Understanding Local Competitiveness

Briefing Paper 12: Identifying Key and Strategic Industries, Karratha 2001-2011

**PAUL PLUMMER, RACHEL CHAPMAN
& FIONA HASLAM McKENZIE**

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1.   EXECUTIVE SUMMARY:

This briefing shows that Karratha has been a strong performing economy throughout the 2001-2006 period. During 2001-2006, Karratha created more jobs, and hence employment, than would have been expected given the specialisation if its industrial base which is highly oriented to the resources industries. This trend can be attributed to the strength of the resource sector, particularly after 2006. Job creation and employment continued to grow at an even faster rate in the construction, mining and support industries 2006-2011 after the mining boom hits its peak in 2007. The Karratha economy is driven by a highly specialised economy, with mining and construction dominating employment. Other mining support industries showed strong growth, particularly in the 2006-2011 period.   Compared to the broader Western Australian economy, Karratha demonstrated comparative advantage, although its lack of industry diversity points to potential economic vulnerability.   As a corollary, during this period, employment became increasingly spatially concentrated, with Karratha outperforming the level of job creation at the State level.

In the **2001-2006 period**, Karratha had **comparative advantage** in the following sectors:

- Rental, hiring & real estate services
- Public administration & safety
- Mining
- Construction
- Electricity, gas, water & waste services
- Transport, postal & warehousing
- Industries inadequately stated

In the same period, Karratha had **competitive advantage** in the following sectors:

- Rental, hiring & real estate services
- Public administration & safety
- Mining
- Construction
- Transport, postal & warehousing

In the **2006-2011 period**, Karratha had **comparative advantage** in the following sectors:

- Rental, hiring & real estate services
- Mining

- Construction

- Electricity, gas, water & waste services

- Transport, postal & warehousing

- Administrative & support services

In the same period, Karratha had **competitive advantage** in the following sectors:

- Rental, hiring & real estate services

- Mining

- Construction

- Transport, postal & warehousing

- Administrative & support services

2.   The Western Australia Regional Capitals Alliance

This is the latest in a series of reports into the dynamics of competitiveness across the Western Australian settlement system. This research is conducted as part of a strategic collaboration between the *Western Australian Regional Capitals Alliance (WARCA)* and the *Centre for Regional Development* at the *University of Western Australia*. The objectives of this ongoing collaboration are:

- To gain a clear understanding of the opportunities and barriers to regional growth and resilience across Western Australia.
- To facilitate evidence-based policy, indicating specific areas of policy-making that may require revision.

In this report, we explore the local competitiveness of Karratha by identifying the key and strategic industries that have driven job creation over the 2001-2011 resource boom. We address two key questions about the dynamics of growth:

- What are the most important industries in Karratha in terms of employment and job creation?
- What industries constitute the economic base of the Karratha economy?

Using the analysis of this report it is possible to target local economic policy by identifying those industries that are the most important drivers of growth, those that are potentially emerging industries, and those that are most vulnerable.

The information contained in this report is supported by the following documents:

1.   UWA/Regional Capitals in the WA Settlement Hierarchy Research:

   a) Briefing Paper 2 - Employment Change and Job Creation
   b) Briefing Paper 3 – Employment Diversity and Growth
   c) Briefing Paper 4 – Endogenous Growth and Local Competitiveness
   d) Briefing Paper 5 – Identifying Regional Capitals

2.   Academic Papers:

Plummer, P., Tonts, M. Martinus, K (2014) "Endogenous Growth, Economic Restructuring and Local Contingency in the Evolution of a Patchwork Economy: Regional Western Australia, 2001-2011" *Journal of Economic and Social Policy* 16(1) 1-31.

3.   Planning Documents:

Government of Western Australia (2014) "State Planning Strategy 2050" (http://www.planning.wa.gov.au/publications/6561.asp)

3.   Job Creation, Economic Diversity and Local Competitiveness

The contemporary Western Australian economy can be characterized by a multi-speed economy, driven by a strong and consistent pattern of job creation. Over the past decade, job creation across industries has not played out evenly across Western Australia. This has resulted in an increasingly 'patchwork economy', with larger and more economically diverse economies forging ahead of less resilient smaller settlements. Within this broader context, there is clear evidence that the Regional Capitals are making an increasingly significant contribution to the evolution of employment across the State. In particular, the economic performance of WARCA members relative to the other localities across Western Australia indicates that:

- Engagement in the global economy and broader socio-economic processes have been important in driving economic growth across WARCA members.

- Nonetheless, local competitiveness is critical in both allowing localities to overcome an unfavourable mix of industries or to capitalize on their industry structure.

- The relative importance of local competitiveness and the ways in which localities engage with broader socio-economic processes varies significantly across localities.

Overall, these findings have the following implications for the formation of local economic policy:

- The qualitatively different experience of the WARCA members questions the efficacy of a 'one size fits all' policy stance.

- While it is true that local attributes are important in contributing to growth, we should not underestimate the significance of external demand in driving development.

- Caution needs to be exercised in focusing excessively on local competitiveness as a means of developing the economies of the regional capitals.

This briefing report is one of series of complementary reports which begin to unpack the growth experience of each WARCA member, exploring the local competitiveness through the propulsive industries (industries/sectors that are identified as the primary drivers of local economic and employment growth) thus driving the local economy.

4.   Unpacking the Dynamics of Local Competitiveness

A recently published report by the *Western Australian Department of Regional Development* (2014) focuses on identifying the key drivers of local competitive and comparative advantage across the Western Australian economy. Similarly, the strategic blueprint reports submitted by the *Regional Development Commissions* in 2014 were required to identify those economic activities in which they have a comparative advantage. In this report series we undertake a preliminary investigation of the dynamics of WARCA members, imputing competitiveness and comparative advantage from the underlying industrial structure and ability of these localities to create jobs.

(A) *Local Competitive Advantage: the Ability to Create Jobs Locally*

Cities and regions compete with each other for global, national, and local 'market share'.

Tracking the competitive advantage of the Karratha economy is imputed from information on local job creation, specifically:

- SIZE: The importance of an industry in terms of the number of persons employed in each industry.
- GROWTH: The industries growing most rapidly over a particular period of time in terms of their ability to create jobs locally.

For a variety of reasons, industries perform differently in particular locations and, not surprisingly, local and regional economies perform differently to each other. Some of those reasons include natural resources, geographic advantages, access to transport, energy or information networks, local policies and human capital. Human capital brings knowledge, skills and competencies which have a productive value. Housing, education, amenity and services all shape the availability and employability of human capital.

Using the benchmark of the overall performance of the Western Australian economy, it is possible to categorize local industries in terms of SIZE and GROWTH:

- FAST GROWING: relatively large sectors that have exhibited rapid recent growth.
- RESTRUCTURING: relatively large sectors that make a significant contribution to the economic base but with little or no growth over the recent past.
- UNDERDEVELOPED: low levels of activity.

(B) *Comparative Advantage: Local Economic Specialization and Interregional-Trade Patterns:*

Conventionally it is assumed that localities specialize in those activities in which they have a comparative advantage. **Comparative advantage** is the principle that a country, region or locality should specialise in producing and exporting goods in which it has comparative or

relative cost advantage over others, and import goods in which it has a cost disadvantage. Factors which may influence comparative advantage are natural resources but also development of technology and human skills, economies of scale and access to advantageous trade opportunities (transport, markets etc).

A comparative advantage provides the opportunity to sell goods or services at a lower price than the competitors and thus realise positive margins.

Trade theory assumes that localities specialize in those activities in which they have a comparative advantage. The comparative advantage of the Karratha economy is imputed using information on:

- SPECIALIZATION: The importance of an industry in terms of the degree to which the local economy specializes in that economic activity.
- ECONOMIC BASE: A measure of the degree to which economic activity and employment is related to servicing local demand as against servicing demand external to the region.

Determining the pattern of local economic SPECIALIZATION using location quotients identifies the industries that drive and underpin the local economy (see technical appendix). Location quotients (LQ) measure the concentration of an industry or economic activity in a particular location, compared to the State or nation overall. It therefore identifies the specialisation(s) of a particular place or region in relation to the bigger jurisdiction. Put differently, location quotients also indicate the proportion of people employed in an industry in a locality relative to the proportion of people employed in that industry in the larger, reference or benchmark economy (for example, the State economy or that of the nation overall), in this instance Western Australia. If a particular industry's share of regional employment is greater than that industry's share of State employment, i.e. the location quotient is greater than one, (or unity), then the locality is assumed to specialize in that economic activity.

For example, if ten per cent of a region's workforce is employed in agriculture, but only eight per cent of the overall State population is employed in agriculture then the LQ is (.10/.08) 1.25 meaning that agriculture is twelve and half times more concentrated in that region than for the State overall. A LQ greater than one suggests that the particular industry outputs are exported and hence bring income to the region.

Since local economic data on trade flows does not exist, location quotients have also been widely used to infer regional trade patterns:

- BASIC Sector: The greater the location quotient above one (or unity), the larger the economy's net sectoral exports from that sector (i.e. the greater the proportion or share of the local economy of a particular industry, and therefore exports from that region).
- Non-BASIC Sector: The greater the location quotient below unity (or one), the larger the economy's net sectoral imports from that sector (i.e. the proportion or share of the local economy of a particular industry is less than the overall State proportion, and therefore imports into that region).
- NEUTRAL Sector: For a location quotient of unity, (or one), the economy is neither a net exporter nor a net importer for that sector.
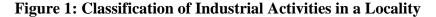
The level of ECONOMIC BASE in a local economy can be calculated by aggregating export oriented employment across all industries in which the locality is specializing in terms of employment (see technical appendix). A region with a healthy economic base is likely to be one that specializes in industries with **high LQ and high employment**.
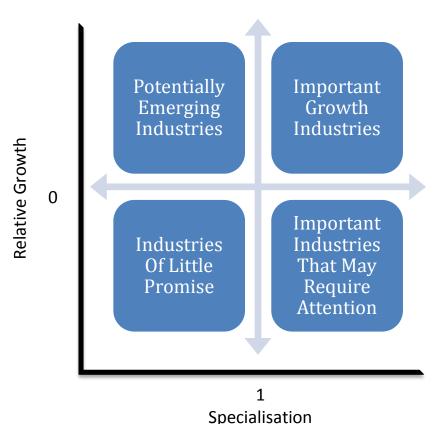
(C) Classifying Industrial Activities

Combining the information on an economy's ability to create jobs locally and identifying the patterns of specialization and inter-regional trade within sectors of the economy, it is possible to classify industries in terms of their growth potential and comparative advantage. Figure 1 classifies the economic structure of a local economy with relative growth measured on the vertical axis and relative specialization measured on the horizontal axis:

- IMPORTANT GROWTH INDUSTRIES: characterized by above average employment growth, relative economic specialization, and export orientation.
- IMPORTANT INDUSTRIES THAT MAY REQUIRE ATTENTION: characterized by below average employment growth, relative economic specialization, and export orientation.
- POTENTIAL EMERGENT INDUSTRIES: characterized by above average employment growth, but currently oriented towards servicing local demand.
- INDUSTRIES OF LITTLE PROMISE: characterized by below average employment growth and currently oriented towards servicing local demand.

The potential significance of each industry in terms of size is represented by the corresponding size of the graduated circle representing the industry on the graph.

Figure 1: Classification of Industrial Activities in a Locality

5.   Data Description: Employment by Industrial Classification

This report uses Australian Bureau of Statistics (ABS) Census of Population and Housing time series profiles, which count the number of persons in each industry of employment (based on place of enumeration) for all 138 local government areas (LGAs) in Western Australia for the census periods 2001, 2006, 2011. The members of the *Western Australia Regional Capitals Alliance (WARCA)*: Albany, Broome, Greater Bunbury[1], Kalgoorlie-Boulder, City of Greater Geraldton, Port Hedland, and City of Karratha. Boundaries for all LGAs are according to the ABS 2011 definition. To identify the key and strategic industries for each member of WARCA, employment is disaggregated by industrial sector, as defined by the Australian and New Zealand Standard Industrial Classification (ANZSIC) industry coding [2]. It should be noted that one limitation widely reported by regional local governments is the likely undercount of employees by the ABS. This arises out of the difficulty in capturing fly-in/fly-out workers and other temporary residents. There is no immediate means of overcoming this data limitation, except to use 'place of enumeration', (in other words, the place where the census participant actually filled out the census form, as opposed to their place of usual residence, which may or may not be different on the particular night of the census), data as has been done here.

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[1] Greater Bunbury is an amalgamation of the LGAs of Bunbury, Capel, Dardanup, and Harvey.
[2] Found at http://www.abs.gov.au/ausstats/abs@.nsf/Lookup/2901.0Chapter5802011

6.   The Structure and Dynamics of Local Job Creation: Karratha

(a) Local Competitive Advantage: the Ability to Create Jobs Locally

Figure 2 summarizes the distribution of employment across Karratha's industrial sectors for 2001, 2006, and 2011 whilst Figure 3 provides an overview of the changing distribution of economic activities across this time period. It is clear that over the period 2001-2011 Karratha's ability to create jobs locally improved significantly.

- In 2001, the highest employing industries, consistent with the emerging mining boom, were mining (1,276 people, 16% total employment), and construction (961 people, 12% total employment). The other important employment sectors were retail (687 people, 9% total employment), public administration and safety (520 people, 6% total employment) and education and training (509 people, 6% total employment).
- In 2006, as the mining boom accelerated, mining and construction grew significantly; mining (1,985 people, 21% total employment), and construction (1,424 people, 15% total employment). Retail increased the number of people employed (720) but this represented only 8% of the total employment as the whole local economy grew. Education and training increased its overall share of employment marginally but increased its total employment (546 people, 6% total employment).   Consistent with a growing mining economy, transport, postal and warehousing (610 people, 6% total employment) and public administration and safety (548 people, 6% total employment) also grew in this period.
- At the peak of the boom in 2011, mining (3,246 people, 21% total employment) and construction (4,359 people, 28% total employment) continued to dominate employment with construction now representing the highest percentage of employment in the local economy; mining, and construction. Transport, postal and warehousing (922 people, 6% total employment) continued to be an important industry sector, with professional, scientific and technical services (751 people, 5% total employment), accommodation and food services (716 people, 4.6% total employment) and public administration and safety (681 people, 4.4% total employment) all emerging as significant employers.
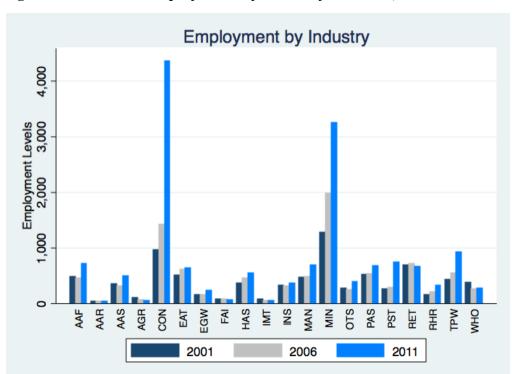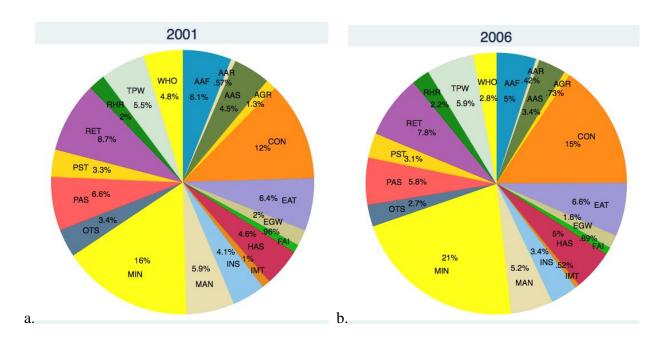
Figure 2: Karratha employment by industry for 2001, 2006 and 2011.

Expressed differently, Figure 3 clearly shows how employment changed over the period 2001-2011 in Karratha.

Figure 3: Percentage of employment by industry in Karratha for (a) 2001, (b) 2006 and (c) 2011.
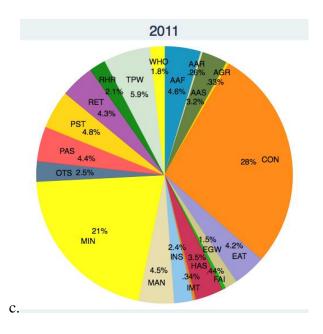

a.

b.

c.

Table 1 shows the performance of Karratha's economy relative to the other Western Australian regional centres. The 2001-2006 period shows considerable growth which was strong relative to the Western Australian economy at the time. After the mining boom ramped up in 2007, the Karratha economy grew even more strongly and its performance in the 2006-2011 relative to the rest of Western Australia was outstanding.

Table 1: Job Creation for Western Australian Regional Centres 2001, 2006 and 2011.

	Growth 2001-2006	Growth 2006-2011	Growth relative to WA 01-06	Growth relative to WA 06-11
Roebourne	0.165	0.684	0.033	0.507
Albany	0.143	0.067	0.011	-0.11
Geraldton-Greenough	0.115	0.194	-0.017	0.017
Bunbury	0.097	0.063	-0.035	-0.114
Broome	0.053	0.165	-0.079	-0.012
Kalgoorlie-Boulder	0.018	0.106	-0.114	-0.071
Port Hedland	-0.088	0.695	-0.22	0.518

Figure 4 summarized job creation by industrial sector for Karratha relative to the average growth of the same sector across the Western Australian economy:

- Over the 2001-2006 period, the fastest growing industries in Karratha relative to Western Australia were wholesale trade, rental hiring and real estate services and information, media and telecommunications.

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- Over the same period, the slowest growing industries in Karratha relative to Western Australia were administrative and support services and other services.
- Over the 2006-2011 period, the fastest growing industries in Karratha relative to Western Australia were in rental hiring and real estate services, information, media and telecommunications and construction. Professional, scientific and technical services also grew relative to the Western Australia, but not at the same rate as the other sectors.
- Over the same period, the industries that lost jobs relative to the Western Australian benchmark were manufacturing, retail and jobs that were inadequately described.

Figure 4: Growth rates of Karratha industries relative to Western Australian growth rates.
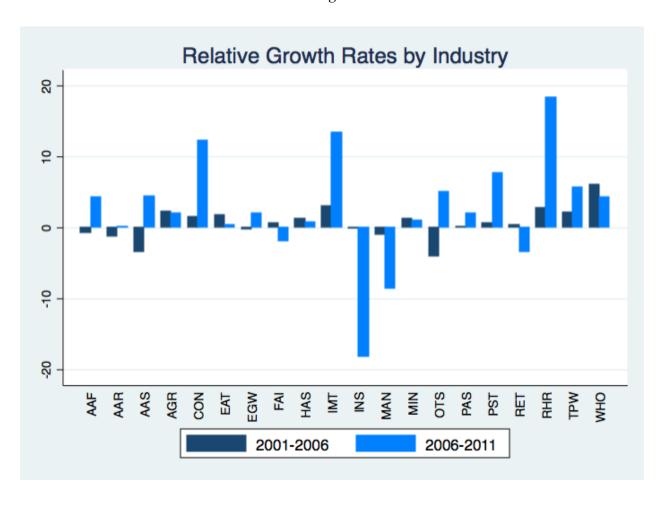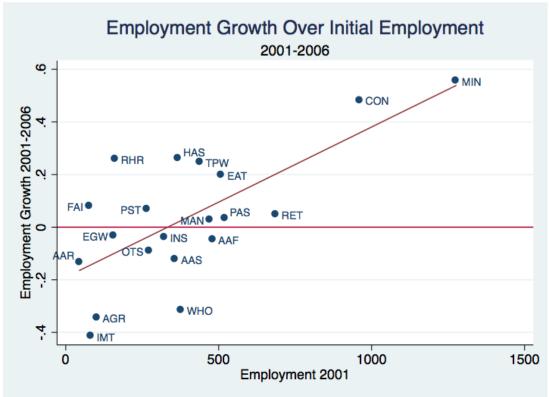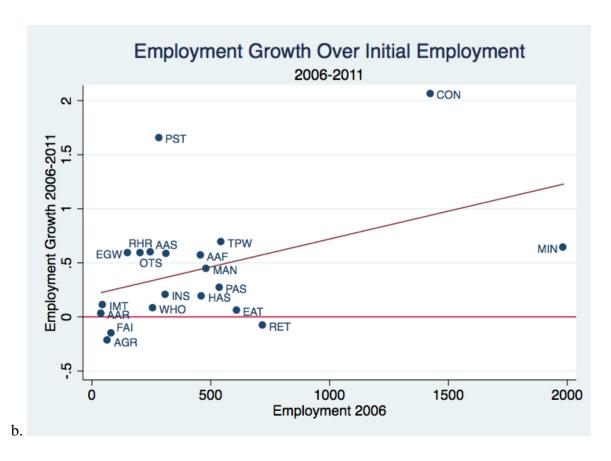

Figure 5 shows the overall pattern of competitive advantage for Karratha in terms of the relationship between absolute growth rates and the size of each industrial sector. Overall, in the period 2001-2006 and 2006-2011there was a positive relationship between the size of an industry in terms of employment and the growth rate of that industry. As expected during a mining boom, the mining and construction industry sectors dominated, especially in the 2001-2006 period as the local economy grew.

Figure 5: Employment growth rate, relative to initial size of employment for (a) 2001-2006 and (b) 2006-2011.

a.

Employment Growth Over Initial Employment
2006-2011

b.

Interpreting Figures 5(a) and (b).

The steady red line at zero signifies the growth threshold. i.e. those industry sectors below that red line have not grown in the intercensul period. It follows then that those sectors above the line have grown. As explained above, of those sectors which grew, those which employed the largest number of people (moving across the horizontal axis), tended to grow faster than the smaller industry sectors, as shown by the red line moving upward, indicating increasing specialisation with a strong orientation to the mining and construction industries. In the 2006-2011 period, there were fewer sectors below the red static line (retail, financial and insurance services and agriculture, forestry and fishing).

Table 2 summarized the overall structure of local competitiveness for Karratha's industries over the period 2001-2006 and 2006-2011.

- There is a consistent and stable pattern of industrial activities across the two periods, with industries remaining as FAST GROWING, RESTRUCTURING, or UNDERDEVELOPED between the two periods.

- The exceptions to this rule were mining and rental, hiring and real estate services, which shifted from FAST GROWING to RESTRUCTURING industries between the two periods.

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Table 2: Local Competitive Advantage: the Ability to Create Jobs Locally

	2001-2006	2006-2011
Fast Growing Industries	Construction Mining Rental, Hiring and Real Estate Services Transport, Postal and Warehousing	Construction Transport, Postal and Warehousing
Industries Restructuring	Administrative and Support Services Electricity, Gas, Water and Waste Services Public Administration and Safety	Administrative and Support Services Electricity, Gas, Water and Waste Services Mining Rental, Hiring and Real Estate Services
Underdeveloped Industries	Accommodation and Food Services Arts and Recreational Services Agriculture, Forestry and Fishing Education and Training Financial and Insurance Services Healthcare and Social Services Information Media and Telecommunications Manufacturing Professional, Scientific and Technical Services Retail Trade Wholesale Trade	Accommodation and Food Services Arts and Recreational Services Agriculture, Forestry and Fishing Education and Training Financial and Insurance Services Healthcare and Social Services Information Media and Telecommunications Manufacturing Public Administration and Safety Professional, Scientific and Technical Services Retail Trade Wholesale Trade

(b) Local Economic Specialization and Interregional-Trade Patterns:

Figure 6 shows the pattern of local specialization for Karratha across the 2001-2011 period. Overall, Karratha has a specialised economy with economic activities focusing on the mining and construction industries.

Figure 6: The specialisation of each industry by employment, relative to levels of employment in Western Australia. LQ values greater than one demonstrate local specialization in that industry.
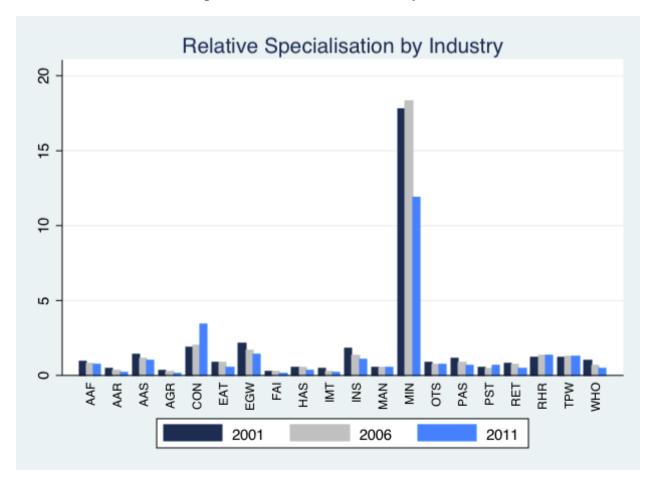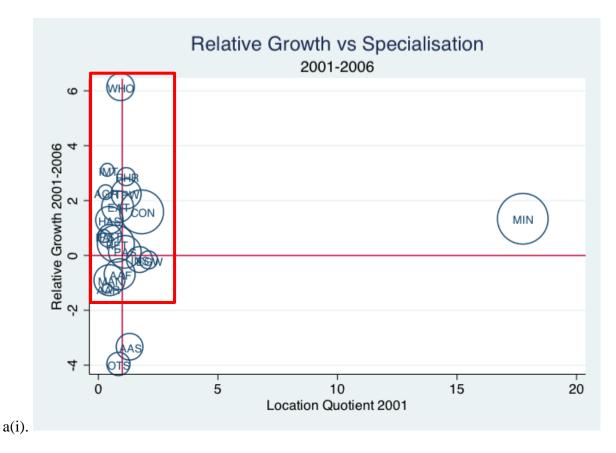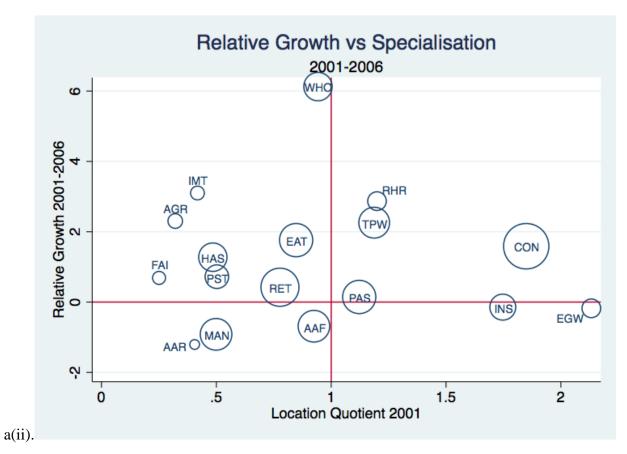

Figure 7 examines the relative growth of industry based on the level of specialisation. The data portrayed in Figure 7a(ii) and Figure 7b(ii) is that of the data shown in Figure 7a(i) and Figure 7b(i) respectively but in greater detail.

Figure 7: The relative growth of the industry based on level of local specialization for (a) 2001-2006 and (b) 2006-2011. The size of the circle demonstrates the proportion of that industry to total employment.

a(i).

Relative Growth vs Specialisation
2001-2006

a(ii).

Relative Growth vs Specialisation
2006-2011

b(i).

Relative Growth vs Specialisation
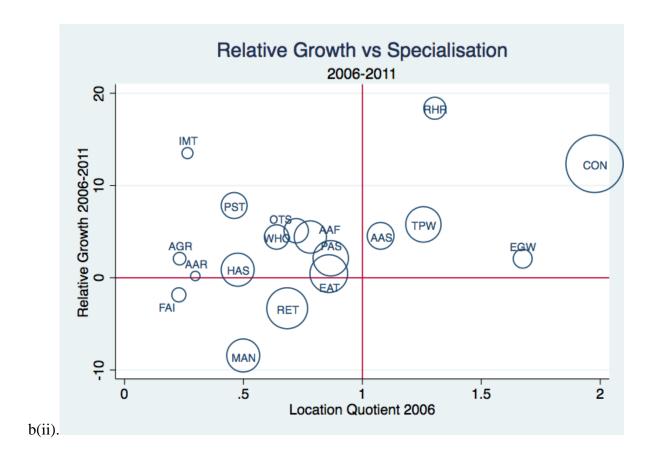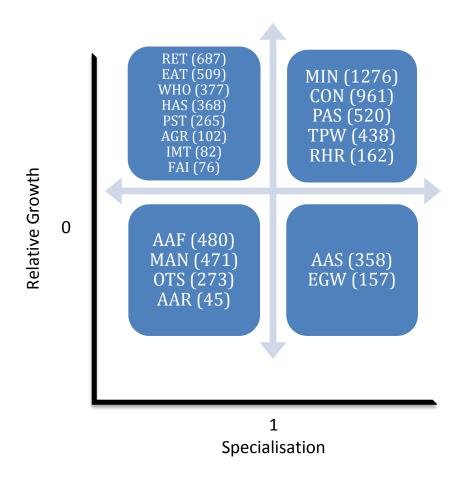2006-2011

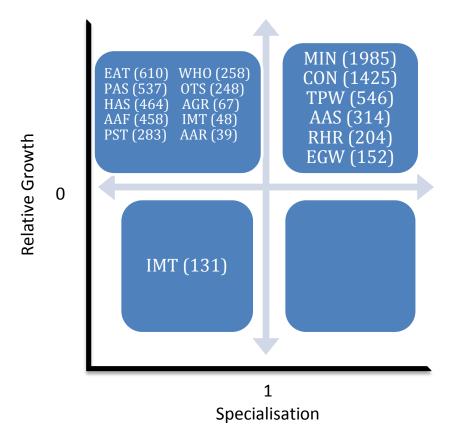b(ii).

(c) Classifying Industrial Activities

Combining the information on an economy's ability to create jobs locally and the sectoral patterns, it is possible to classify industries in terms of their growth potential and comparative advantage. Figure 7 and Figure 8 classify the economic structure of the Karratha economy into IMPORTANT GROWTH INDUSTRIES, IMPORTANT INDUSTRIES THAT MAY REQUIRE ATTENTION, POTENTIAL EMERGENT INDUSTRIES, INDUSTRIES OF LITTLE PROMISE.

- Karratha has a specialised economy focusing on mining and construction activities and services which support those sectors. Not surprisingly, the IMPORTANT GROWTH INDUSTRIES for the entire 2001-2011 period are mining, construction, transport, postal and warehousing, rental and hiring and real estate services.
- In 2001-2006 public administration and safety was an IMPORTANT GROWTH INDUSTRY but in 2006-2011, it was classified as a POTENTIAL EMERGENT INDUSTRY.
- In the 2001-2006 period, two sectors were classified as INDUSTRIES OF LITTLE PROMISE; administrative and support services and electricity, gas, water and waste services. By 2006-2011, these sectors were classified as IMPORTANT GROWTH INDUSTRIES.
- Information, media and telecommunications, a relatively small employing sector was the only sector identified as INDUSTRY OF LITTLE PROMISE in the 2006-2011 period.

- Of those industries in which Karratha specializes, a large number also grew rapidly relative to Western Australia.
- The 2006-2011 period shows the Karratha economy to be considerably more robust than was the case in 2001-2006 period. There are no IMPORTANT INDUSTRIES THAT MAY REQUIRE ATTENTION and significantly more sectors are classified as POTENTIAL EMERGENT INDUSTRIES.

Figure 8: Classification of industries based on their specialisation and relative growth for (a) 2001-2006 and (b) 2006-2011. Within each category, industries are ranked based on their level of employment (shown in brackets).

Relative Growth / Specialisation matrix

Upper-left quadrant:
EAT (610)   WHO (258)
PAS (537)   OTS (248)
HAS (464)   AGR (67)
AAF (458)   IMT (48)
PST (283)   AAR (39)

Upper-right quadrant:
MIN (1985)
CON (1425)
TPW (546)
AAS (314)
RHR (204)
EGW (152)

Lower-left quadrant:
IMT (131)

Axes: Relative Growth (vertical), with 0 marked; Specialisation (horizontal), with 1 marked.

7.   Implications for Local Economic Policy

Competitive and comparative advantage are technically two separate, independent concepts which measure economic performance. However, when viewed together they have the potential to measure:

- multiple factors in the economy of a particular place;
- the relationship of a particular locality with other localities nearby ('neighbours');
- the interdependence between industries; and
- the performance of that economy with other local economies.

The degree of economic integration is also an important factor and this underpins the robustness of the Western Australian state economy. Consequently, in regional Western Australia, the links each regional capital has with its 'neighbours' can be important depending upon the relative location or proximity of a regional capital and/or the remoteness of the 'neighbours'. The strength of the direct and indirect impacts of a regional economy on its neighbours and also the direction and flows of the impacts are important to understand and this is best described as 'connectivity'. The links and connectivity also indicate accessibility. Factors which influence accessibility are numerous, including: transport networks, social capital, commodities, labour force, infrastructure and services.

Understanding the links, flows, connectivity and accessibility provide the necessary information to explain how competitive and comparative advantage and industry specialisation of a local

economy will impact on neighbouring economies and the strategic positioning of regional capitals in the Western Australian economy overall.

The dynamics and drivers of local competitiveness and comparative advantage shape a regional economy's responsiveness to externalities and help explain the underlying forces triggering 'catch-up', 'falling behind' and 'forging ahead'. They also assist in forecasting economic impacts including:

- the direct and indirect effect of investing in regional capitals,
- the influence of local investment beyond the regional capitals, and
- the potential for diffusion of external shocks across the economic system.

In the case of Karratha, there are indications there is a high level of dependence between Karratha and its neighbours; investment in Port Hedland has a positive flow-on effect on its neighbours. Future research, through the Western Australian Regional Model (WARM) will explore the impact of the degree of connectivity and economic integration between Karratha and its neighbours and Karratha Hedland and the Western Australian economy overall.

8. APPENDIX A: ANZSIC INDUSTRIAL CLASSIFICATION

ANZSIC Classification	Mnemonic
Accommodation & food services	AAF
Arts & recreation services	AAR
Administrative & support services	AAS
Agriculture, forestry & fishing	AGR
Construction	CON
Education & training	EAT
Electricity, gas, water & waste services	EGW
Financial & insurance services	FAI
Health care & social assistance	HAS
Information media & telecommunications	IMT
Inadequately described/Not stated	INS
Manufacturing	MAN
Mining	MIN
Other services	OTS
Public administration & safety	PAS
Professional, scientific & technical services	PST
Retail trade	RET
Rental, hiring & real estate services	RHR
Transport, postal & warehousing	TPW

9.   TECHNICAL APPENDIX:

(1)   Relative Growth Rates:

Let $E_{ir,t}$ define the number of persons employed in industry i in region r at time t. It follows that the local growth rate g_{ir} can be defined as:

$$g_r = \frac{E_{ir,t+1}}{E_{ir,t}} - 1$$

Similarly, the average growth rate across the benchmark economy, in this instance Western Australia, g_{iWA}, can be defined as:

$$g_{iWA} = \frac{E_{iWA,t+1}}{E_{iWA,t}} - 1$$

It follows that the relative local economic performance, A_{ir}, in terms of job creation is defined as:

$$A_{ir} = g_{ir} - g_{iWA}$$

If $A_{ir} > 0$ then industry i in region r is performing better than the same industry in the benchmark economy. Conversely, if $A_r < 0$ then industry i in region r is performing worst than in the benchmark economy.

(2)   Local Specialization and the Economic Base:

Conventionally, basic sector employment is assumed to include Agriculture, Mining, Tourism, State/Federal Government and manufacturing (partially) whereas non-basic economic activities include retailing, commercial banking, local government, local public schools, services. However, this rule-of-thumb can be augmented with a more objective measure of local specialization, the location quotient. An employment location quotient (LQ_{ir}) is used to define the relative specialization of an industry i in a region r relative to the employment in the same industry in a benchmark economy:

$$LQ_{ir} = \frac{E_{ir}/E_r}{E_{iWA}/E_{WA}}$$

Where, E_{iWA} is the level of employment in industry i, in the benchmark economy and E_{WA} is the total employment in the benchmark economy, in this instance Western Australia.

Where local economic data on trade flows does not exist regional trade patterns need to be imputed from measures of local economic structure. Specifically, it is assumed that the patterns of trade can be imputed from the patterns of industrial specialization. In general,

(a)   the greater is the LQ_{ir} above unity, the larger will be there regions net sectoral exports

(b)   the greater is the LQ_{ir} below unity, the larger will be the regions net sectoral imports

(c)   for an LQ_{ir} of unity, the region is neither a net exporter nor a net importer.

From which it is possible to calculate the level of base sector employment in a local economy:

$$E_{ir}^B = (1 - 1/LQ_{ir})E_{ir} = \left(\frac{E_{ir}}{E_{iWA}} - \frac{E_r}{E_{WA}}\right)E_{iWA} \qquad \forall LQ_{ir} > 1$$

The first term on the right hand side of this equation can be considered as a proxy for the local economy's share of the total production, or quantity supplied, of the products of industry i for the base economy WA. Similarly, the second term can be considered a proxy for the region's share of the 'base' economy's consumption, or quantity demanded. If the difference is positive (ie a $LQ_{ir} > 1$) then the local economy produces a greater share of the 'base' economy's production than it consumes and the excess is assumed to be exported. As a corollary, this equation can be used to calculate net export employment, that is the local economic base by aggregating across all industries, $E_r^B = \sum_{i=1}^{n} E_{ir}^B$.