburbs of Melbourne confirms the results of similar research undertaken on financial business services in London (Taylor et al 2003) and on design based business services in Vancouver (Hutton 2000 and 2004a). This study confirms that the geography of producer services is more nuanced than just concentrating in the CBD of cities. There are a range of producer services, such as graphic design, that choose to locate near or adjacent to the CBD of their city but not within it.

The significant contribution this research makes to the discourse of producer services is its use of time series analysis. It was found that some agglomerations exhibit a degree of inertia, that once an agglomeration of graphic design firms is established, it tends to persist. Having said that the agglomerations should not be seen as solid, inflexible and set in stone as they exhibit a degree of malleability in their location, shape, area, density and number of firms within them. For example the South Melbourne
Agglomeration, which is the oldest, has experienced an increase in the number of firms within it as well as a change in its shape and location. This is an example of the long persistence of an agglomeration. On the other hand there are agglomerations, such as the St Kilda/Elwood Agglomeration that was identified for the first and only time in 1996, before being absorbed into the Prahran/St Kilda Agglomeration. This change is very small in general terms as the south east fringe of the CBD has remained a key location for this industry. Hence the agglomerations exhibit differences in their persistence with some agglomerations growing, that is increasing in the number of firms that decide to locate in that area, while others merge with other agglomerations or disappear. Therefore once an agglomeration is identified there is no certainty that it will continue to exist and so there is a level of dynamism in the geography at the local scale that perhaps has not been exposed before. Change in the location of producer services is not unusual. Analysis of the location of producer services has often identified areas of gain and areas of loss. For example, financial services in New York have been changing over time moving from Wall Street to other locations such as Mid Town. The reasons for this change in location are a combination of technological change, such as communications technology, organisational change, such as the splitting of front office and back office functions and, to a lesser extent, the result of the terrorist attack on the 11th of September 2001 (Pohl 2004). Yet the old core of lower Manhattan, like the core of graphic design in South Melbourne, remains a significant location for this industry.
The results presented here go to the heart of a debate about the impact of telecommunications and other media on firm location. As discussed in the literature review, the weightless economy thesis claims that many products produced in developed economies exist as electronic information and virtually weightless. These products can be transported anywhere with the use of information and communication technologies. In this circumstance it is claimed that the role of geography in the location of businesses and the creation of products is reduced or, at its most extreme, prophesizes its death. Applying the weightless economy thesis to the location of graphic design in Melbourne would see firms free to locate in any part of the metropolitan area and avoid spatially related costs and limitations such as high commercial rents in the inner city or difficulties with parking in the inner suburbs. Ultimately any pattern of distribution or clustering of firms would be an anomaly or short lived.

In contrast to this notion, the research established that there is a distinct geography of graphic design firms in Melbourne and that the pattern of firms agglomerating in distinct parts of the inner city is a long term and persistent pattern. There are features of the inner city and agglomerations of firms, such as face-to-face communication, that outweigh the ability to locate anywhere across the metropolitan region. As discussed below, this observation would be strengthened by further research into the reasons why firms locate where they do. So reports of the death of geography are greatly exaggerated.

While this research uses metropolitan Melbourne and graphic design firms as a case study, this work contributes to the wider idea of the remaking of the economic geography of the city and the renewal of the inner city. The renewal
and remaking of local economic geography is a phenomenon that is occurring in most inner areas of metropolitan areas. London (Taylor et al 2003), Vancouver (Hutton 2004a and 2004b) and Boston (Glaeser 2004) have received recent attention. Inner Melbourne has witnessed a sea change in the way its spatial economy is expressed. In the 1950s there were a wide range of different uses inhabiting the inner city. It was the location for head offices of resource companies, banks, retailers and manufacturers. However there have been some marked changes in the location of some of these industries. For instance manufacturing in the inner city has declined significantly from employing 143,000 people, (60% of manufacturing workers in the metropolitan area in 1949 (MMBW 1954)) to approximately 30,000, or 12% of manufacturing workers in the metropolitan area in 2001 (ABS Census of Population and Housing). This decline in the centralisation of manufacturing is magnified when looking at the CBD where 37,000 people were employed in manufacturing, or 16% of manufacturing workers in the metropolitan area, in 1949 (MMBW 1954) compared to 3,400 people, or just 1% of manufacturing workers in the metropolitan area, in 2004 (Census of Land Use and Employment 2004, City of Melbourne). Manufacturing space in the twenty first century is now primarily located near freeways on the fringe of the metropolitan area (DSE 2004). While retail services and producer services such as banking and finance have always existed in the inner area of Melbourne, particularly the CBD, new producer services, such as management consulting, computing and graphic design are reshaping the economic geography of the inner city, often utilising the spaces left by manufacturing. This research also illustrates this outcome in one particular
service, showing how selective this renewal is on a detailed geographic scale. Areas wax, such as South Melbourne and Collingwood, others wane, such as Richmond, while some areas, for the time being, miss out entirely, such as Footscray to the west or Brunswick to the north of the CBD, as the economic landscape of the inner city is remade.

A way forward

No piece of research is perfect, there are always limits as to what the researcher can provide as part of a thesis. There will always be questions that open as a result of the research that have to be left for another time or for others to undertake. This section is a discussion of the questions that have been left hanging in the thesis or are a logical extensions of this work and could be tackled in the future. The most significant step would involve a behavioural emphasis, one that provides reasons why selected firms locate where they do.

One theme to explore is the importance of face-to-face contact to the flow of information

**Hypothesis:** Face-to-face contact is the key method of communication for producer services and so these firms locate close to their key contacts/clients.

Part of an explanation for the agglomeration of graphic design firms was provided by an analysis of industries allied to it. For example there are
similarities in the location of advertising firms and the agglomerations of graphic design firms. It was suggested that this is evidence of the need for these two industries to interact with each other on a frequent and face-to-face basis while lithographic printing firms and graphic design firms did not share similar areas of the metropolis as the information exchange is of a more technical and formulaic nature not requiring face-to-face contact. On the surface there appears to be a strong argument for advertising agencies and graphic designers to use similar parts of the metropolitan area. In order to confirm this hypothesis a diary of contacts could be used to track the:

- company and sector the graphic design firms interact with
- location of the interaction
- type of contact, ie face-to-face meeting, telephone conversation, email etc

By using a diary of contacts a more accurate picture of the actual interactions and flows of information across space could be produced as the participants update the information on a regular basis rather than relying on the vagaries of memory.

Another area of exploration is the character of the agglomerations

**Hypothesis:** The agglomerations surrounding the Central Business District have unique character and attract a particular type of firm to locate within them.

As argued in Chapter 6, the agglomerations surrounding the CBD are not homogeneous. The agglomerations represent different cultural groupings. For instance based on some preliminary fieldwork, firms in the South
Melbourne Agglomeration were described as more “corporate” compared to the “funky” and “edgy” firms that are located in the newer Collingwood/Fitzroy Agglomeration. An element of this difference in the agglomerations is the branding or commodification of space, where specific areas are seen as representing a particular cultural ethos, much in the same way the “City” in London is seen as a type of brand, although in the case of the “City” it is an internationally recognized brand. This branding of space may influence the search decisions of users of graphic design firms and also new graphic design firms looking for space. In order to test this idea it would be necessary to interview the firms about their location preferences to determine if the agglomerations are seen as different in character.

The final area to explore is the suburbanisation of producer services

**Hypothesis:** There is a disjunction in the graphic design industry with specialist graphic design firms agglomerating in the inner suburbs of Melbourne while less specialised firms are dispersed across the metropolitan area.

While the focus of the research has been on the agglomerations of graphic design firms it has been dealing with a minority of all graphic design firms in Melbourne. The majority of firms, some 72% of them in 2001, locate outside of the agglomerations identified here distributed across the metropolitan area of Melbourne. The research suggested that these scattered firms are likely to be small concerns as they tend to be located within residential zones. This spatial division within the industry raises two issues.
First that the firms in the suburbs serve a smaller and localised area, with a more limited range of services to clients that do not require the diverse skill base of a specialised graphic design service based in the agglomerations surrounding the CBD. This proposition is based on land use zoning information and needs to be confirmed with a survey of firms, both in the agglomerations and those scattered across the suburbs of metropolitan Melbourne.

An alternative interpretation is that graphic design firms located anywhere within the metropolitan area have access to a wide range of clients and suppliers and so firms can locate within any suburb. However not all areas are equally serviced by transport infrastructure, so if face-to-face interaction is a key concern, then firms less well served by transport infrastructure, both in distance and time (due to issues such as accessibility to the freeway network or congestion), will be at a disadvantage compared to those firms that are located close to clients and suppliers. As stated above, these firms may service a more localised clientele. This notion could be tested by using a diary of contacts by the two groups of firms, one within the agglomerations and the other outside the agglomerations. An analysis of the results showing differences and similarities in terms of the location of contacts and type of communication used would show the effect of location on business networks.

A further level of complexity in the suburbanisation of producer services is highlighted by the work of Coffey and Shearmur (2002) on Montreal and Boiteux and Guillain (2005) on metropolitan Paris. These studies have found
that while some producer services are moving from the CBD to suburban locations, these firms tend to locate in particular areas in the suburbs. So while the intensity of agglomeration in the CBD appears to be weakening, agglomerations in the suburbs are strengthening. Both Coffey and Shearmur and Boiteux and Guillain suggest that the agglomeration in the suburbs still reflects the importance of face-to-face interaction as a key manner of communication and that all that has changed is the location it takes place in. In order to test this idea it is necessary to identify agglomerations at a smaller scale than the one used for this research. This could be a matter of applying a different set of parameters to CrimeStat or the application of a different technique.

There is much work still to be done in order to fully understand the spatial dynamics of non-finance sector producer services, such as graphic design. The research agenda outlined above is a start although there are a couple of logical augmentations. The first is to apply this research to a range of different producer services. As mentioned previously, the location of producer services is more nuanced than just the concentration of firms in the CBD and so by applying this research to a range of services the similarities and differences between industry sectors can be observed. This agenda could be widened to include comparative research of producer services in other metropolitan areas and examine how their individual geographies vary and the reasons why. All cities are different in terms of social and business culture, infrastructure, land use planning policy, topography, just to name a few aspects. Although there may be some commonalities in the location and
business requirements of producer services, such as face-to-face
communication, local physical and policy environments might create special
local outcomes. This research agenda would provide a higher degree of
insight into the location of producer services as well as a greater
understanding of the economic remaking and renewal of the inner city.
Bibliography


Appendix A

CrimeStat 2.0 Instructions for Nearest Neighbour Clustering Routine


Nearest Neighbor Hierarchical Clustering (Nnh)

The nearest neighbor hierarchical clustering (Nnh) routine in CrimeStat identifies groups of incidents that are spatially close. It is a hierarchical clustering routine that clusters points together on the basis of a criteria and proceeds to group the clusters together. The clustering is repeated until either all points are grouped into a single cluster or else the clustering criteria fails. Hierarchical clustering methods are among the oldest cluster routines (Everitt, 1974; King, 1967; Systat, 2000). Among the clustering criteria that have been used are the nearest neighbor method (Johnson, 1967; D'andrade, 1978), farthest neighbor, the centroid method (King, 1967), median clusters (Gower, 1967), group averages (Sokal and Michener, 1958), and minimum error (Ward, 1967).

The CrimeStat Nnh routine uses a nearest neighbor method that defines a threshold distance and compares the threshold to the distances for all pairs of points. Only points that are closer to one or more other points than the threshold distance are selected for clustering. In addition, the user can specify a minimum number of points to be included in a cluster. Only points that fit both criteria - closer than the threshold and belonging to a group having the minimum number of points, are clustered at the first level (first-order clusters).

The routine then conducts subsequent clustering to produce a hierarchy of clusters. The first-order clusters are themselves clustered into second-order clusters. Again, only clusters that are spatially closer than a threshold distance (calculated anew for the second level) are included. The second-order clusters, in turn, are clustered into third-order clusters, and this re-clustering process is continued until no more clustering is possible, either all clusters converge into a single cluster or, more likely, the clustering criteria fail.

In order to conduct clustering, the user specifies two parameters:

1. First, for the threshold distance, a one-tailed confidence interval around the random expected nearest neighbor distance. The t-value
corresponding to this probability level, \( t \), is selected from the
Student's t-distribution under the assumption that the degrees of
freedom are at least 120.\(^2\)

2. Second, the minimum number of points that are required for each
cluster. This criteria is used to reduce the number of very small
clusters. The default is 10. By decreasing this number, more clusters
are produced; conversely, by increasing this number, fewer clusters
are produced.

Criteria 1: Nearest Neighbor Distance

The first criteria that is used for clustering points together is the confidence interval
around the random expected nearest neighbor distance for first-order nearest neighbors.
This is controlled by a slide bar under the routine (see Figure 6.3). From chapter 5, the
mean random distance was defined as

\[
\text{Mean Random Distance} = d(\text{ran}) = 0.5 \sqrt{\frac{N}{A}} \quad (5.2)
\]

where \( A \) is the area of the region and \( N \) is the number of incidents. The confidence interval
around that distance is defined as

\[
\text{Confidence Interval for Mean Random Distance} = \text{Mean Random Distance} \pm t^* \text{SE}_{\text{dist}}
\]

\[
= 0.5 \sqrt{\frac{A}{N}} \pm t \left( \frac{0.26136}{\sqrt{N/A}} \right) \quad (6.1)
\]

where \( A \) is the area of the region, \( N \) is the number of incidents, \( t \) is the \( t \)-value associated
with a probability level in the Student's t-distribution.

The lower limit of this confidence interval is

\[
\text{Lower Limit of Confidence Interval for Mean Random Distance} = 0.5 \sqrt{\frac{A}{N}} - t \left( \frac{0.26136}{\sqrt{N/A}} \right) \quad (6.2)
\]

and the upper limit of this confidence interval is
Upper Limit of Confidence Interval for Mean Random Distance
\[ A \times 0.26136 \frac{0.5 \sqrt{\frac{N}{A}}}{\sqrt{N}} + t \text{[equation (6.3)]} \]

The confidence interval defines a probability for the distance between any pair of points. For example, for a specific one-tailed probability, \( p \), fewer than \( p \% \) of the incidents would have nearest neighbor distances smaller than this selected limit if the distribution was spatially random. If the data were spatially random and if the mean random distance is selected as the threshold criteria (the default position on the slide bar), approximately 50% of the pairs will be closer than this distance. For randomly distributed data, if a \( p \leq 0.05 \) level is taken for \( t \) (two steps to the left of the default or the fifth in from the left), then only about 5% of the pairs would be closer than the threshold distance. Similarly, if a \( p \leq 0.75 \) level is taken for \( t \) (one step to the right of the default or the fifth in from the right), then about 75% of the pairs would be closer than the threshold distance.

In other words, the threshold distance is a probability level for selecting any two points (a pair) on the basis of a chance distribution. The slide bar has 12 levels and is associated with a probability level for a \( t \)-distribution from a sample of 120 or larger. From the left, the \( p \)-values are approximately (Table 6.2):

<table>
<thead>
<tr>
<th>Scale Bar Position</th>
<th>Probability</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.00001</td>
<td>Far left point of slide bar</td>
</tr>
<tr>
<td>2</td>
<td>0.0001</td>
<td>1-2nd from left</td>
</tr>
<tr>
<td>3</td>
<td>0.001</td>
<td>3-4th from left</td>
</tr>
<tr>
<td>4</td>
<td>0.01</td>
<td>4-5th from left</td>
</tr>
<tr>
<td>5</td>
<td>0.05</td>
<td>5-6th from left</td>
</tr>
<tr>
<td>6</td>
<td>0.1</td>
<td>6-7th from left</td>
</tr>
<tr>
<td>7</td>
<td>0.5</td>
<td>7-8th from right (default value)</td>
</tr>
<tr>
<td>8</td>
<td>0.75</td>
<td>8-9th from right</td>
</tr>
<tr>
<td>9</td>
<td>0.9</td>
<td>9-10th from right</td>
</tr>
<tr>
<td>10</td>
<td>0.95</td>
<td>10-11th from right</td>
</tr>
<tr>
<td>11</td>
<td>0.99</td>
<td>11-12th from right</td>
</tr>
<tr>
<td>12</td>
<td>0.999</td>
<td>Far right point of slide bar</td>
</tr>
</tbody>
</table>

This is the threshold distance for the routine. Taking a broader conception of this, if there is a spatially random distribution, then for all distances between pairs of points, of which there are

218
\[
\frac{N (N-1)}{2}
\]

combinations, fewer than \( p\% \) of the pairs will be shorter than this threshold distance.

**Area must be defined correctly**

Note: it is very important that area be defined correctly for this routine to work. If the user defines the area on the measurement parameters page (see chapter 3), the Nnh routine uses that value to calculate the threshold distance. If the user does not define the area on the measurement parameters page, the routine calculates the area from the minimum and maximum X/Y values (the bounding rectangle). In either case, the routine will be able to calculate a threshold distance and run the routine.

However, if the area units are defined incorrectly on the measurement parameters page, then the routine will certainly calculate the threshold distance wrongly. For example, if data are in feet but the area on the measurement parameters page are defined in square miles, most likely the routine will not find any points that are farther apart the threshold distance since that distance is defined in miles. In other words, it is essential that the area units be consistent with the data for the routine to properly work.

**Criteria 2: Minimum Number of Points**

This does not mean, however, that the probability of finding a cluster is equal to this probability. It only indicates the probability of selecting two points (a pair) on the basis of a chance distribution. If additional points are to be included in the cluster, then the probability of obtaining the cluster will be less. Thus, the probability of selecting three points or four points or more points on the basis of chance will be much smaller.

The second criteria, therefore, is the minimum number of points that should be included in any cluster. The routine will only include points in the final clustering that are part of groups (or clusters) in which the minimum number is found.

**First-order clustering**

Using these criteria, CrimeStat constructs a first-order clustering of the points. For each first-order cluster, the center of minimum distance is output as the cluster center, which can be saved as a .dbf file. To identify the approximate cluster location, a standard deviational ellipse is calculated for each cluster (see chapter 4 for definition). The user can choose between 1X (the default), 1.5X, and 2X. Typically, one standard deviation will cover more than 50% of the cases, one and a half standard deviations will cover more than 90% of the cases, and two standard deviations will cover more than 99% of the cases, although the exact percentage will depend on the distribution. The user specifies the number of standard deviations to save as ellipses in .ArcView .shp, .MapInfo .mif or Atlas*GIS .bna formats.
In general, use a 1X standard devitional ellipse since 1.5X and 2X standard deviations can create an exaggerated view of the underlying cluster. The ellipse, after all, is an abstraction from the points in the cluster that may be arranged in an irregular manner. On the other hand, for a regional view, a 1X standard devitional ellipse may not be very visible. The user has to balance the need to accurately display the cluster compared to making it easier for a viewer to understand its location.

**Second and higher-order clusters**

The first-order clusters are then tested for second-order clustering. The procedure is similar to first-order clustering except that the cluster centers are now treated as 'points' which themselves are clustered. The process is repeated until no further clustering can be conducted, either all sub-clusters converge into a single cluster, or the threshold distance criteria fails, or there are fewer than four seeds in the higher-order cluster.

**Guidelines for Selecting Parameters**

In the Nnh routine, the user has to define three parameters - the likelihood (or p-value) for selecting a pair by chance (the threshold distance), the minimum number of points, and the number of standard deviations for the ellipses that are output. The p-value is selected with a likelihood slider bar (see figure 6.3). This bar indicates a range of p-values from 0.00001 (i.e., the likelihood of obtaining a pair by chance is 0.001%) to 0.999 (i.e., the likelihood of obtaining a pair by chance is 99.9%). The slider bar actually controls the value of t in equation 6.3, which varies from -3.719 to 3.090. The smaller the t-value, the smaller the threshold distance. With smaller threshold distances, fewer clusters are extracted, which are typically smaller (although not always).

If only pairs of points were being grouped, then the threshold distance would be critical. Thus, if the default p ≤ 0.5 value is selected, then about half the pairs would be selected by chance if the data were truly random. However, since there are a minimum number of points that are required, the likelihood of finding a cluster with the minimum number of points is much smaller. The higher the minimum number that is required, the smaller the likelihood of obtaining a cluster by chance.

Therefore, one can think of the slide bar as a filter for grouping points. One can make the filter smaller (moving the slide bar to the left) or larger (moving the slide bar to the right). There will be some effect on the final number of clusters, but the likelihood of obtaining a cluster by chance will be generally low. Statistically, there is more certainty with small threshold distances than with larger ones using this technique. Thus, a user must trade off the number of clusters and the size of an area that defines a cluster with the likelihood that the result could be due to chance.

This choice will depend on the needs of the user. For interventions around particular locations, the use of a small threshold distances may actually be appropriate; some of the ellipses seen in 6.7 below cover only a couple of street segments. These define micro neighborhoods or almost pure hot spot locations. On the other hand, for a patrol
route, for example, a cluster the size of several neighborhoods might be more appropriate. A patrol car would need to cover a sizeable area and having a larger area to target might be more appropriate than a 'micro' environment. However, there will be less precision with a larger cluster size covering this type of area.

A second criterion is the minimum number of points that are required to define a cluster. If a cluster does not have this minimum number, CrimeStat will ignore the seed location. Without this criterion, the Nnh routine could identify clusters of two or three incidents each. A hot spot of this size is usually not very useful. Consequently, the user should increase the number to ensure that the identified cluster represents a meaningful number of cases. The default value is 10, but the user can type in any other value.

The user may have to experiment with several runs to get a solution that appears right. As a rule of thumb, start with the default settings. If there appears to be too many clusters, tighten up the criteria by selecting a lower probability for grouping a pair by chance (i.e., shifting the threshold distance to the left) or increasing the minimum number of points required to be defined as a cluster (e.g., from 10 to 20). On the other hand, if there appears to be too few clusters, loosen the criteria by selecting a higher probability for grouping pairs by chance (i.e., shifting the threshold distance to the right) or decreasing the minimum number of points in a cluster (e.g., from 10 to 5). Then, once an appropriate solution has been found, the user can fine tune the results by slight changes.

In general, the minimum number of points criteria is more critical for the number of clusters than the threshold distance, though the latter can also influence the results. For example, with the 1996 Baltimore County robbery data set (N=11381 incidents), a minimum of 26 and a maximum of 28 clusters were found by changing the threshold distance from the minimum p-value ($p<0.00001$) to the maximum p-value ($p<0.999$). On the other hand, changing the minimum number of points per clusters from 10 to 20 reduced the number of clusters found (with the default threshold distance) from 26 to 11.

The third criterion is the output size of the clusters. For each cluster in turn, a standard deviational ellipse is calculated (see chapter 4). The user specifies the size of the ellipse in terms of standard deviations. The choices are 1X (the default), 1.5X and 2X standard deviations. Typically, one standard deviation will cover more than 50% of the cases, one and a half standard deviations will cover more than 90% of the cases, and two standard deviations will cover more than 99% of the cases, although the exact percentage will depend on the distribution.

In general, use a one standard deviational ellipse since 1.5X and 2X standard deviations can create an exaggerated view of the underlying cluster. On the other hand, for a regional view, a one standard deviational ellipse may not be very visible. The user has to balance the need to accurately display the cluster compared to making it easier for a viewer to understand its location.
Visualizing Change in Drug Arrest Hot Spots
Using Nearest Neighbor Hierarchical Clustering:
Charlotte, N.C. 1997 - 98

James L. LeBeau
Administration of Justice
Southern Illinois University at Carbondale

Stephen Schnelly
Criminology & Criminal Justice
University of Missouri - St Louis

The CrimeStat Nearest Neighbor Hierarchical clustering routine and GIS were used for defining, comparing, analyzing, and visualizing changes in drug arrest clusters between 1997 and 1998. Using a minimum cluster size of 25 arrests some of the emerging patterns or relationships include: 1) the overlapping of secondary clusters, but those emerging during 1998 were much larger, especially in the north because of new primary clusters; 2) many primary clusters during 1997 remaining static or increasing in area during 1998; and 3) the disappearing of some 1997 primary clusters during 1998, with new clusters emerging close by implying displacement.
**Nnh Output Files**

The Nnh routine has six outputs. First, for each cluster that is identified, the hierarchical order and the cluster number. Second, for each cluster that is calculated, CrimeStat calculates the mean center of the cluster. Only 45 of the seed locations are displayed on the screen. The user can scroll down or across by adjusting the horizontal and vertical slider bars and clicking on the Go button. This can be saved as a '.dbf' file. Third, the standard devitional ellipses of the clusters. The size of the ellipses are determined by the number of standard deviations to be calculated (see above). Fourth, the number of points in the cluster. Fifth, the area of the ellipse and, sixth, the density of the cluster (number of points divided by area).

The ellipses can be saved in ArcView '.shp', MapInfo '.mif' or Atlas 'GIS '.bna' formats. Because there are also orders of clusters (i.e., first-order, second-order, etc.), there is a naming convention that distinguishes the order. The convention is

\[
\text{Nnh}<O><\text{username}>
\]

where \( O \) is the order number and \( \text{username} \) is a name provided by the user. Thus,

\[
\text{Nnh1Robbery}
\]

are the first-order clusters for a file called `Robbery' and

\[
\text{Nnh2NightBurglaries}
\]

are the second-order clusters for a file called `NightBurglaries'. Within files, clusters are named

\[
\text{Nnh}<O>\text{E}<N><\text{username}>
\]

where \( O \) is the order number, \( N \) is the ellipse number and \( \text{username} \) is the user-defined name of the file. Thus,

\[
\text{Nnh1E11Robbery}
\]

is the tenth ellipse within the first-order clusters for the file `Robbery' while

\[
\text{Nnh2E11NightBurglaries}
\]

is the first ellipse within the second-order clusters for the file `NightBurglaries'.

In other words, names of files and features can get complicated. The easiest way to understand this, therefore, is to import the file into one of the GIS packages and display it.

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Appendix B

Example of the text report generated by CrimeStat

Nearest Neighbor Hierarchical Clustering:

Sample size: 732
Likelihood of grouping pair of points by chance: 0.00001 (0.001%)
Z-value for confidence interval: -3.719
Measurement type: Direct
Output units: Kilometers, Square Kilometers, Points per Square Kilometers
Standard Deviations: 1.5
Clusters found: 8
Simulation runs: 0
Start time: 03:29:23 PM, 10/24/2005
End time: 03:29:26 PM, 10/24/2005

Displaying 8 ellipse(s) starting from 1

<table>
<thead>
<tr>
<th>Order</th>
<th>Cluster</th>
<th>Mean X</th>
<th>Mean Y</th>
<th>Rotation</th>
<th>X-Axis</th>
<th>Y-Axis</th>
<th>Area</th>
<th>Points</th>
<th>Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>144.96438</td>
<td>-37.83828</td>
<td>25.18930</td>
<td>1.56479</td>
<td>1.00022</td>
<td>4.91703</td>
<td>70</td>
<td>14.236226</td>
</tr>
<tr>
<td>1</td>
<td>2</td>
<td>144.98582</td>
<td>-37.85674</td>
<td>36.86110</td>
<td>0.89095</td>
<td>1.40230</td>
<td>3.92505</td>
<td>61</td>
<td>15.541218</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>144.95954</td>
<td>-37.82098</td>
<td>33.62471</td>
<td>0.51173</td>
<td>1.57912</td>
<td>2.53867</td>
<td>28</td>
<td>11.029378</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
<td>144.97750</td>
<td>-37.80242</td>
<td>71.84221</td>
<td>1.09747</td>
<td>2.92986</td>
<td>45.30512</td>
<td>7</td>
<td>12.667609</td>
</tr>
<tr>
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<td>5</td>
<td>144.95609</td>
<td>-37.81114</td>
<td>23.52217</td>
<td>1.40494</td>
<td>0.51863</td>
<td>2.28908</td>
<td>20</td>
<td>8.737123</td>
</tr>
<tr>
<td>1</td>
<td>6</td>
<td>144.99233</td>
<td>-37.83544</td>
<td>5.11812</td>
<td>0.69373</td>
<td>1.11363</td>
<td>2.42707</td>
<td>23</td>
<td>9.476439</td>
</tr>
<tr>
<td>1</td>
<td>7</td>
<td>144.99553</td>
<td>-37.82381</td>
<td>47.78224</td>
<td>1.19867</td>
<td>0.94130</td>
<td>3.54466</td>
<td>26</td>
<td>7.334979</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>144.97588</td>
<td>-37.82697</td>
<td>68.18800</td>
<td>4.92210</td>
<td>2.92986</td>
<td>45.30512</td>
<td>7</td>
<td>0.154508</td>
</tr>
</tbody>
</table>
Appendix C

Sensitivity analysis of CrimeStat

This appendix is an application of CrimeStat’s nearest neighbour hierarchical clustering routine to identify agglomerations of graphic designers in metropolitan Melbourne for 2001. The objective of this discussion is to illustrate how varying the parameters of the nearest neighbour hierarchical clustering routine affects the results reported by the CrimeStats software.

The Parameters for the Nearest Neighbour Clustering routine

There are three parameters that can be adjusted by the user for identifying clusters of points in the Nearest Neighbour Clustering routine. These parameters are:

- Level of Tolerance (value of $t$)
- Minimum Number of Firms (minimum number of points)
- Number of Standard Deviations

Each of these parameters is discussed below using the data of graphic designers in Melbourne for 2001. For the investigation of each parameter, all the other parameters are kept constant while the parameter under investigation is varied. For each parameter a standard package of results is produced which consists of:

- The number of agglomerations identified
There are three sections, one for each parameter:

- Level of Tolerance (value of $t$)
- Minimum Number of Firms (minimum number of points)
- Number of Standard Deviations

**Level of Tolerance**

The following worked investigation is based on the following parameters

**Table A.1.1**  CrimeStat parameters to test the variation in the level of tolerance

<table>
<thead>
<tr>
<th>Name of Parameter</th>
<th>Value of Parameter</th>
<th>Constant or Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Tolerance</td>
<td>0.001% to 99.9%</td>
<td>Variable</td>
</tr>
<tr>
<td>Minimum number of firms</td>
<td>10</td>
<td>Constant</td>
</tr>
<tr>
<td>Standard deviations</td>
<td>1</td>
<td>Constant</td>
</tr>
</tbody>
</table>

From figure A.1.1 it can be seen that there is no simple relationship between the level of tolerance and the agglomerations identified. This is due in part to the complex nature of the data which uses the actual location of graphic design firms in Melbourne. The Level of Tolerance varies the number, location, size and orientation of clusters identified by the nearest neighbour cluster routine. However the general location of the clusters of the different levels of tolerance is relatively consistent, except for the clusters to the South East for the main body of clusters.
Figure A.1.1 Effect of varying the level of tolerance, graphic design firms, 2001.
Figure A.1.2  Effect varying the level of tolerance on the number of agglomerations identified

Generally the higher the level of tolerance (eg 0.001%) the fewer agglomerations identified. The number of agglomerations peaks at 13 agglomerations with the level of tolerance set at 50% and 75% and then drops slightly although not to the same levels when the level of tolerance is set at 0.001%.
Figure A.1.3 shows that the number of firms located within the identified agglomerations increases as the level of tolerance increases from 308 firms at 0.001% tolerance to 358 firms (or nearly half the graphic design firms in metropolitan Melbourne) at a level of tolerance of 50%.

Figure A.1.4 illustrates the effect of varying the level of tolerance on the area of the agglomerations. It shows that as the level of tolerance is increased the area of the agglomerations also increases. This increase in area is due to two things. First as the level of tolerance increases number of agglomerations identified also increases and so the sum of the area of the agglomerations is greater. For example when the level of tolerance is set at 0.001% nine agglomerations were identified compared to thirteen when the level of tolerance was set at 50%. Hence the greater the number of agglomerations the greater the total area of the agglomerations. Second as the level of
tolerance increases, the area of individual agglomerations increases. For instance with a level of tolerance set at 0.001% nine agglomerations are identified the average size of the agglomerations is 3km$^2$ while the average size of the agglomeration with a tolerance level of 0.1% is 3.4km$^2$ while the average area of the agglomerations with a level of tolerance set at 50% is 4.5km$^2$. Generally the lower the level of tolerance the smaller the average area of the agglomerations.

**Figure A.1.4** Effect varying the level of tolerance on the area of agglomerations, 2001.

Figure A.1.5 shows how the density, in this case firms per square kilometre is altered, as the level of tolerance varies.
From Figure A.1.5 it can be seen that the lower the level of tolerance the greater the density of firms within the agglomerations. The density of firms drops away sharply after the first two levels of tolerance, that is 0.001% and 0.01%. Once the tolerance level of 50% is used the density of firms within the agglomerations plateaus at about 6 firms per square kilometre. This is significantly less than the 11 firms per square kilometre when the 0.001% level of tolerance is used.
Minimum Number of Firms

The following worked investigation is based on the following parameters

Table A.1.2  CrimeStat parameters to test the variation in the minimum number of firms per agglomeration.

<table>
<thead>
<tr>
<th>Name of Parameter</th>
<th>Value of Parameter</th>
<th>Constant or Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Tolerance</td>
<td>0.001%</td>
<td>Constant</td>
</tr>
<tr>
<td>Minimum number of firms</td>
<td>5 to 30 (in increments of 5 firms)</td>
<td>Variable</td>
</tr>
<tr>
<td>Standard deviations</td>
<td>1</td>
<td>Constant</td>
</tr>
</tbody>
</table>

From Figures A.1.6 and A.1.7 it can be seen that the minimum number of firms per agglomeration influences the number of agglomerations identified. The lower the number of agglomerations the greater the number of agglomerations identified. It should be noted that there is a significant decrease in the number of agglomerations when the minimum number of firms per agglomeration is set at 10 firms compared to 5 firms. The number of agglomerations drops away sharply once the minimum number of firms per agglomeration reaches 25 and 30 firms.

It can also be seen from Figure A.1.6 that the minimum number of firms per agglomeration does not influence the shape of the agglomerations.
Figure A.1.6  Effect of varying the minimum number of firms per agglomeration, graphic design firms, 2001.
Figure A.1.7  Effect of varying the minimum number of firms per agglomeration on the number of agglomerations identified, 2001.

Figure A.1.8  Effect of varying the minimum number of firms per agglomeration on the number of firms identified within agglomerations, 2001.
From Figure A.1.8 it can be seen that the lower the minimum number of firms per agglomeration the higher the number of firms that fall within the agglomerations. This is due again to the greater number of agglomerations that are identified. As more agglomerations are identified more firms fall within the agglomerations.

**Figure A.1.9** Effect of varying the minimum number of firms per agglomeration on the area of agglomerations, 2001.

The area of the agglomerations is related to the number of agglomerations that have been identified. From Figure A.1.9 it can be seen that the total area of the agglomerations increases as the minimum number of firms per agglomeration decreases.
From Figure A.1.10 it can be seen that the density of firms varies with the minimum number of firms per agglomeration. Using a minimum number of firms of 5 firms per agglomeration produces a large number of loose agglomerations while using a larger minimum number of firms per agglomeration produces a smaller number of dense agglomerations. However it can be seen that there is little difference in density between using a minimum of 15 firms per agglomeration or 30 firms per agglomeration.
Number of Standard Deviations

The following worked investigation is based on the following parameters

Table A.1.1  CrimeStat parameters to test the variation in standard deviation.

<table>
<thead>
<tr>
<th>Name of Parameter</th>
<th>Value of Parameter</th>
<th>Constant or Variable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Tolerance</td>
<td>0.001%</td>
<td>Constant</td>
</tr>
<tr>
<td>Minimum number of firms</td>
<td>15</td>
<td>Constant</td>
</tr>
<tr>
<td>Standard deviations</td>
<td>1, 1.5 and 2</td>
<td>Variable</td>
</tr>
</tbody>
</table>

From Figure A.1.11 it can be seen that varying the standard deviation parameter increases the size the agglomerations and does not alter the orientation or number of agglomerations.

For a standard deviation of 1.5 the diameter of the agglomeration is increased by 50% while for a standard deviation of 2 the diameter of the agglomeration is increased by 100%.
Figure A.1.11 Effect of varying the number of standard deviations, graphic design firms, 2001.
Figure A.1.12 illustrates the effect on the number of firms located within the agglomerations. While the simple fact is that the larger the agglomeration the more firms fall within its borders there is a degree of variation. For instance the increase in the number of firms located in the agglomerations between 1 and 1.5 standard deviations is 72% compared to a 22% increase between 1.5 and 2 standard deviations. Closer examination of Figure A.1.11 shows that there are a number of firms that fall just outside of the 1 standard deviation ellipse while there are few firms that fall between the 1.5 and 2 standard deviation ellipses. This confirms the estimates made in the instructions for the nearest neighbour hierarchical clustering routine that a 1 standard deviation ellipse will contain about 50% of the firms identified by CrimeStat, that is the textual report, a 1.5 standard deviation ellipse will contain about 95% and a 2 standard deviation ellipse will contain about 99%.
As noted previously, increasing the number of standard deviations increases the size of the agglomerations and so the area of the agglomerations will increase.

Figure A.1.14 illustrates the way the density of the firms varies with the change in the standard deviation. From this figure it can be seen that as the agglomerations increase in size the density decreases. So the larger parameter for the agglomeration actually diminishes the notion of an agglomeration. It also shows that the difference in density between the 1.5 and the 2 standard deviation ellipses is greater than the difference between the 1 and 1.5 standard deviation ellipses.
Figure A.1.14  Effect of varying the number of standard deviations on the density of firms within agglomerations, 2001.
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Elliott, Peter Vincent

Title: 

Date: 
2005-10

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