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MOUNT ISA TRANSITION FRAMEWORK

PART FOUR: IDENTIFY THE OPPORTUNITY
DIVERSIFICATION ANALYSIS

Title

Mount Isa Transition Framework

Part Four: Identify the Opportunity - Diversification Analysis

Authors

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Acknowledgement of Country

This report was written on Kalkadoon and Karuna Land. The McKell Institute acknowledges Aboriginal and Torres Strait Islander peoples as the Traditional Owners of Country throughout Australia and their continuing connection to both their land and seas.

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Executive Summary

Instances of large-scale job loss pose two central and interrelated problems: what happens to the workers and what happens to the region, in the immediate aftermath and over the medium and long term.

Regions that are highly dependent on a single industry or employer, like Mount Isa, are at greater risk of extended periods of unemployment because it is less likely that the available work will require the same skillsets as the industries shedding labour. Past closures reveal that the loss of a major employer can have individual, regional and national repercussions. And that without sufficient and suitable intervention they can have a devastating and lasting (sometimes inter-generational) psycho-social effect on workers, their families, and their communities.

No two shocks are the same, and so we must be cautious about any attempts to identically replicate success stories. What worked in one instance will not necessarily do so in another. Closure interventions require a clear understanding of the severity of the problem to inform the level of support needed to mitigate both the direct short-term impacts, as well as the longer-term flow-on impacts which result from a regional shock. Effective management of large-scale job losses require a holistic transition response that simultaneously considers people and place, jobs and skills, and goals and strategies - now and into the future.

Managing an industry closure requires planning for a future without the industry. An industry transition plan is specific to the industry that is closing and the region. In order to plan for the future, policy makers need to know what opportunities are available to manage the transition. With proper planning, an industry closure is an opportunity for industry and regional development. This means policy makers need to understand the relationship between different jobs in the region, and how best to apply the skills available in these jobs into new areas of strategic, regional, or national importance.

This section introduces a method of diversification analysis and applies it for Mount Isa to reveal industrial opportunities based on occupation and industry employment. The method is considered in the context of the closure of the Mount Isa Copper Operations (MICO) and the copper concentrator and forms **part four** of the McKell Institute's Mount Isa Transition Response.

Diversification analysis provides a quantitative base for understanding the relationship between regional employment in different industries and occupations, as well as the similarity between regions based on the jobs worked. It highlights the industries and occupations (which we refer to as "jobs") in which a region is specialised, and how these jobs are distributed across Australia. Regions that are specialised in many jobs, and specialise in jobs that are not common specializations across other regions are considered complex regions. In turn, jobs which are not common across other regions, and are specialised by regions with high complexity are considered complex jobs. Complexity also relates to how the knowledge intrinsic in a job relates to other jobs. For example, jobs which are complex tend to utilise a broad range of knowledge and skills, which can be applied to other jobs which may not lie within the same industry or occupation. We can also assess job and regional similarity based on the likelihood of a region

being specialised in a pair of jobs. The place based nature of this analysis allows for the identification of opportunities which are specific to the region.

Our analysis finds that the regional specialisations in Mount Isa are limiting in terms of diversification opportunities, and this requires a more hands-on approach by regional and state policy makers. This is due to:

- **specialisation in low complexity jobs:** jobs in Mount Isa are concentrated in the Mining industry, including Copper Ore Mining, Silver, Lead and Zinc Ore Mining, and Other Metal Mining, and Mining occupations, including Mining Support Workers, Metallurgists, Miners, and Drillers. These jobs are found to be low in complexity, and are most related to other jobs in the Mining industry and Mining related occupations. This relatedness limits the ability to transition employees from Mining jobs to other jobs which may be more beneficial to Mount Isa in meeting strategic, regional and national goals. Additionally, the similarity between Mining jobs does not necessitate that other Mining opportunities are available in Mount Isa.

- **similarity of job opportunities in other regions:** the most similar regions to Mount Isa, based on industry and occupation employment are also regional Mining towns, including Port Hedland and Kalgoorlie-Boulder. The closure in Mount Isa may result in affected workers seeking similar jobs in these regions, which are also likely to be commensurate in salary and skill utilisation.

- **path dependency:** the concentration of employment in low complexity jobs means that the relationship between job relatedness and regional benefit in Mount Isa is negative. This means that the jobs which provide the greatest benefit to the region are the furthest away from Mount Isa's current capabilities and it will be more difficult to build a specialisation in these jobs.

To mitigate these limiting factors, we recommend some short term opportunities for managing the immediate closure within the Construction industry and Machinery Operators and Drivers occupations, and recommend that Mount Isa consider their long-term diversification strategy in line with regional, state, and national priorities and goals. This requires alignment of a strategic vision across three levels of policy making - council, state and federal governments. Specifically, Mount Isa should seek to diversify through alignment with the goals of sovereign capability development, and green industrial development which are supported by the National Reconstruction Fund, Net Zero Plan, and Circular Economy Ministerial Advisory Group. As an example, diversification opportunities for Mount Isa could focus on building the value chain to develop products which can assist in decarbonisation, such as components for batteries, wind turbines, or solar panels.

1. Diversification analysis

Mount Isa is a regional town with a workforce concentrated in the Mining industry. The closure of the Mount Isa Copper Operations (MICO) and Copper Concentrator represent a significant risk to the short and long term health of the town. Up to 980 jobs may be **directly** affected by the closure - or about half of the towns total employment in Copper Ore Mining, and an additional 908 jobs may be affected through industrial linkages. Without intervention, significant negative economic impacts are expected both within Mount Isa and across Queensland and Australia[1].

The closure of an industry in a region can lead to significant disruption of a local population, especially when the industry is a significant employer within the region. This disruption can take the form of mass unemployment, population decline, or a fractured community. It is important to develop policy responses to the disruption which can assist workers transition from one job to another, while utilising their existing skills and remaining local to the region.

Keeping employment local is important because of the interaction between employment and social and community resilience. Affected workers who leave the region may also sell their house, or leave as a family, spreading the economic impact beyond the initial impact to the closing industry. This also risks impacting vulnerable residents in Mount Isa who are unable to leave to find employment opportunities[2].

It is critical when managing an industry closure to identify opportunities for regional diversification. This policy response must strike a balance across three dimensions:

1. The type of work done by the affected employees,
2. The suitability of opportunities in terms of available skills in the region, and
3. Relevant strategic, regional, and national goals.

An industry transition plan provides an opportunity to develop skills and capabilities in areas of key national interest, including the development and establishment of a sovereign capability, re-industrialisation and on-shoring of manufacturing jobs, and the decarbonisation agenda. Too often in transition planning, this is neglected in favour of short term, minimum effort solutions. While a short term response is necessary to provide an immediate mitigation of the impact, focusing on the short term at the exclusion of long term planning risks alienating affected workers who may be unwilling to move jobs to something that does not utilise their skills, is not fulfilling, or does not meet their income requirements or expectations. In this case, the short term response merely delays the economic impact.

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[1] A detailed economic impact assessment of the MICO and Copper Concentrator closure is presented in Part Three: Map the Threat - Impact Analysis.

[2] Short and long-term risks to the region from the closure of Glencore's operations in Mount Isa is presented in Part Two: Understand the Regional Context - Labour Market Analysis.

Identifying opportunities requires both a quantitative as well as a qualitative approach. We term the quantitative approach as *diversification analysis* which uses data to map regional strengths to opportunities through an aggregate understanding of how jobs are related across reiongs in Australia.

However, for a region such as Mount Isa, and other regions likely to face industry closure in the future, employment is highly concentrated in a single industry or occupation. This limits the availability of related jobs for diversification. In such instances, it is necessary for policy makers to consider the regional diversification strategy with respect to larger strategic goals and priorities. This forms the qualitative aspect of the analysis. .

The approach for identifying opportunities requires understanding:

- What skills from affected Mount Isa employees are available to be utilised?
- What diversification opportunities are suitable for the existing skills?
- What are the strategic, regional, or national goals or priorities?

Diversification analysis uses the concept of economic complexity. Economic complexity is based on the idea that what a region does reveals what it knows. What a region does can be measured in multiple ways, including:

- the products a country or state exports
- the industry or occupation that employs people in a Local Government Area
- the technology class of patents produced.

The presence of an industry, technology class, occupation, or product, suggests a level of knowledge (be that at the local, sub-national, or national level) necessary to be competitive in the activity. This allows for the productive structures of regions or countries to be characterised, and also reveals the path dependency of development.

Economic complexity has gained prominence as a method for identifying both the existing productive capabilities of a location as well as the connections between existing capabilities in a location, and potential future capabilities. Complexity methods also help to provide a quantitative base for modern policy efforts such as smart specialisation (Hidalgo 2021). Economic complexity has been applied at both the regional and national level to quantify the structure of economies in the United States, China, Mexico, Canada, Russia, Brazil, Uruguay, Australia, Turkey, Spain, Italy, Paraguay, and the United Kingdom (see for an exhaustive list of related papers). However, the link between economic structure and policy directives has been explored less. Economic complexity methods have also been used to analyse and identify the growth opportunities of countries in specific areas – such as the green economy (Mealy and Teytelboym 2017).

Economic complexity aims to quantify the level of knowledge or skills present in an economy. Economies who can combine knowledge across many different industries are able to produce more products, and products which are more knowledge intensive. Conversely, those

economies which are simpler have a narrower base of production and hence produce fewer and simpler products (Hausmann et al. 2014).

In this report, we utilise Census data from the Australian Bureau of Statistics (ABS) to characterize economic complexity at the Local Government Area based on employment by industry and employment by occupation[3]. Local Government Areas are a natural geography to use for regional diversification analysis as they represent regions with distinct identity, and are the smallest regions with governing bodies.

Our analysis excludes LGAs with fewer than 50 total employed people, as well as occupations and industries which employ fewer than 50 people across Australia. In total, we calculate economic complexity indicators for 538 regions across Australia, covering 1,106 occupations and 496 industries.

Economic complexity methods produce many indicators describing the economic structure of a region, including diversity, ubiquity, proximity, complexity outlook gain, distance, complexity outlook index, product complexity index, and economic complexity index. The analysis which follows will focus on the relationship between a regions existing strengths and diversification opportunities. To that end, the measures of the *economic complexity index, density*, *product complexity index, proximity and complexity outlook gain* will be prioritised over other measures. These are selected as they respectively provide a quantitative description of how industries and occupations are related to existing strengths, the benefit of building capabilities in a new industry or occupation, and a summary measure of the structure of the economy. A description of these concepts is provided in Section 1.1, with the mathematical derivation shown in Section 7.

[3] Local Government Areas are used partly to minimise the impact of regions with low total employment. When these areas are disaggregated to 4-digit industry and 6-digit occupation, there is insufficient information for the region to accurately identify economic complexity. Additionally, the ABS limits data availability where total employment in an industry or occupation in a region is less than ten.

1.1 Key concepts

Revealed Comparative Advantage

Revealed comparative advantage (RCA) is a measure of the relative strength of a job (based on industry or occupation employment) based on its regional employment relative to national employment. We call a job with revealed comparative advantage a **specialisation** for a region.

Diversity

Diversity is a simple measure of the number of jobs in which a region is specialised. A higher diversity implies a broader range of knowledge to build from.

Ubiquity

Ubiquity is a simple measure of the number of regions which specialise in a job. The more ubiquitous a job, the more common it is across Australian regions.

Economic Complexity Index

The economic complexity index (ECI) is a measure of the level of knowledge embedded within a Local Government Area. This index will be calculated for both employment by occupation and employment by industry at the Local Government Area level. The derivation of the indicator is the same, however the input data is different. The Economic Complexity Index uses diversity and ubiquity to determine regional complexity.

Job Complexity Index

A complex job is one in which only few regions are able to specialise in. That is, it is non-ubiquitous. Additionally, the regions which maintain complex jobs also specialise in many different occupations or industries. That is, they are diverse.

Proximity

Proximity between two jobs is a measure of the relatedness between two jobs based on the knowledge required for a region to specialise in them. It is based on the proportions of regions which have revealed comparative advantage in both jobs. Proximity can also measure the relatedness between two regions based on the similarity of their specialisations.

Density

Density provides an indication of how near a region is from the productive knowledge required to specialise in a new job. The density to a new job is the proportion of related jobs that the region already specialises in, weighted by the proximity between the related jobs and the new job.

Complexity Outlook Gain

The complexity outlook gain is the potential benefit, in terms of future diversification, to a region from building a specialisation in a new job. The complexity outlook gain represents the strategic value of the new job based on how many potential other jobs it may lead to.

2. Industry strengths

Mount Isa has a comparative advantage in 81 industries. The median number of industry strengths for a Local Government Area is 86.

The industries shown to have the highest level of comparative advantage in Mount Isa are related to Mining activities, including Copper Ore Mining, Silver, Lead and Zinc Ore Mining, as well as Other Metal Mining. The ten industries with the highest level of comparative advantage in Mount Isa are shown in Table 1.

Mining support services, smelting and refining also feature as industry strengths of Mount Isa. Outside of Mining, there are some strengths in Manufacturing, however these are also adjacent to the Mining Industry (such as metal ore refining) and are likely to also be impacted negatively by the industry closure.

Table 1: Employment by industry, Revealed Comparative Advantage, Mount Isa

Industry	RCA	Employment	Ubiquity
Silver-Lead-Zinc Ore Mining	246.4	991	49
Copper Ore Mining	228.0	1,754	47
Copper, Silver, Lead and Zinc Smelting and Refining	59.9	90	15
Fertiliser Manufacturing	14.2	36	69
Other Mining Support Services	10.5	136	102
Pipeline Transport	9.2	16	35
Other Specialised Industrial Machinery and Equipment Wholesaling	7.3	93	60
Explosive Manufacturing	7.2	17	63
Mineral Exploration	7.0	47	138
Other Metal Ore Mining	5.8	17	77

Ubiquity is a representation of how many regions specialise in a job. The median ubiquity for an industry is 73, which means half of all regions specialise in more than 73 industries. From an industry perspective, the least ubiquitous (most rare) industry that Mount Isa specialises in is

Copper, Silver, Lead and Zinc Smelting and Refining. Only 15 regions in Australia specialise in this industry.

3. Occupation strengths

Mount Isa is specialised in 210 occupations. The median occupation diversity across Australia is 208 occupations.

The occupations shown to have the highest level of comparative advantage in Mount Isa are also related to the Mining industry, including Mining Support Workers, Metallurgists, Miners, and Drillers. The ten occupations with the highest level of specialisation in Mount Isa are shown in Table 2.

The median ubiquity for an occupation is 85. From an occupation perspective, the least ubiquitous occupation that Mount Isa specialises in is Stationary Plant Operators, which is only a specialist occupation for 38 regions in Australia. Geophysicist is another example of a non-ubiquitous occupation in which Mount Isa is specialised.

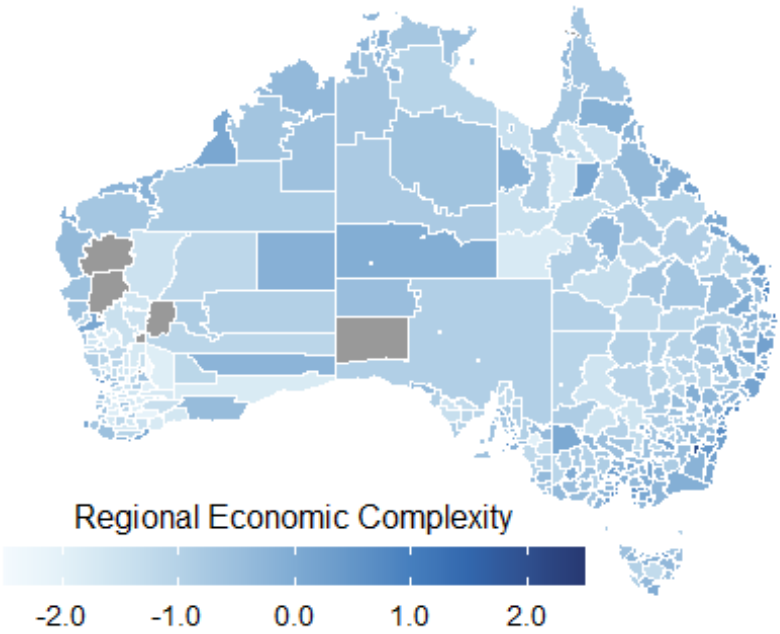
Table 2: Employment by occupation, Revealed Comparative Advantage, Mount Isa

Occupation	RCA	Employment	Ubiquity
Mining Support Worker	52.2	70	123
Radiocommunications Technician	31.9	16	60
Metallurgist	30.7	28	75
Stationary Plant Operators, nfd	23.5	5	38
Shot Firer	23.5	50	86
Miner	21.6	726	125
Mine Deputy	20.3	125	116
Fitter-Welder	19.4	12	91
Refuge Worker	16.8	3	41
Driller	16.5	102	139

4. Economic complexity

A map of the distribution of economic complexity, derived by industry employment is shown below in Figure 1. While complexity is highest in capital cities and across other population

centres there are still some regions in the Australian interior with moderate levels of economic complexity.



(a) Note: regions in grey have insufficient employment information to determine complexity.

Figure 1: Economic complexity index, by industry employment

Mount Isa's economic complexity based on industry employment is -0.03, ranked 241 out of 535 Local Government Areas analysed. This results from employment in Mount Isa being concentrated in low complexity industries. Table 3 shows the ten largest industry classes by employment size. Note that despite the high level of employment in Takeaway Food Services, Mount Isa is not considered to be specialised in this industry because the revealed comparative advantage (RCA) is less than one. This arises due to how common Takeaway Food Services is as an employing industry across Australia.

Table 3: Employment by industry, Mount Isa

Industry	Employment	Complexity	RCA
Copper Ore Mining	1,754	-2.03	228.0
Silver-Lead-Zinc Ore Mining	991	-1.76	246.4
Hospitals (Except Psychiatric Hospitals)	568	-0.79	1.2

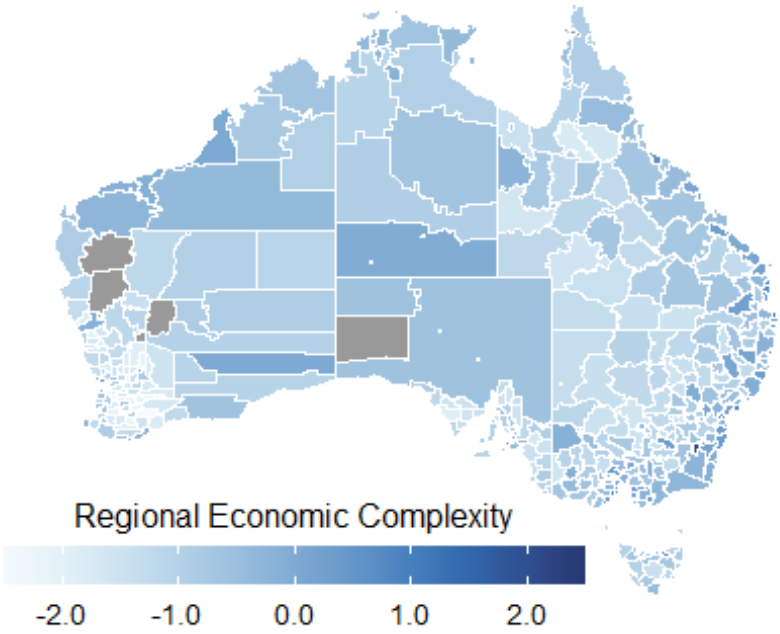
Primary Education	329	-1.20	1.4
Supermarket and Grocery Stores	224	-0.97	0.8
Coal Mining	202	-1.98	4.7
Secondary Education	196	-0.95	1.1
Takeaway Food Services	186	-0.06	0.9
Police Services	167	-1.18	2.3
Accommodation	166	-1.78	1.7

Mount Isa is specialised in only 7 complex industries, as shown in Table 4, however these are not significant employing industries for Mount Isa.

Table 4: Employment by industry, complex industries, Mount Isa

Industry	Employment	Complexity	RCA
Investigation and Security Services	56	0.74	1.4
Taxi and Other Road Transport	33	0.67	1.4
Motion Picture Exhibition	13	0.52	1.7
Freight Forwarding Services	34	0.46	1.7
Motor Vehicle New Parts Wholesaling	14	0.11	1.3
Sport and Camping Equipment Retailing	15	0.01	1.0
Special School Education	18	0.00	1.2

From an occupation perspective, Mount Isa's economic complexity based is 0.14, ranked 203 out of 535 Local Government Areas analysed. The measures of economic complexity based on industry employment and occupation employment reveal a similar distribution of complexity across Australia. Figure 2 below shows the distribution of economic complexity by occupation.



(a) Note: regions in grey have insufficient employment information to determine complexity.

Figure 2: Economic complexity index, by occupation employment

As with industry employment, employment in Mount Isa is also concentrated in low complexity occupations, which are in support of the Mining industry. The ten largest employing occupations for Mount Isa are shown in Table 5.

Table 5: Employment by occupation, Mount Isa

Occupation	Employment	Complexity	RCA
Miner	726	-2.04	21.6
Fitter (General)	473	-1.87	8.3
Sales Assistant (General)	332	-0.69	0.7
Electrician (General)	324	-1.46	3.4
General Clerk	280	-1.36	1.3
Truck Driver (General)	197	-1.92	1.6
Primary School Teacher	173	-1.49	1.2

Metal Fabricator	167	-1.74	4.6
Commercial Cleaner	149	-1.77	1.3
Police Officer	130	-1.37	2.7

Mount Isa is specialised in 6 complex occupations, as shown in Table 6, however as with industry complexity, these are not significant employing occupations for the region.

Table 6: Employment by occupation, complex occupations, Mount Isa

Occupation	Employment	Complexity	RCA
Registered Nurse (Paediatrics)	14	0.49	2.2
Radiocommunications Technician	16	0.23	31.9
Contract Administrator	22	0.19	1.2
Emergency Medicine Specialist	15	0.13	4.4
Education Professionals, nfd	14	0.13	1.5
Resident Medical Officer	21	0.01	1.5

5. Proximity

Proximity reveals intrinsic similarities between jobs based on the likelihood that they are both present within a region. The proximity between jobs is not dependent on region - it is a summary across all regions. For example, the proximity between Copper Ore Mining and Silver-Lead-Zinc Ore Mining is 0.46, indicating that 46% of regions that have an industrial strength in Copper Ore Mining also have an industrial strength in Silver-Lead-Zinc Ore Mining. In this example, the linkage is likely due to the concentration of mining activities in remote regions. However it can also reveal linkages in terms of skills, or similarity of job.

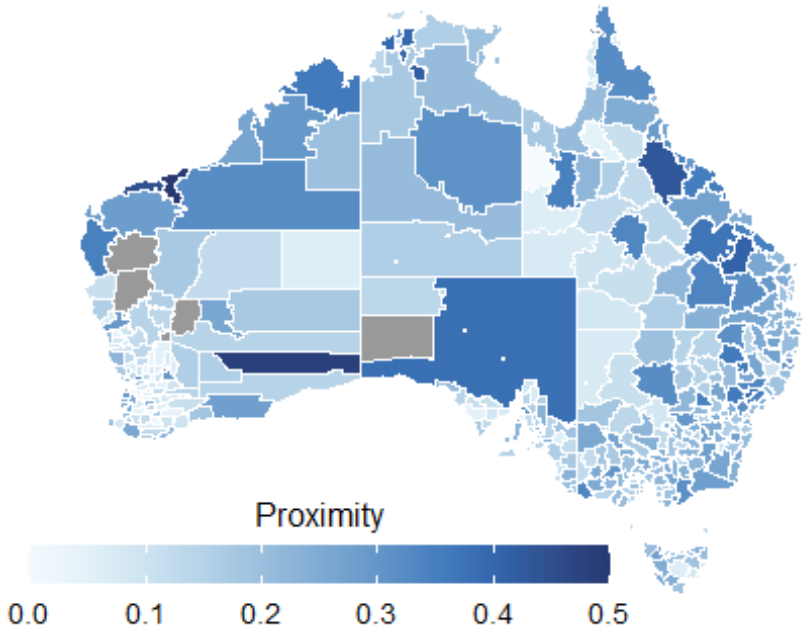
Additionally, proximity can identify similarity of regions, based on the similarity of industrial or occupational strengths between regions. For example, Mount Isa and Port Hedland have a proximity of 0.50, indicating that half of the industrial strengths in Port Hedland are also industrial strengths in Mount Isa.

Based on industry specialisation, the 10 most similar regions to Mount Isa are shown below in Table 7, and summarised for all regions analysed in Figure 3. For occupation specialisation, the 10 most similar regions are shown in Table 8, and summarised for all regions analysed in Figure 4.

For individuals whose employment is affected by the closure of Glencore in Mount Isa, these regions are likely to provide opportunities for similar employment in a job which utilises their skills and pays a commensurate salary.

Table 7: Similar regions, by industry employment, Mount Isa

Region	Proximity (Industry)
Port Hedland	0.50
Kalgoorlie-Boulder	0.48
Alice Springs	0.47
Karratha	0.45
Charters Towers	0.43
Katherine	0.42
Banana	0.41
Broken Hill	0.40
Whyalla	0.40
Unincorporated NT	0.40



(a) Note: regions in grey have insufficient employment information to determine proximity

Figure 3: Regional proximity to Mount Isa, based on industry employment

Table 8: Occupation proximity, Mount Isa

Region	Proximity (Occupation)
Kalgoorlie-Boulder	0.53
Port Hedland	0.50
Whyalla	0.49
Central Highlands (Qld)	0.49
Maranoa	0.48
Unincorporated SA	0.48
Karratha	0.47
Unincorporated NT	0.47
Port Augusta	0.47
Ashburton	0.46

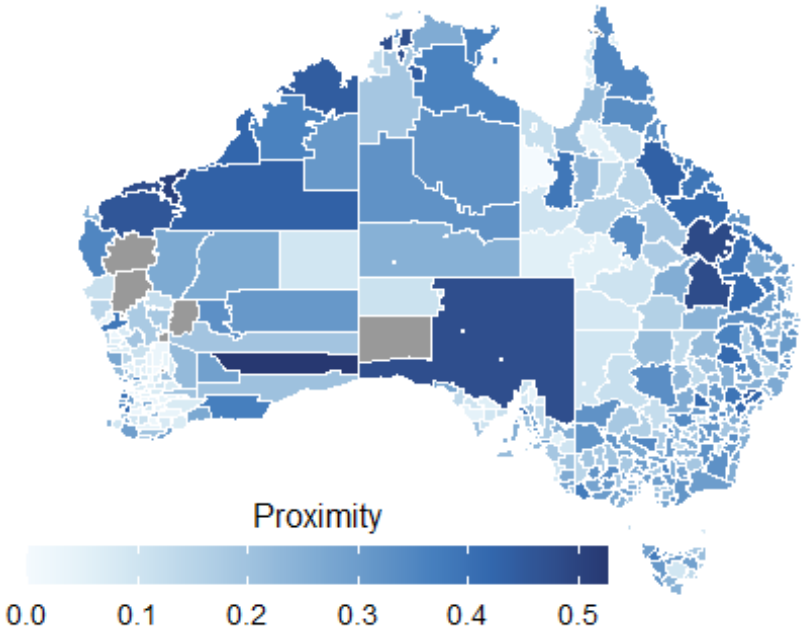


Figure 4: Regional proximity to Mount Isa, based on occupation employment

6. Opportunities

When identifying future opportunities for Mount Isa, the trade off between benefit to the region, and cost, or difficulty delivering the opportunity must be considered. Figure 5 shows the relationship between relatedness and complexity gain (or benefit) for industries that Mount Isa does not currently specialise in. The size of each point represents the current level of employment in that industry.

The relationship between relatedness and benefit for Mount Isa is *negative*, meaning that the more beneficial industry developments are *further away* from the current set of industrial strengths. This is a consequence of the low level of economic complexity in Mount Isa.

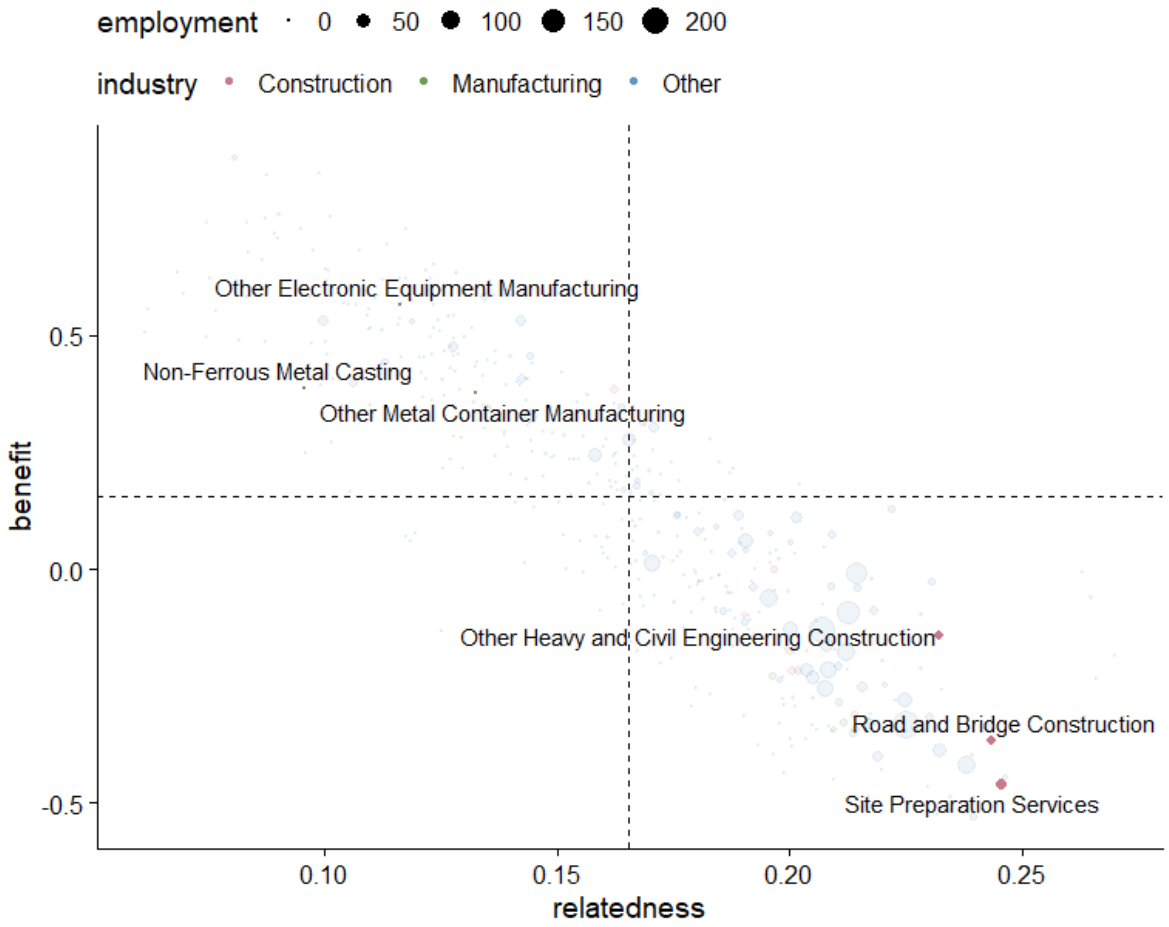


Figure 5: Industry opportunities, Mount Isa

Six industries have been highlighted as relevant industry development opportunities.

The three industries in the bottom right quadrant are Construction related activities and represent opportunities which will be easier to pursue in Mount Isa, but won't deliver long term benefits to building local complexity. These opportunities are ideal for short-term job support in Mount Isa.

The three industries in the top left quadrant are Manufacturing related activities and represent more long term opportunities for Mount Isa. These opportunities should be considered in the context of State and national industry development and strategic goals.

Figure 6: Occupation opportunities, Mount Isa

At the occupation level, opportunities appear to be more limited, however we have highlighted six relevant occupations in Figure 6. The three occupations in the bottom right quadrant are related to Machine Operators and Drivers, and represent opportunities which will be easier to pursue in Mount Isa in the short term. The occupations in the top left quadrant are related to Management and Professional occupations, and should be considered in the context of regional, state, and national strategic goals.

7. Conclusion

No two closures are alike. It is imperative that policymakers understand the potential opportunities for industry and employment replacement in the affected region.

This document, **Part four: Identify the Opportunity** of the McKell Institute's Mount Isa Transition Response has introduced a method for diversification analysis and applied it for Mount Isa to reveal industrial opportunities based on occupation and industry employment.

We find that **employment is concentrated in low complexity jobs**. These jobs are most related to other jobs in the Mining industry and Mining related occupations, which limits the ability for workers to transition from Mining jobs to other jobs. The **regional strengths of Mount Isa are not unique** to the region. There are other similar regions to Mount Isa based on industry and occupation employment, which are also regional Mining Towns. Industry closure in Mount Isa may result in affected workers seeking similar jobs in other regions, exacerbating population outflow.

Critically, Mount Isa faces **negative industrial path dependency.** This means that the relationship between job relatedness and regional benefit to Mount Isa is negative, and that jobs which provide the greatest benefit to the region are the farthest away from the current capabilities of Mount Isa. As such, it will be more difficult to build a regional specialization in these jobs.

To mitigate these limiting factors, we recommend some short-term opportunities for managing the immediate closure within the Construction industry and Machinery Operators and Drivers occupations and recommend that **Mount Isa consider their long-term diversification strategy in line with regional, state, and national priorities and goals**.

Specifically, Mount Isa should seek to **diversify through alignment with the goals of sovereign capability development, and green industrial development which are supported by the National Reconstruction Fund, Net Zero Plan, and Circular Economy Ministerial Advisory Group**.

This document is part four of the McKell Institute's Mount Isa Transition Response, a four-part report that devises a holistic transition framework for Mount Isa's response strategy, informed by best practice from past industry closures. *Part One: Closure Framework* employs best practice findings from past closures to devise an overarching holistic framework for Mount Isa's transition response which is then deployed over the following three reports. *Part Two: Understand the Regional Context* outlines the current and historical status of the labour market in Mount Isa in the context of the closure. *Part Three: Map the Threat – Impact Analysis* summarises both the direct and indirect impacts on employment and gross regional product impacts from the closure.

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9. Appendix

9.1 Revealed Comparative Advantage

$$RCA_{rj} = \frac{X_{rj}}{\sum_r X_{rj}} / \frac{\sum_i X_{rj}}{\sum_{rj} X_{rj}}$$

Where r represents the region (LGA), j represents a job and X is employment. Values of RCA of 1 or higher indicate that a region has comparative advantage (or specialises) in employment in that job. That is, the share of the region's total employment in a job is greater than the share of Australia's employment in the same job.

9.2 Economic Complexity Index

Let M_{rj} be a binary matrix such that:

$$M_{rj} = \begin{cases} 1 & RCA_{rj} \geq 1 \\ 0 & RCA_{rj} < 1 \end{cases}$$

$$M_{rr} = \sum_j \frac{M_{rj} M_{r'j}}{k_{r0} k_{j0}}$$

The ECI is the eigenvector corresponding to the second largest eigenvalue of M_{rr}. The Economic Complexity Index is normalised to have a mean of zero and standard deviation of one.

9.3 Job Complexity Index

The Job Complexity Index is analagous to the Product Complexity Index of Hausmann and Hidalgo, 2014.

$$M_{ii} = \sum_r \frac{M_{ri} M_{ri'}}{k_{c0} k_{p0}}$$

The Job Complexity Index is the eigenvector corresponding to the second largest eigenvalue of M_{ii}

9.4 Proximity

$$\phi_{jj'} = \frac{M_{rj} M_{rj'}}{\max(k_{j0}, k_{j'0})}$$

9.5 Density

$$d_{rj} = \sum_{j'} \frac{(1 - M_{rj'}) \phi_{jj'}}{\sum_{j'} \phi_{jj'}}$$

9.6 Complexity Outlook Gain

$$COG_{rj} = \sum_{j\prime} \frac{\phi_{jj\prime}}{\sum_{p\prime\prime} \phi_{p\prime\prime p\prime}} \left(1 - M_{rj\prime}\right) PCI_{j\prime}$$