

Sufficiency of Employment Self-sufficiency Targets in Reducing the Need to Travel

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Abstract: With the economic, social and environmental impact of escalating congestion, Australian city plans increasingly require more locally-based workplace solutions to reduce the need for cross-city travel. Exacerbated by rapid and high population and economic growth, the strategic growth plans of cities such as Perth, Western Australia, are often focussed on higher intensity infill and more peripheral lower density greenfield development to accommodate growth. Both are frequently framed in terms of achieving “balanced growth” through the setting of employment self-sufficiency targets where numbers of residents and employment opportunities are “balanced” at a sub-regional basis throughout the city to reduce the need to travel. In this paper, the current policy of planning for self-sufficiency in the Perth metropolitan area is evaluated against an enhanced understanding of the wider literature on the motives, measures, achievements and complexities inherent in the notion of balanced growth. Focussing on employment-side complexities, an acknowledged underdeveloped area of inquiry in relation to achieving balanced growth, this paper presents a preliminary analysis of 2011 journey-to-work data disaggregated by occupation and industry of employment for selected sub-metropolitan regions in Perth. It is argued that the current jobs-housing balance derived self-sufficiency targets of the strategic growth plan for the Perth metropolitan area are inappropriate in their present form for reducing travel between sub-regions for two reasons. Firstly, labour market differentiation and specialisation means that skills-job matching seldom occurs on a local basis (i.e. people do not work at the nearest work location). Secondly, other than the service sector, the spatially uneven distribution of industry is based on proximity to resources (taking advantage of economies of scale and agglomeration benefits such as access to specialised labour, inputs or complimentary firms) rather than where people live. It is concluded that measurements of balanced growth must extend beyond the use of local aggregate jobs-housing balance targets which do not account for residents working outside their local regions. Furthermore, setting of these targets should be informed by a more rigorous and nuanced understanding of employment-side dynamics and journey-to-work realities.

Key words: Self-sufficiency; self-containment; jobs-housing balance; balanced growth; reduced travel; employment industry; occupation

Introduction

With escalating congestion threatening regional economic, social and environmental sustainability, Australian cities are increasingly required to plan for more locally-based workplace solutions to reduce the need to travel. This is exacerbated in cities, such as Perth, Western Australia (WA), where rapid and high population and economic growth is generating new challenges for urban containment and the consolidation of centres. The policy response has been a combination of higher intensity infill of the urban core and lower density greenfield developments in peripheral local government areas (Forster, 2006). ‘Balanced growth’ is frequently promoted through policies setting self-sufficiency targets where numbers of residents and employment opportunities are balanced sub-regionally throughout the city.

Despite good intentions, academics have reported more failures than successes in the achievement of increased self-sufficiency rates in practice (Sams and Beed, 1984; Kemp, 1997; Newton *et al.*, 1997; Cervero, 1998; Hui and Lam, 2005; Yigitcanlar *et al.*, 2007) and that such policies offer little potential for reducing automobile commuting (Cervero, 1998; Downs, 1992; Giuliano, 1992; Giuliano and Small, 1993; Wachs *et al.*, 1993; Peng, 1997; Wang, 2000 and Li *et al.*, 2012). Whilst the majority of self-sufficiency (and jobs-housing balance) literature of Australian cities focuses on Melbourne and Sydney (O’Conner and Healy, 2004; Parolin, 2005; Sams and Beed, 1984; Yigitcanlar *et al.*, 2007) and to a lesser extent on Perth (Curtis and Olaru, 2010; Kemp, 1997), there is broad agreement that there is a lack of clarity in the use of self-sufficiency targets in the planning context (Curtis and Olaru, 2010). O’Conner and Healy

(2004) argue that greater success depends on an improved understanding of both housing and labour market patterns and dynamics.

This paper examines the current concepts and measures for the Perth metropolitan area as applied in the current metropolitan planning strategy of the Department of Planning and Western Australian Planning Commission (DOP and WAPC, 2010), Direction 2031 and Beyond (D2031). Using Australian Bureau of Statistics journey-to-work data (ABS, 2011), this paper discusses the self-sufficiency targets of D2031 in the context of employment patterns and commuting dynamics disaggregated by occupation and industry for selected sub-regions of Perth's metropolitan area.

Understanding self-sufficiency

Terminology used in relation to self-sufficiency is varied and confusing creating difficulty in comparing results between studies and circumstances. However, it essentially relates to the co-location of housing and workplaces (Yigitcanlar *et al.*, 2007) or the number of people residing and working in a defined area (Burby and Weiss, 1976; Cervero, 1995). There are three related terms all calculated from two of three variables. The three variables are: total workers residing and working in a local area; total workers residing in that local area but working across the entire region; and, total workers from across the region, working in that local destination area. Firstly, employment self-sufficiency (ESS) is the proportion of local jobs filled by local residents (Eq. 1) and indicative of inward flows (higher self-sufficiency rates equate to lower levels of travel into the local area). Secondly, employment self-containment (ESC) is the proportion of local resident workers working locally (Eq. 2) and indicative of outward flows (higher self-containment rates point to lower levels of outward flows) (Sams and Beed, 1984). Travel self-containment is a variation of self-containment, being the proportion of local trips relative to all trips made by residents. A high rate of travel self-containment indicates less travel overall (Yigitcanlar *et al.*, 2007; Cervero *et al.*, 2001). Finally, jobs-housing balance (JHB) is the ratio of local jobs to resident workers (Eq. 3) with no consideration of whether these residents work locally (or outside the area) or if the local jobs are filled by locals (or outside residents). In other words, it indicates the "potential" for balance (Cervero, 1996) but does not take into account actual commuting. These terms can be formally described as follows:

$$ESS = \frac{L_i}{\sum_{j=1}^n L_{ij}} \quad (1)$$

$$ESC = \frac{L_i}{\sum_{i=1}^n L_{ij}} \quad (2)$$

$$JHB = \frac{\sum_{i=1}^n L_{ij}}{\sum_{j=1}^n L_{ij}} \quad (3)$$

where i is the area of origin (residence); j is the area of destination (work); n is the number of areas; L is total labourforce; and L_i is the labourforce working and living in area i .

The following examines how the three related terms are treated within the literature. The second part of the paper analyses the job-housing balance measurement used in the Perth metropolitan area strategic plan, D2031, which is incorrectly referred to in the document as 'self-containment'.

There are a range of issues and complexities associated with measurements particularly in relation to the modifiable areal unit problem (MAUP) which occurs when the same basic data aggregated with different boundaries or at different scales will significantly alter results (Cervero, 1996; O'Conner and Healy, 2004; Curtis and Oлару, 2007). The larger the size of the area, the more likely it is to achieve balance although larger sub-regions with high self-containment rate can have high levels of intra-region car travel (Fagan and Dowling, 2005). Uneven sizes of administrative boundaries and population and employment differences between areas make it difficult to compare across regions. There is a significant body of work surrounding boundary identification including that of functional regions which can be applied to reduce this effect (Bill *et al.*, 2007; Watts, 2009; Mitchell and Watts, 2010; Li *et al.*, 2012; Landre and Hakensson, 2013). The ABS's new geographical standard, the Australian Statistical Geography Standard (ASGS) has

amended Statistical Area 4 (SA4) level boundaries to account for local labour catchments in large cities using journey-to-work analysis (ABS, 2013). This innovation will further contribute to reducing MAUP.

Planning for self-sufficiency

The quest for self-sufficiency in some form or other has preoccupied urban planners and managers since Ebenezer Howard (1898) first espoused his ideal of the “Garden City” with jobs and housing co-located in self-contained units, separated by green belts (Cervero, 1996; Curtis and Olaru, 2007). The motivations for self-sufficiency have evolved in response to changing socio-economic and political context. Objectives of the post-war period were to relieve congestion and development pressures by decanting jobs and residents from large urban areas like London (Curtis and Olaru, 2010). Since car travel began dominating urban development, the motivation has shifted to reducing the need to travel (Naess *et al.*, 1995) for reasons of environment sustainability (energy efficiency and reduced pollution) and economic efficiency (enhanced productivity and deferring infrastructure investment). In Australia, since 1980, metropolitan planning strategies have consistently promoted containment, consolidation and activity centres in the interest of economic efficiency. Since the mid-1990s, this has shifted to environmental sustainability objectives (Forster, 2006). More recently, there are indications of shifts to increasing productivity and financial savings by deferring the need for new infrastructure investment (Department of Infrastructure and Transport, 2012). There are also increasingly calls to refine the concept of travel reduction in terms of mode. Curtis (1995) and Curtis and Olaru (2010) argue that the sustainable travel rationale must move beyond overall travel reduction to car travel reduction and increasing public transport accessibility. According to Forster (2006), the longer term vision for Australian cities is to limit suburban expansion, create a strong multi-nuclear structure with high density housing around centres and corridors, and infill and densification in inner and middle suburbs. Under this concept, residents will live close to work in largely self-contained suburban labour sheds, with public and non-motorised transport trips having increased significantly.

Internationally, there is little evidence that planning for self-sufficiency reduces levels of actual travel. The new towns of Hong Kong and Seoul have achieved only 15% self-containment rates (Hui and Lam 2005), while Stockholm satellite towns, with targets of 50% self-containment have attained levels of only 25% (Cervero, 1998). In Australian capital cities, travel self-containment is low (Cervero, 1998; Hui and Lam, 2005) at between 0.1%-14.1%. Canberra new towns which specifically targeted 30% self-containment have achieved only half that (Newton *et al.*, 1997). Other research has indicated these levels may be lower in suburban areas (Sams and Beed, 1984; O’Conner and Healy, 2004). More recently, Yigitcanlar *et al.* (2007) measured travel self-containment for master-planned estates in Australia reporting levels up to 13.8%, indicating little improvement in rates over time.

Policy initiatives aimed at self-containment/self-sufficiency on their own, appear to offer little potential for significantly improving commuting or employment outcomes (Downs, 1992; Giuliano, 1992; Giuliano and Small, 1993; Wachs *et al.*, 1993; Peng, 1997; Cervero, 1998; Wang, 2000; Parolin, 2005; Curtis and Olaru, 2007, 2010; Li *et al.*, 2012). Cervero (1995; 1996) argued that demand side (road pricing and parking restrictions) and supply side (improvements in level and quality of transit services) might be better ways of reducing vehicle travel than land-use initiatives like jobs-housing balance (the base of self-sufficiency measures). He attributes the difficulties in achieving self-sufficiency to the complexity of the housing and employment relationship and resultant commuting patterns, definition and measurement, as well as planning objectives and the factors influencing housing, travel and firm location decisions. Cervero (1996) further suggests that if reduced vehicle travel and increased active transport are the policy objectives, targeting improved housing-affordability and skills-job matching is more appropriate than rolling out standard jobs-housing targets.

Complexities of self-sufficiency

A key concern is that the concept of neatly structured suburban development organised around centres and self-contained urban realms do not adequately engage with increasingly complex patterns of and interrelationships between economic development, labour force participation and journey-to-work (Forster, 2006). Indeed, measures, such as self-sufficiency, are generated from the need of planning authorities to overly-simplify what is an extremely complex issue for the purpose of delivering ‘achievable’

outcomes or performance indicators. Forster (2006, p. 180) refers to the “existence of parallel urban universes: one occupied by metropolitan planning authorities and their containment-consolidation-centres consensus; the other by the realities of the increasingly complex, dispersed, residentially differentiated suburban metropolitan areas most Australians live in”. O’Conner and Rapson (2003, p. 41) describe policies on metropolitan centres as “operating in a world of wishful thinking... remote from the real world priorities of employers and employees”.

There is general consensus regarding the variety, connectedness and complexity of factors influencing the co-location of work and workers (Alonso, 1969; Cervero, 1996; O’Conner and Healy, 2004; Parolin, 2005; Yigitcanlar *et al.*, 2007 and Curtis and Olaru, 2010). The following section reviews these discussions under the broad categories of household-side, employment-side and travel-to-work considerations.

Household-side factors relate to the socio-demographic and behavioural characteristics of workers and their households which influence residential location and work choices. Yigitcanlar *et al.* (2007) found that higher self-containment rates are correlated with higher levels of income education, retirees and part-time workers, but with lower levels of car ownership. Further complexity is introduced by the rising trend towards smaller household sizes with more than one worker, each travelling to different work locations (e.g., double income households) and housing rental versus purchase decisions (O’Conner and Healy, 2004). In addition, how people participate in employment has become more complex and varied with more part-time and casual work, longer hours of work and fewer secure long-term jobs (O’Conner *et al.*, 2001; Forster, 2004, 2006). Curtis and Olaru (2007) investigated household behaviour and choice to identify the extent to which residents actually consider travel minimisation in housing choice, finding that the primary push factor of households moving into rail station catchments (i.e., areas of higher perceived self-containment) is a change in family size or structure (55% - 72%). The main pull factor was affordable housing (25% - 52%) with safety, quality of schools and closeness to family and friends also featuring to different extents in different locations. Travel time to work, proximity to rail and facilities were deemed less important.

Travel factors relate to travel behaviours of households. Curtis and Olaru (2007, 2010) conclude that individual travel patterns are complex and diverse, having a wider ‘spatial reach’ with regular activities and non-work trips spanning areas well beyond the local. They highlighted that whilst the goal of self-containment is noble it is incompatible with the reality given their findings of the relatively low numbers of people working close to home and high dominance of the car as a commuting choice over public transport. As such, they suggest that self-containment is achievable only through the planning of transit-oriented development which aims to integrate jobs and residents using public transport and non-motorised travel (Curtis and Olaru, 2010).

Employment-side factors relate to employment choice and journey-to-work dynamics of households. Far less has been done to understand these than residential-side factors. O’Conner and Healy (2004) note that the need for urban consolidation has led to a focus on increasing residential densities with limited research on the distribution and density of jobs. Li *et al.* (2012) identify more socially disaggregated analysis of journey-to-work including industry sector, travel mode and gender, as an avenue for further research. Curtis and Olaru (2010) stress the need to better understand firm location dynamics to align planning ideals and complex realities of employment location.

Some attention has been given to trends in the distribution of aggregate employment in relation to housing trends comparing CBD and suburban locations (Freestone and Murphy, 1998; Pfister *et al.*, 2000; Healy and O’Conner, 2001; O’Conner and Rapson, 2003; Parolin and Kamara, 2003; Foster, 2004; Forster, 2006). Based on an assessment of self-containment trends in Melbourne, O’Conner and Healy (2004) argue that the pattern of housing and jobs have become more complex, with some centralising and others dispersing. This is exemplified by global changes in firm location with manufacturing, logistic and warehouse related industries pushed to outer suburbs, whilst finance and advanced business services move to the central business area (Daniels, 1993; Lang, 2000; O’Conner, 2001).

This overview highlights the complexities inherent in the concepts relating to self-sufficiency and the greater degree to which household- and travel-side factors have been investigated elsewhere in the world and in the eastern states of Australia. Less attention has been given to understanding employment-side complexities, particularly in the Perth metropolitan context. A more nuanced view of the complex trends

and patterns of commuting, firms, housing and employment is called for (O'Conner and Healy, 2004; Bill et al., 2007). Bill *et al.* (2007) emphasise the importance of a more disaggregated consideration of self-containment ratios for different occupations, given that self-containment rates are higher for some low-skilled occupations relative to those in advanced business and professional services, as well as knowledge-intensive industries.

The next part of this paper examines the application of the self-sufficiency concept in the current strategic planning policy of the Perth metropolitan region, and presents a preliminary attempt at a more nuanced consideration of employment-side factors by disaggregating journey-to-work data by occupation and industry.

Evaluating self-sufficiency in Perth

This part of the paper focuses on the use of employment self-sufficiency targets to guide employment development across the six planning sub-regions of the Perth metropolitan area as set out in the current strategic planning document - Directions 2031 and Beyond (D2031, DOP and WAPC, 2010). It reports the preliminary findings of disaggregated employment journey-to-work data in two sub-regions - Perth Central and Perth North-West Corridor (PNWC, comprised of the Local Government Areas (LGAs) of Joondalup and Wanneroo)

Planning for self-sufficiency in Perth

Self-sufficiency has been advocated in all five of Perth's metropolitan planning strategies since 1955 (Curtis and Olaru, 2007; DOP and WAPC, 2010). The 1955 Stephenson Hepburn Plan promoted a compact region (Alexander, 2003) with a series of self-contained communities including land for employment in close proximity to residential areas (Carr, 1979). The 1970 Corridor Plan was structured around four corridors surrounded by urban wedges with regional centres within the corridors providing local employment. This attempted to counter-balance the rising congestion of the Perth CBD. The 1990 Metroplan built on the corridor concept widening the four corridors to facilitate greater outward growth. The 2004 Network City Plan aimed to accommodate a doubling of the population through a more compact, less car-dependent city with travel minimisation through transit-oriented activity centres which enhanced employment opportunities in activity centres (Curtis and Olaru, 2007). Currently, D2031 is the central strategic policy document guiding the planning and growth of Perth. It is organised into five themes and objectives which feed into sub-regional strategies and structure plans.

In D2031, employment self-sufficiency is identified as a key strategy in delivering on the theme of building a prosperous city (DOP and WAPC, 2010). The preferred 'connected city' future growth scenario is expected to 'improve the relationship of where people live and where they work...deliver improved levels of employment self-sufficiency across the outer-sub-regional areas...[with an] equitable distribution of jobs...' (p. 30), occurring "in a more balanced way" (p. 33). The objective is clearly stated: 'to reduce commuting time and cost, and the associated impact on transport systems and the environment' (DOP and WAPC, 2010, p. 30). Self-sufficiency is achieved by using the structuring device of a hierarchy of activity centres differentiated by role and function. D2031 provides for a seven-tier hierarchy of activity centres including the higher order centres of capital city, primary and strategic metropolitan centres, and lower order centres of secondary, district, neighbourhood and local. In addition, a series of specialised and industrial centres, metropolitan attractors and urban corridors also form part of the activity centre network. The acknowledged challenge is to increase the level of diversity and mix of uses, particularly in the higher order centres by "attract[ing] higher-order jobs such as business-to-business services, as distinct from population-driven jobs" (p. 49) to "other centres in the upper levels of the hierarchy....[to] encourage higher levels of self-sufficiency outside the capital" (p. 49).

The D2031 document proceeds directly from an exposition of metropolitan strategies to a high level description of each of the six identified sub-regional planning areas. This is intended to form the basis for sub-regional strategies which will, in turn, inform the preparation of strategic and statutory plans and policies and structure plans (p. 75). In addition to a description of administrative area, unique development characteristics and challenges and growth projections under the connected city scenario, an employment self-sufficiency target is specified for each sub-region (DOP and WAPC, 2010).

Two key observations about self-sufficiency in Perth as per D2031:

- The measure used (JHB), which is calculated from the projected resident labour force and number of local jobs, does not support the objectives of the strategy as it does not incorporate commuting movements between sub-regions; and
- Employment-side complexities are acknowledged in the plan and integral to the concept of the activity centre hierarchy, but there is no direct or transparent translation of these strategic ambitions into sub-regional employment self-sufficiency targets.

The remainder of the paper addresses these two key observations by reporting the results when alternative measures are applied and highlighting the complexity of commuting measures through a simple disaggregation of employment occupation and industry for two metropolitan sub-regions. It is argued that incorporating such complexities when setting employment targets will better address the strategic challenge of reducing travel between sub-regions. The focus on the two sub-regions of Perth Central and Perth's Northwest Corridor (PNWC) is motivated by the fact that they respectively had the highest (124%) and lowest (41%) 2008 JHB according to D2031 (Table 1). In addition, these two sub-regions allow the comparison between a sub-region with the highest order centre of a capital city (Perth Central) and a sub-region with the strategic metropolitan centre of Joondalup, being a higher order activity centre targeting further high-order employment.

Table 1: Employment, resident labour force and resulting D2031 JHB in Perth Central and PNWC

	Perth Central		PNWC	
	2008	2031	2008	2031
Resident labour force	342,000	469,000	137,000	209,000
No. of jobs	423,000	570,000	56,000	125,000
JHB D2031	124%	121%	41%	60%

Source: Adapted from DOP & WAPC (2010)

Measurement method

Despite the strategic objective of reducing the need to travel, the calculation method applied to the measurement termed 'self-sufficiency' in D2031 is in reality a measure of JHB and does not take into account commuting. Instead, it uses the ratio of total jobs in the sub-region (whether or not they are filled by local residents) to working population (whether or not they work in the local sub-region). To account for travel between sub-regions, employment self-sufficiency or self-containment would need to be applied. ESS is a measure of the proportion of inward travel flows with higher rates commensurate with lower levels of inward travel. Outward travel flows are reflected by the ESC measure with lower rates corresponding to higher level of outward travel for work. In sub-regions with high levels of outward flow, where the strategy is to reduce outward flow through more local employment, ESC is the more appropriate measure to use for targeting and tracking progress.

Using 2011 ABS journey-to-work data, the alternative measures of JHB, ESS and ESC are calculated for PNWC, where the ABS local government areas (LGAs) of Joondalup and Wanneroo are used to represent the D2031 PNWC sub-region¹ (Table 2). The ESS figure indicates a high proportion (79%) of PNWC jobs filled by its residents with relatively low levels of inward movement of workers coming from outside the area to fill local jobs (21%). ESC, on the other hand, demonstrates a large proportion of PNWC residents traveling to other regions for work (64%). In contrast, the D2031 JHB of 46% is an indication of the proportion of local PNWC residents who could *potentially* be employed locally (Figure 1). Put another way, if all the local jobs were filled by local residents, only 46% of the resident labour force could have local work. Although JHB has increased from the 2008 JHB rate of 41% (Table 1) to 46% in 2011, it over-estimates the proportion of local residents actually working locally by 10%, as is evident

¹ Perth Central in D2031 can be calculated using ABS Level 3 Statistical Areas of Claremont-Cottesloe, Perth City, Bayswater-Bassendean, Stirling, Belmont-Victoria Park, Canning, South Perth, Fremantle and Melville.

from the lower ESC ratio of 36%, which accounts for those that travel outside the area to work (Table 2). . As such, D2031 JHB becomes an inappropriate measure of the efficacy of planning policy aimed at reducing commuter flows. In the case of PNWC, ESC is the appropriate measure to use to target and track progress in reducing the extent of the high proportion of outward flows by increasing the number of local employment opportunities.

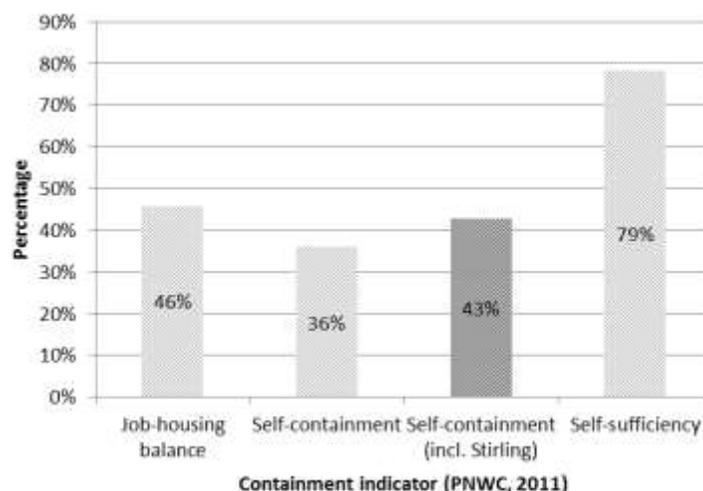
Table 2: Calculation for alternative measures using ABS 2011 journey-to-work data

	Work in PNWC	Work in other sub-regions	Total PNWC labour force
Reside in PNWC	55212 (a)	97518	152730 (b)
Reside in other sub-regions	15018		
Total PNWC jobs	70292 (c)		
JHB (c/b) = 46%	ESS (a/c) = 79%	ESC (a/b) = 36%	

Source: Adapted from ABS (2011)

As identified in the first part of the paper, calculations are complicated by measurement discrepancies with sub-regional boundaries differing between government institutions. This can significantly change results. For example, according to the D2031 boundary demarcation of PNWC, the adjacent LGA of Stirling is included in the Perth Central sub-region, but according to the ABS it is part of the Main Statistical Area of Perth Northwest. Applying the ABS-defined boundaries for PNWC (LGAs of Joondalup, Wanneroo and Stirling), the self-containment rate increases from 36% to 43% (Figure 1). This implies a significant proportion of PNWC residents work in Stirling. Getting the boundaries right in terms of capturing strong functional relationships between place of residence and place of work is imperative in measuring JHB, ESS and ESC.

Figure 1 The effect of boundary changes on the self-containment rate of PNWC, 2011



Disaggregate employment dynamics

This section discusses how an improved understanding of employment dynamics at a more disaggregated level can further contribute to establishing employment commuting measures pertinent to the characteristics of the sub-region. It employs a rudimentary analysis of employment by occupation and industry to understand how these factors might influence commuting flows to the different centre hierarchies. Location quotients are used to describe the variation between the relative concentrations of employment and occupation types found in the different centre hierarchies of PNWC and Perth Central. This is followed by an analysis of the commuting dynamics of PNWC resident workers, disaggregating the industry and occupation of PNWC residents who work locally in comparison to those who work in Perth Central.

ABS 2011 census data (place of work) by occupation and industry of employment (1-digit level) were used to calculate location quotients (LQ) for the Perth Central and PNWC sub-region using the Perth Metropolitan Area (PMA) as a base. LQs indicate the level of concentration of a particular industry or occupation in a sub-area in comparison to a wider reference area. LQs over 1 indicate a higher relative proportional concentration of employment type, with LQs below 1 indicating lower concentrations when compared to the PMA. PNWC has a definable industrial landscape with concentrations in: agriculture, forestry and fishing; education and training; accommodation and food services; retail trade; and construction industries (Figure 2). Mining is the most dominate industry group in Perth Central with an LQ of 1.4 followed by: financial and insurance services; professional, scientific and technical services; and information, media and telecommunications, at rates of higher than 1.2 (Figure 2). The largest differences (>0.5) between Perth Central and PNWC occur in: agriculture; forestry and fishing; education and training; retail trade; and construction, where PNWC dominates. Perth Central dominates most strongly in relation to PNWC in the industries of: mining; professional, scientific and technical services; financial and insurance services; electricity, gas, water and waste services; and information, media and telecommunications (Figure 2).

Figure 2: Location quotients for industry of employment

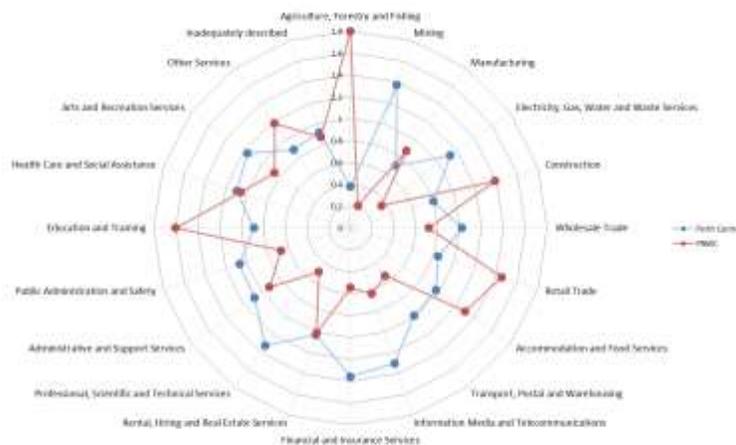


Figure 3 maps LQs across occupation types. Perth Central achieves a LQ of greater than 1 for: professionals; managers; and clerical and administrative workers. PNWC has higher relative concentrations of: sales workers; labourers; community and personal services workers; and technicians and trades workers (Figure 3). The largest differences (>0.3) between Perth Central and PNWC are for: sales workers; labourers; and community and personal service workers, which are more concentrated in PNWC while professionals; and clerical and administrative workers are more concentrated in Perth Central (Figure 3).

Figure 3: Location quotients for occupation



Whereas this analysis of LQs has reveals distinct differences in concentration of employment types between Perth Central and PNWC, it does not account for actual commuting patterns. An analysis of ABS journey-to-work data (2011) of PNWC residents disaggregated by employment industry and occupation provides an understanding of the employment types related to local travel within PNWC and those associated with outward travel to surrounding sub-regions. The majority of these outflows are to the capital city activity centre of Perth Central.

Figure 4 presents the percentage of the PNWC's labour force by occupation working locally and in Perth Central, sorted from highest to lowest percentage of local work. The cross-over point (50%) is representative of the threshold between which employment types could be considered to be most associated with local travel (employment types to the left of the 50% point) and those to the rights of the 50% point, most associated with outward travel to Perth Central.

A similar pattern to the LQ analysis emerges, showing distinct variation between the employment concentrations of the different centres within the metropolitan hierarchy. This suggests a correlation between disaggregated employment concentrations and commuting patterns. Occupations which tend to be more locally based within PNWC are labourers (the biggest percentage difference between PNWC and Perth Central), sales workers, community and personal service workers and machine operators (marginally over 50%). Whilst occupations most related to outward flows of PNWC residents to Perth Central for work (work occupations conducted more Perth-centrally) are: professionals (the greatest percentage difference between PNWC and Perth Central); clerical and administrative workers; managers and technicians; and trades workers. Applying the same analysis to industry of employment, the industries related most strongly to outward travel of PNWC residents to Perth Central for work (industries of work conducted more Perth-centrally) are: mining; electricity, gas, water and waste services; financial and insurance services; information, media and telecommunications; professional, scientific and technical services; public administration and safety; wholesale trade; transport, postal and warehousing; administrative and support services; health care and social assistance; manufacturing; and rental, hiring and real estate services (Figure 5).

Figure 4: Percentage of total PNWC labour force working in PNWC and in Perth Central, by occupation

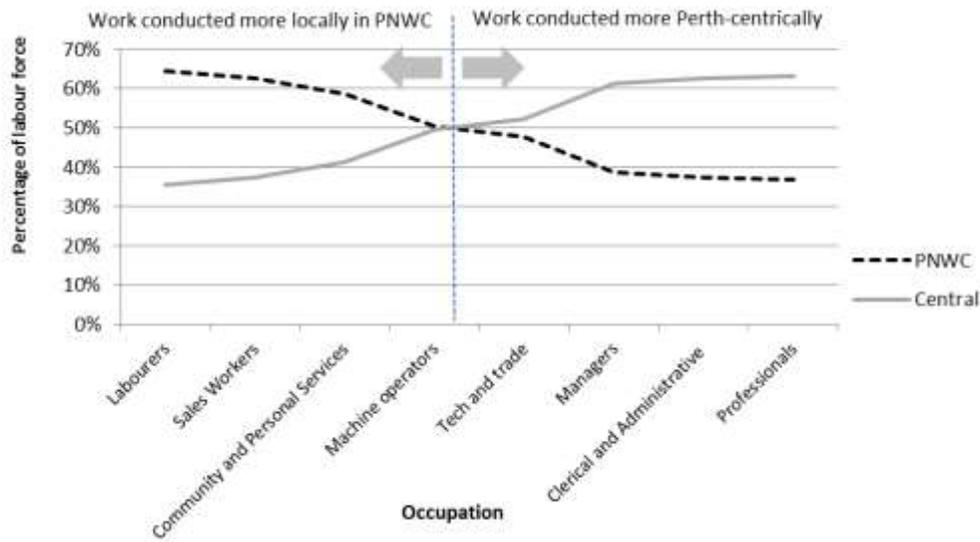
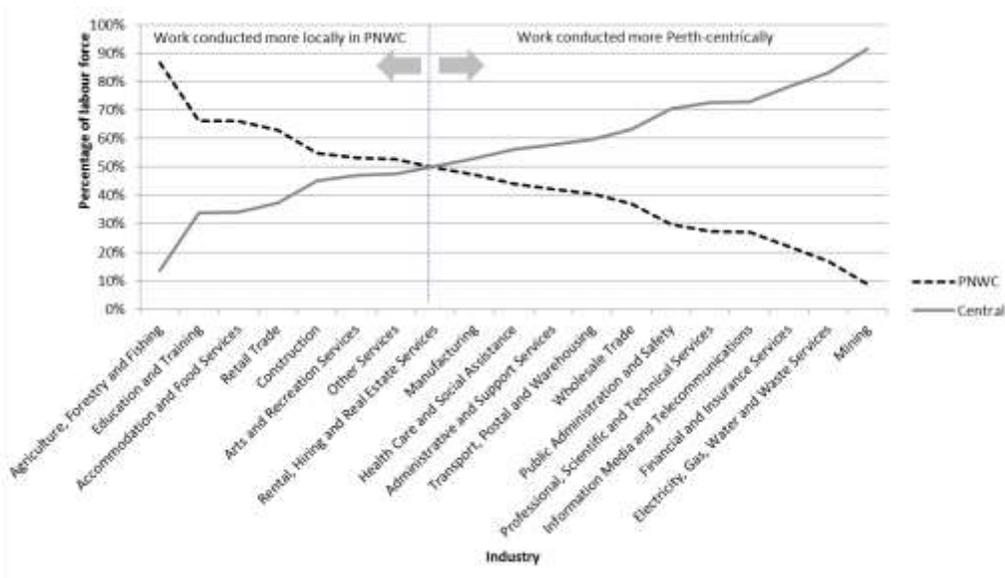


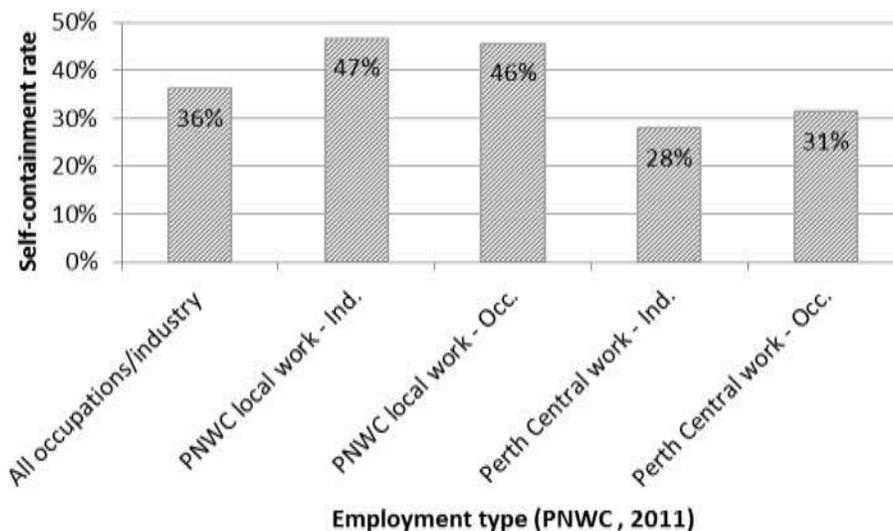
Figure 5: Percentage of total PNWC labour force working in PNWC and in Perth Central, by industry



This preliminary analysis of commuting disaggregated by employment occupation and industry provides insight into the complex employment and occupation landscape of commuting flows. These flows, in the context of the specific employment targets of different activity centres, which need to be taken into account when setting ESS targets. Using the 50% point to define the change between jobs/occupations associated with lower commuting compared to those jobs/occupations with greater commuting, Figure 6 calculates self-containment results. The considerable difference in ESC when occupation and industry are disaggregated further highlights the difficulties in applying blanket measurements aimed at assessing the success of employment strategies to decrease sub-regional commuting.

Indeed, in the PNWC case study area, the ESC rates for both industries (47%) and occupations (46%) occupying the lower 50 percentile of commuting flows are at least 10% higher than that obtained for the aggregate ESC rate (Figure 6). In contrast the ESC rates for work more likely to involve commuting outside of the PNWC are lower than both the aggregate ESC rate. The industry-disaggregated ESC ratio yields the lowest rate of 28%. A better understanding of how commuting flows impact industry of employment and occupation ESC ratios across centres is needed to more specifically target and track travel reduction.

Figure 6: ESC rates for the PNWC sub-region, disaggregated by occupation and industry of employment



Conclusion

Despite a growing body of knowledge questioning the relevance and effectiveness of self-sufficiency as a planning mechanism to reduce the need to travel, there is continued focus on achieving containment, concentration, consolidation and balanced growth by metropolitan planning initiatives. Employment self-sufficiency is identified as a central strategy in the current Perth metropolitan plan, Directions 2031 and Beyond (DOP and WAPC, 2010), setting sub-regional employment self-sufficiency targets.

Presenting an analysis of journey-to-work, disaggregated by occupation and industry of employment for a sub-metropolitan region in Perth, this paper concludes that local measurements of travel reduction must look beyond the use of sub-regional aggregate jobs-housing balance targets. It suggests that better understanding, analysis and accommodation of labour market complexities of the dynamics of employment and journey-to-work, will provide planners with more accurate measures to assess economic performance and the sustainability of work travel patterns. This paper concludes that the D2031 JHB is an insufficient mechanism on its own for assessing commuting needs and tracking the success of employment strategies to reduce travel. This paper presents the preliminary analysis of disaggregated occupation and industry of employment data for one sub-region. It concludes that future measures of the success of a region to provide jobs for its residents must take into account the differences between the three measures (JHB, ESC and ESS), difficulties in defining boundaries and variations in the employment commuting dynamics of different industries and occupations. As such, there is a need to better understand the meaning of phrases in D2031 such as 'higher order' jobs and occupations, as well as the impact this has on setting sub-regionally specific ESC targets. This paper concludes that there is considerable research to be done on the significant overlaps between industry of employment and occupation if measures, such as self-containment and self-sufficiency, are to be of value to employment and travel policy discussions.

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