THE SPATIAL DIVISION OF LABOUR IN THE SYDNEY AND MELBOURNE INFORMATION TECHNOLOGY INDUSTRIES[1]

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ABSTRACT: This paper analyses the spatial distribution of employment in information technology (IT) industries in Sydney and Melbourne in 2006, and the spatial distribution of occupations in the largest two IT industries, computer and related equipment manufacturing, and computer services. The analysis indicates two main job locations: central and inner city areas, and a suburban business parks. Managerial and professional occupations predominate in central areas, while there tend to be more integrated occupation profiles in non-central clusters. Nevertheless, the spatial division of labour identified here is relatively truncated, and needs to be considered in the context of the global division of labour in the IT industry sector. The main policy implication of the analysis arises from the way that large firms' preferences for business parks reduce employment accessibility from lower income suburbs.

1. INTRODUCTION

Information technology industries have been a focus of government industry policies since it became apparent that they were associated with rapid employment and productivity gains, especially in selected regions. Yet such policies frequently ignore the heterogeneous structure of the IT industry sector, particularly in terms of its spatial differentiation at the local scale. This paper will illustrate that important aspect of the industry.

In particular, the paper draws attention to regional aggregations of IT firms, which are often treated as homogeneous clusters in policy terms (for example, the recent Sydney metropolitan strategy (New South Wales Government, 2005)). In practice, what have been seen as IT industry aggregations in large regions such as metropolitan areas may contain a range of different IT industries, each with their own spatial division of activities and associated occupational differentiation. These differences may be expressed in distinctive spatial systems, flows and connections, including separate spatial divisions of labour. Recognition of such distinctive structures is important for the generation of appropriately nuanced IT industry policies.

This paper addresses this issue by analysing the location of jobs in the different IT industries in Sydney and Melbourne in 2006, and then analysing the spatial division of labour in the main IT industries using ABS occupational data. Its core concern is the way that the division has a distinctive spatial manifestation.

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The analysis covers the bulk of Australia's IT industry sector. In 2006, Sydney and Melbourne contained two-thirds of Australia's employment of 119,949 in the six IT industries defined by the Australian Bureau of Statistics (ABS) (see text below for IT industry identification). Sydney had a share of 38.6 percent and Melbourne's share was 28.1 percent.

2. THE SPATIAL DIVISION OF LABOUR AND IT INDUSTRIES

The conceptualisation of a division of labour within global systems of production, expressed as the New International Division of Labour (NID), appeared in the 1970s (Wallerstein, 1974). In this conceptualisation, headquarters and R&D functions are carried out in developed countries while routine production is located in newly industrialising countries.

An extension of that notion of a regional division of labour within the production process in developed nations was then advanced by Massey in 1979 (Massey, 1979; Massey, 1984). Massey's starting point is that the division of labour in production results when separate operations are assigned to different workers (Braverman, 1974). The spatial division of labour which then emerges can take several forms. Massey (1984, p. 77) gives three examples of the spatial structures that may be created by the planned organization of the production process: First, a locationally concentrated system with all administration and control and total production at one site; second, cloned branch plants (branch administration and control plus total production at each branch, as well as total production at HQ); and third, a part-process structure (one part of the production process at HQ and others at each branch). Thus spatial divisions of labour within an industry can emerge via spatial decentralisation of activities within firms, or via outsourcing of activities and production to firms in different locations. In terms of actual outcomes, Massey (1984) found that there was an emerging division of labour within the UK in which high status jobs remained in London and lower status, more routine jobs were being decentralised, with this tendency being stronger in bigger companies. The importance of these distinctions for the present research is underscored by Scott's (1998) ideas that such intra-firm structures might contribute to the creation of local industry clusters. He identifies a range of possible locational outcomes according to the size of externalities and of spatially dependent transaction costs of each mode of production. Scott also alludes to the literature concerning the extent of vertical integration within firms, which is fundamental to the range of activities and occupations that are kept within each firm. Hence understanding the spatial organisation of an activity within and between firms can provide a sound foundation to understand the local geography and in turn the regional development implications of that activity.

Application of the ideas of the spatial division of labour outlined above to intra-metropolitan contexts has been limited to analysis of the spatial distribution of occupation groups in total. Lack of application of the idea to specific industries has denied the opportunity to develop a closer interpolation between occupations, activities and location within an industry. The aggregate perspective can be seen in an early spatial analysis for all industries in Sydney

published by Hutchinson and Searle (1987), while a more recent analysis for Melbourne was published in the Melbourne Atlas (Department of Sustainability and Environment, 2006).   This paper moves beyond those overviews to undertake a preliminary industry-specific analysis of the intra-metropolitan spatial divisions of labour in two parts of the IT industry sector, computer hardware and electronic equipment manufacturing, and computer system design and related services.   Its spatial framework allows an investigation of the tendency for these activities to cluster in some pats of the metropolitan area. The approach was built upon customised tables produced from place of work data from the 2006 Census of Population and Housing by the Australian Bureau of Statistics. This was used to identify occupational shares in IT activities and used measures of the dispersion around the mean value of employment as an indicator of local specialisation or division of labour.

3. THE LOCATION OF JOBS IN DIFFERENT IT INDUSTRIES IN SYDNEY AND MELBOURNE

The analysis begins with a comparison of the location of jobs in each of five IT industries as defined by ABS. Results are shown in Figures 1 (Sydney) and 2 (Melbourne) (software publishing is excluded because of its very small total employment).

The dominant IT industry is computer systems design and related services (hereafter computer services).   The location of employment in Sydney and Melbourne shows familiar clustering patterns. In both cities, the main centre of employment is the central city.   However, this is balanced by a significant concentration of jobs in nearby higher amenity suburbs favoured as residential areas by managerial and professional workforces. In Sydney, this concentration extends from North Sydney (an extension of the CBD) along the Lower North Shore to nearby North Ryde (Macquarie Park). The latter has been planned as a high technology zone since the late 1960s (Freestone, 1996) and today it is a high status business park with an IT focus that was encouraged by its initial zoning for advanced technology industries associated with adjacent Macquarie University. Baulkham Hills has a significant outlier of the northern Sydney computer services employment concentration, centred on the major Norwest business park and on the freestanding IBM office complex. In Melbourne there is a similar concentration of computer services jobs extending to inner and middle eastern and south eastern suburbs as far as Monash, where the presence of university research and expertise along with high quality suburban business real estate has encouraged a grouping of computer services firms.

Figure 1 Employment in Information Technology industries, Sydney 2006, by LGA

Figure 2 Employment in Information Technology industries, Melbourne 2006, by LGA

The second significant IT industry in the two cities is computer and electronic equipment manufacturing. The spatial pattern here is different. As can be seen in Figure 3, Central Sydney has a small concentration: this may comprise the marketing and distribution offices of international companies manufacturing overseas. However the other main concentration is in the middle west industrial area of Auburn, where there are several manufacturers of products such as semi-conductors and printed circuit boards. Small pockets of employment are found in Sydney's middle and outer western and northern suburbs. The outer western suburbs have manufacturing activities while the northern suburbs employment is shaped by the location of the warehouses and administrative offices of multinational computer equipment companies. Melbourne (shown in Figure 4) has a smaller cental city concentration than Sydney, but its suburban pattern is similar. The main zone of employment in this industry in Melbourne is found in the middle and outer eastern suburbs. These are likely to have similar activities to equivalent areas in Sydney, perhaps with more administrative functions in the professional residential areas of Knox and Whitehorse, together with some manufacturing in the south-eastern industrial LGAs of Kingston and Greater Dandenong (see also Figure 4 below).

The remaining three IT industries are much smaller and more spatially concentrated. The biggest of the three is internet service providers and web search portals. The focus of this industry in both cities is the central city. Nearby office areas also have several hundred jobs in this industry, in the inner north-east in Melbourne (Yarra) and the Lower North Shore in Sydney (North Sydney and Willoughby). The other two IT industries, internet publishing, and data processing and web hosting etc. are concentrated in the central cities. Reasons for this central concentration await further research, but suffice to note that the presence of internet publishing in central Sydney is an offshoot of traditional publishing, in which central Sydney has a national media head office concentration.

Figure 3 Computer and electronic equipment manufacturing employment, Sydney 2006 by LGA
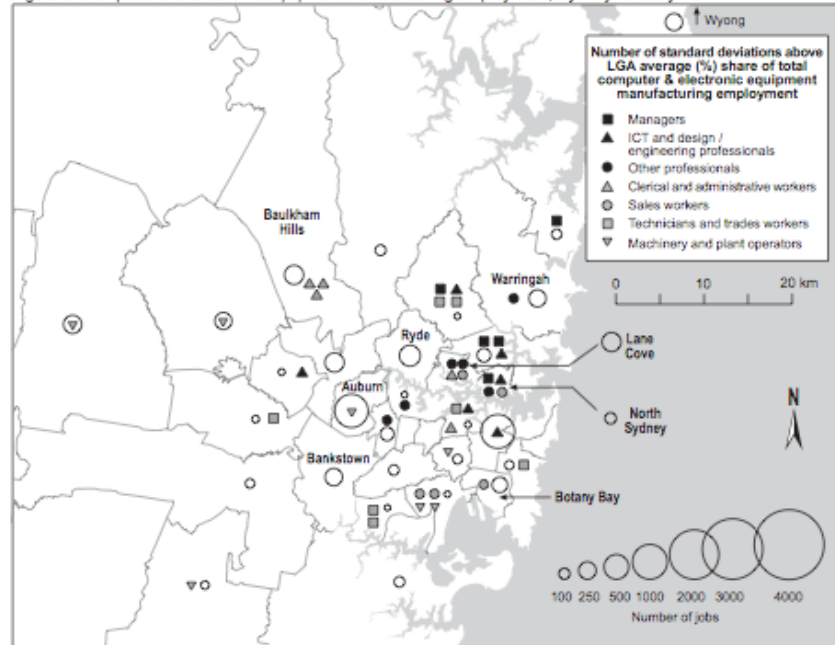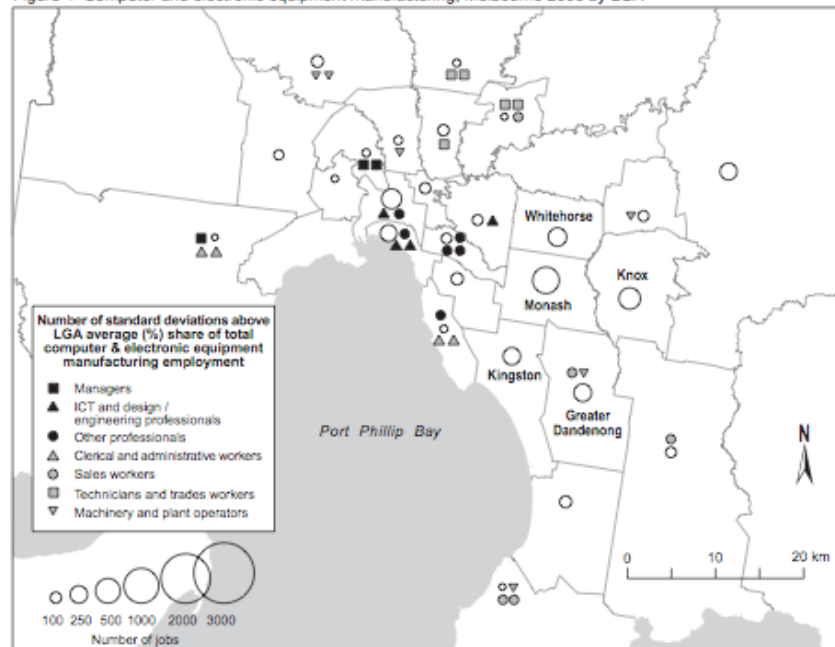

Figure 4 Computer and electronic equipment manufacturing, Melbourne 2006 by LGA

5. THE SPATIAL DIVISION OF LABOUR IN COMPUTER & ELECTRONIC EQUIPMENT MANUFACTURING

The paper now analyses the spatial division of labour in the two largest IT industries, starting with computer & electronic equipment manufacturing. The overall division of labour in each city in this industry is shown in Table 1.

Table 1. Share of occupation groups in total computer & electronic equipment manufacturing, Sydney & Melbourne, 2006 (percent)

Occupation Group	Sydney	Melbourne
Managers	16.8	17.5
ICT & design engineering professionals	14.8	16.2
Other professionals	7.2	6.2
Technicians & trades workers	17.6	20.1
Clerical & admin workers	13.7	14.2
Sales workers	3.1	3.2
Machinery & plant operators	4.9	3.1

Notes: Totals for each city do not add to 100 because minor occupations are excluded. For definition of occupation groups, see Appendix. Excludes LGAs with less than 20 jobs in this industry.

Table 1 indicates an occupational division that is spread across skill and income levels. Professionals in total have the largest share, although managerial, technical/trades and clerical/administrative groups also have significant shares. Given this spread of occupations and tasks, it might be expected that to the extent that labour costs are a significant location factor, jobs in the industry will also be spatially spread across the city.

The maps of job locations in Sydney and Melbourne (Figures 3 and 4) bear this out. In both cities, computer &c equipment manufacturing is located in three main areas. The first is the central city, where offices of major computer equipment companies (and the computer services) are located. The second type of area contains high grade business parks in suburbs acknowledged as centres of high tech activity, notably North Ryde and Lane Cove in Sydney, and Monash and Knox in Melbourne. The third type of location is post-war industrial suburbs, such as Auburn in Sydney and Kingston (Moorabbin) and Dandenong in Melbourne. It is likely that these three zones have different parts of this industry.

In order to test whether there was a spatial division of labour in each city such as this, LGAs were identified where the share of the LGA's employment in particular occupations in this industry was significantly above the average Sydney or Melbourne LGA share in those occupations. The measures adopted for this was a Z score equal to or above +1.0 (i.e. 1 standard deviation), using the percentage of LGA computer &c equipment manufacturing employment in each occupation as the variable.

This analysis found that in Sydney, managers and professionals are variously

over-represented in central Sydney and nearby Lower North Shore office centres (Figure 3). Over-representation of 'other' professionals, which are principally marketing professionals, occurs in Lane Cove and Warringah, where there are business parks with major IT firms. This suggests that employment in these business parks derives especially from multinational firms' sales and marketing whilst the more central office centres, where ICT professionals (perhaps associated in part with computer services) are more prominent, are handling more technical development problems. North Ryde, however, does not have an over-representation of any occupation group, suggesting it contains large, autonomous head offices that have most company activities on site. Freestone (1996) found that for multinational firms in North Ryde, product links mainly comprised the importation of goods, with the North Ryde establishments acting as sales and distribution outlets. A notable feature of Sydney's location pattern is the extreme concentration of clerical jobs in Baulkham Hills. This is probably due to the location there of HQ clerical functions of IBM, which set up its regional head office there several decades ago, and since then shifted back many HQ functions to Sydney CBD.

In Melbourne, the central and inner areas have even stronger over-representation in professional occupations (Figure 4). Again, this suggests a concentration of large computer head offices with a work force that has a particular specialisation in technical problems and development. Central Melbourne has a higher specialisation in marketing professional jobs than central Sydney but lower overall employment, perhaps indicating that multinationals are more likely to have their Australian HQs in central Sydney and to have a marketing presence only in central Melbourne. There appears to be less professional activity specialisation in this industry in the suburban business parks than in Sydney, however. The major IT business park areas, Monash, Whitehorse and Knox, are not over-represented in any occupation, again suggesting the presence of large autonomous head offices.

The post-war and more recent outer industrial areas in both cities have high concentrations of technical and trades, and machinery and plant operator jobs in various LGAs, suggesting a third type of area that contains remnant manufacturing in this industry. In addition, there are several moderately significant concentrations of jobs in the post-war areas (Bankstown in Sydney and Moorabbin in Melbourne) which have no occupational specialisation. The sales specialisation in Botany (Sydney) appears related to the area's role as an importer, associated with its port and airport functions.

6. THE SPATIAL DIVISION OF LABOUR IN COMPUTER SYSTEMS DESIGN AND RELATED SERVICES

The overall division of labour in each city in computer systems design and related services is shown in Table 2. The table indicates that ICT and design/engineering professionals dominate the occupational structure of this industry. However there is a significant difference in the proportion of such professionals between Sydney and Melbourne, with Melbourne having a larger share of these professionals in total employment. Conversely in Sydney, all

other occupation groups have a higher share of total employment than they have in Melbourne. This points to the greater weight of managerial and marketing functions of multinational computer services firms in Sydney, which is the preferred location for their Asia-Pacific regional headquarters.

Table 2. Share of occupation groups in total computer systems design and related services, Sydney & Melbourne, 2006 (per cent)

Occupation Group	Sydney	Melbourne
Managers	20.0	17.2
ICT & design engineering professionals	42.7	50.0
Other professionals	12.3	10.4
Technicians & trades workers	9.7	8.0
Clerical & admin workers	10.6	9.6
Sales workers	2.1	2.0

Notes: Totals for each city do not add to 100 because minor occupations are excluded. For definition of occupation groups, see Appendix 1. Excludes LGAs with less than 20 jobs in this industry.

The same method as for computer & electronic equipment manufacturing was used to identify LGAs with significant over-representation in particular occupations. Figures 5 and 6 show where the significant deviations from the average occupation structures are found. In both cities, the main cluster of employment is in the central city and its satellite office district (North Sydney and St Kilda (Port Phillip)). The central cities have fairly balanced employment structures, although both central Sydney and Melbourne have shares of just under +1 standard deviation above average for each of the managers, ICT/design/engineering professionals and other professionals groups. The satellite districts record shares of over +1 SD for some of these groups. These shares point to the central cities and satellite districts as having prime head office and R&D functions in computer services, particularly for multinational and other major firms. The extreme specialisation of North Sydney in the 'other' professional group is noteworthy. Most jobs in this group are in marketing, pointing to North Sydney's role as an IT marketing hub, tying in with the area's role as a centre for Sydney's advertising and engineering services (Searle, 1996). Inner city areas (inner west in Sydney and inner west and north in Melbourne) have much smaller employment that specialises in ICT/design/engineering professional occupations, suggesting the presence of small firms of IT professionals in which working from home is probably significant.

Both cities have a significant job cluster in major middle suburb office districts: Chatswood (Willoughby) in Sydney and Hawthorn/Camberwell (Boroondara) in Melbourne. Each has a relatively balanced occupational profile, indicating more autonomous computer services companies.

Figure 5 Computer system design and related services employment, Sydney 2006 by LGA
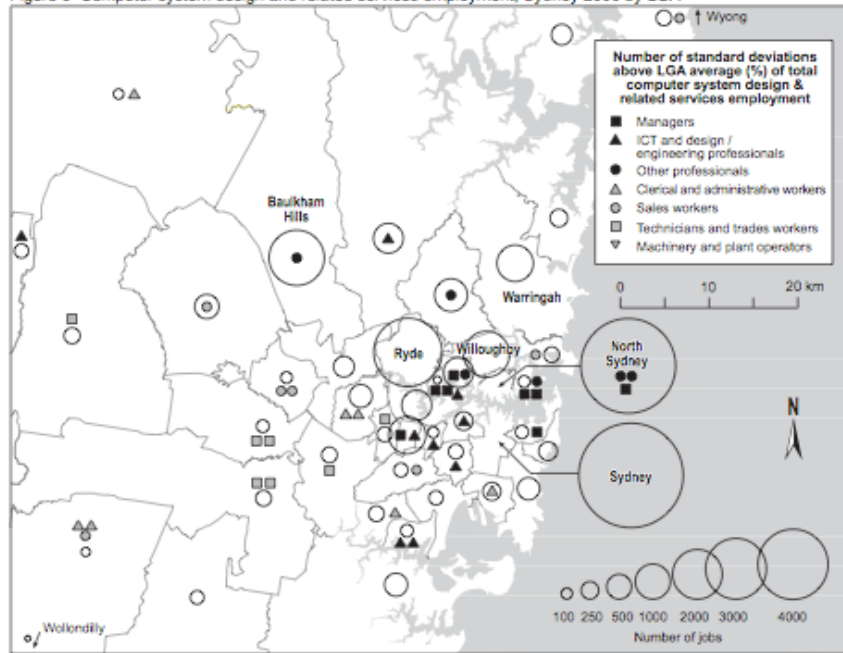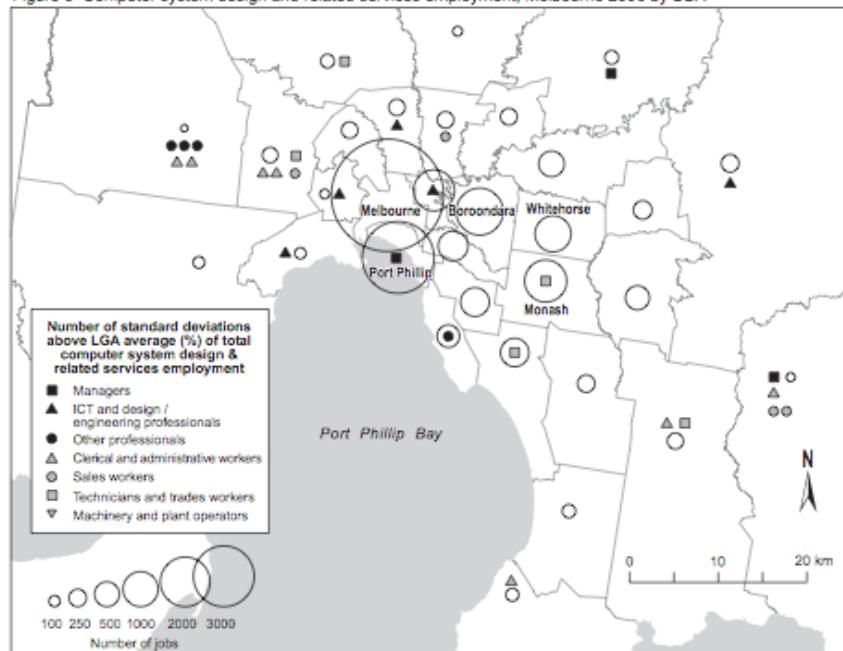

Figure 6 Computer system design and related services employment, Melbourne 2006 by LGA

The other main cluster in this industry is found in business parks in middle and outer-middle suburbs with high professional and managerial labour forces. Northern Sydney is a focus here, particularly in North Ryde, Baulkham Hills and Warringah, while eastern Melbourne is also a focus, notably in Whitehorse and Monash. The business parks tend to contain larger firms, and their overall occupational structure in this industry is fairly balanced. The emergence of Baulkham Hills as a major computer services centre, challenging the traditional IT cluster in North Ryde, is notable. The Baulkham Hills employment is focused on Norwest business park, which contains data centres for the Reserve Bank and other organizations, located there because it is a suitable distance from head offices in central Sydney. There is some tendency for parts of the middle-outer northern Sydney concentration to specialise in professional jobs. The southern part of the middle east Melbourne concentration has some specialisation in technical and trades jobs.

Outside these main clusters, small pockets of employment are found in most LGAs. These tend to have specialised functions related to clerical, sales and technical and trades work. However, there are also a significant number of computer service jobs along the Sydney coast from Gosford in the north through the northern and eastern beaches to Sutherland in the south. These contain a balanced range of job types. This points to the presence of smaller computer service companies carrying out a variety of tasks. The location of these firms is probably determined by worker/ entrepreneur preference for high amenity residential areas.

7. DISCUSSION

The analysis of the spatial division of labour in the main industries has shown that IT industries in Sydney and Melbourne have spatially complex structures of activity. The analysis has confirmed the existence of clusters of jobs around the central city and in higher status sectors radiating out from CBDs. It has also confirmed the predominance of managerial and professional jobs in these areas, being particularly associated with the offices of large multinational and other companies which dominate much of the IT industry sector. Nevertheless, other jobs remain significant in these central clusters. While the analysis has also demonstrated local variation in job structures elsewhere in the main spatial clusters, the main picture is one of fairly integrated occupation profiles in each non-central cluster. Outside the main clusters there is large variation at the local level, though this is not particularly significant in overall industry terms.

To what extent are the spatial divisions of labour outlined here explained by Krugman's (1998) 'new economy' location factors? Krugman (1998) has posited new economy factors of economies of scale and falling communication and transport costs associated with ICT advances to explain the concentration of firms in clusters in IT, high order finance and other new economy industries in selected cities. He believes that these new circumstances are causing producers to shift closer to clients/demand. Could this be shaping outcomes in Sydney and Melbourne? Following Krugman, the concentration of managerial and professional jobs in central areas in particular could be seen in part as the product

of the concentration of national head offices there. However, his approach may not explain the scale of high level employment in suburban locations. At the same time, more widely accepted location frameworks that emphasise inter-firm Marshallian-type traded and untraded interdependencies (Storper, 1995; Scott, 1998) as imperatives for IT industry clustering, along the lines of Silicon Valley, may have some validity here. The inner city and suburban business park clustering could be seen as an outcome of the factors considered in this approach. However the emphasis on sales jobs would weaken this interpretation.

The partial explanations associated with these well established perspectives indicates we need to think differently when we are analysing the location of IT production in Australia. Searle and Pritchard (2005) have provided an initial foundation for that approach. They found activities in the Australian IT industry sector are dominated by multinational firms that identify Australia as a market for, rather than a producer of, IT products and services. The implication is that employees in these firms may coordinate sales strategies and deliver services needed locally, but undertake few other functions. That perception is confirmed by the smaller numbers in production activities outlined in the current research and the large numbers of professionals in marketing and also computer services. Hence any theoretical framework designed to address the Australian IT industry sector and its activities needs to understand the global division of IT industry labour and its production and value chains. A starting point is that ICT advances have radically expanded the spatial choice field for the IT industry, with innovation as well as back office decentralisation, a la Wallerstein (1974), now found in overseas locations such as India. Sydney and Melbourne need to be seen in the context of company operations across the rest of Australia and across the world. To be sure of the future of the Australian IT industry we need to be clearer about Australia's position in this new structure. A follow-up study to this paper will explore this dimension.

Perhaps a more complex issue is the distribution of activity within the cities. The results of the current analysis, showing a variety of employment in several different suburban areas, along with concentrations of professional jobs in some areas, shows that some different reasons may explain suburban development. Whether these too derive from global connections or experience, or reflect locally linked small firm behaviour, needs to be explored in more detail.

8. POLICY IMPLICATIONS

The analysis presents a cautionary note for planning and industry policies in this area. Policies that are predicated on reinforcing existing IT industry activity in order to create new Silicon Valleys are unlikely to be successful if they ignore the nature of actual IT industry activity as overviewed here. For example, the findings of this paper support the assertion of O'Connor et al. (2001, p. 161) that the IT industry concentration at North Ryde is dominated by administration, sales, storage, and distribution. Conversely, the analysis has pointed to inner suburban areas as locations of smaller, perhaps more local, IT firms with high ICT professional specialisation, which should perhaps require a special focus for industry and planning policy.

The form of the spatial division of labour itself in the IT industries has its own policy significance in terms of employment opportunities. The analysis has demonstrated that higher status, higher income jobs are concentrated in central areas and in higher amenity suburbs with large professional and managerial workforces. At the same time, most of these areas also have significant lower income IT industry jobs such as sales and clerical work. Internal firm economies mean that it is not generally economic for firms to split off lower order jobs such as clerical office work away from head office and related activities to lower cost locations elsewhere in the city. The challenges for metropolitan planning policy here are several. The principal one is to ensure that professional, skilled and less skilled workers from the rest of the city have good sustainable access to the main IT industry concentrations. The considerable IT job numbers in outer suburban business parks are a particular concern. While North Ryde will be connected to the Sydney rail system in 2009, this is the exception to generally poor public transport to IT firms in business parks. It remains to be seen whether the policies of the 2002 Melbourne metropolitan strategy and the 2005 Sydney metropolitan strategy to focus office development, including IT industry office activity, around rail/transit stations will be able to be achieved, given the current preference for business park sites in this industry, and the large areas of new and proposed employment zonings in outer Sydney and Melbourne in locations remote from good public transport.

More generally, the analysis in this paper confirms the role of industry location preferences, and associated spatial divisions of labour, in producing spatially polarised cities. IT industries are a significant economic growth sector in both cities, and their preference for locations that largely avoid lower income suburbs serves to decrease the relative access of workers in those suburbs to new jobs across the skill scale, but especially at the more skilled and educated, higher income end of the scale. In this way the patterns detected here are part of the steadily increasing inequality within these two cities.

ACKNOWLEDGEMENT

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APPENDIX: DEFINITION OF OCCUPATION GROUPS IN TABLES AND FIGURES (2 digit ANZSCO classification occupations in each group)

Managers: Managers ntd; Chief executives, General Managers and Legislators; Specialist Managers; Hospitality, Retail and Service Managers.

ICT & Design/Engineering Professionals: Design, Engineering, Science and Transport Professionals; ICT Professionals.

Other Professionals: Professionals ntd; Arts and Media Professionals; Business, Human Resources and Marketing Professionals; Education Professionals; Health Professionals; Legal, Social and Welfare Professionals.

Technicians and Trade Workers: Technicians and Trades Workers ntd; Engineering, ICT and Science Technicians; Automotive and Engineering Trades Workers; Construction Trades Workers; Electrotechnology and Telecommunication Trades Workers; Other Technicians and Trades Workers.

Clerical and Administrative Workers: Clerical and Administrative Workers ntd; Office Managers and Program Administrators; Personal Assistants and Secretaries; General Clerical Workers; Inquiry Clerks and Receptionists; Numerical Clerks; Clerical and Office Support Workers; Other Clerical and Administrative Workers.

Sales Workers: Sales Workers ntd; Sales Representatives and Agents; Sales Assistants and Salespersons; Sales Support Workers.

Machinery and Plant Operators: Machinery Operators and Drivers ntd; Machine and Stationary Plant Operators; Mobile Plant Operators.