Mapping Industry Clusters in NSW:
A Data Driven Approach

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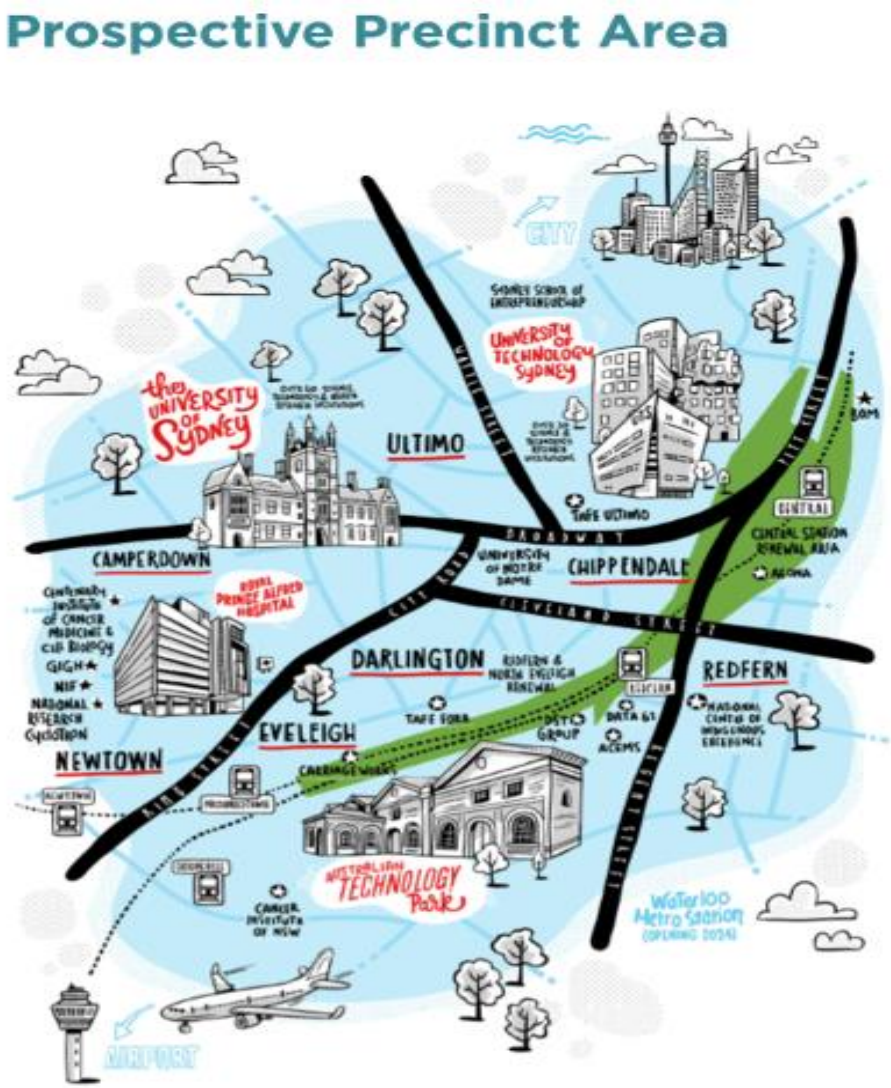
Background of project

Background of the project

- Preliminary results from a major project **“the role of clustering on firm and industry productivity in NSW”**

- A collaborative project between **Investment NSW** and **NSW Innovation and Productivity Council (IPC)**

- The goal is to **provide evidence to support NSW precincts and place based policies**
  - Which industries are highly interrelated in terms of supply chain and labour pooling?
  - Which industries benefit from co-locating with other industries in their cluster?
  - Are firms in clusters more productive when co-located?



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Background of the project

The project has three main phases

Industry Cluster Mapping

- **Identification of existing/potential clusters**
- **Spatial Mapping** of the identified industry clusters

Econometric modelling - the role of firm co-location on productivity

- **Modelling the effect of clustering on firm productivity** using **BLADE** (Business Longitudinal Analysis Data Environment)
- Identify industries benefiting from co-location

Consultations with industry and policy teams

- Confirm the identified industry clusters
- Collect further data e.g. surveys to improve the analysis
- Publications

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Background of the project

Objectives of Phase 1 (Industry Cluster Mapping):

- **Understand what makes a good cluster?**
- **Identify which industries are related in terms of supply chain relationship and labour pooling?**
- **Identify industry clusters that can be used for econometric modelling** (Phase 2)

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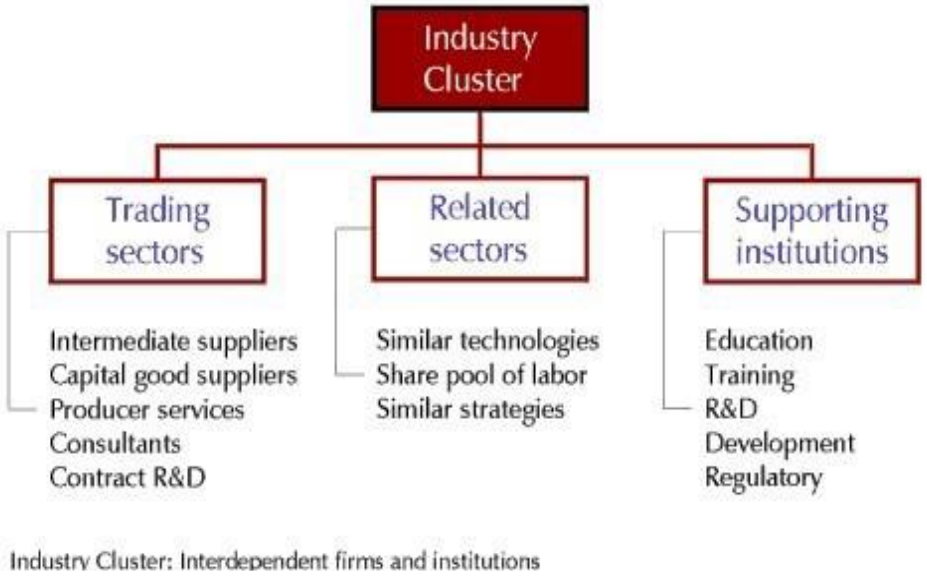
Overview – Industry clusters literature

What are industry clusters?

No agreed definition and method for identifying clusters

Industry clusters - **the tight connections that bind certain firms and industries together in various aspects of common behaviour** (Bergman & Feser, 2020).



Industry Cluster: Interdependent firms and institutions

Source: Bergman & Feser (2020)

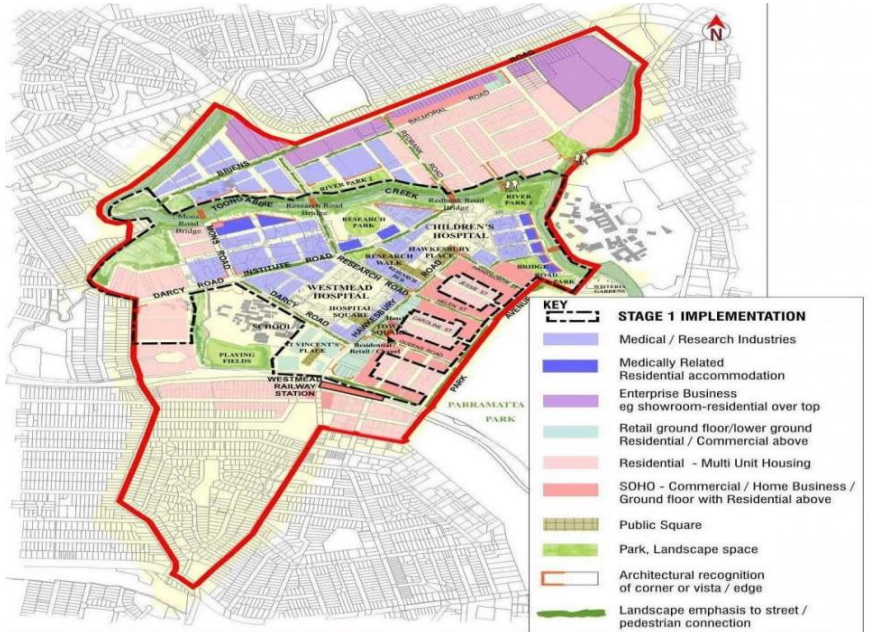
Binding the cluster together are:

1. Linkages

- buyer-supplier relationships
- common labour pools

2. Spatial (geographic location)

- same metropolitan area
- labour market regions



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What are the benefits of industry clusters?

Agglomeration literature (Marshall, 1920; Porter, 2003, Glaeser, 2010) suggest

- **Individual firms** can be **more productive** as a result of the **geographic concentration of firms, services, and industries**.

MAR (Marshallian-Arrow-Romer) externalities and Porter cluster theory suggest **industry clusters can provide the following benefits:**

1. **Proximity to customers and suppliers**
2. **More efficient supply chains**
3. **Enhanced collaboration**
4. **Labour market pooling**
5. **Technological or intellectual spillovers**

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Mapping industry clusters

Cluster mapping is **the quantitative measurement of cluster presence** (Porter, 2003; Delgado et al., 2016).

There is no agreed method for identifying and mapping clusters

Broadly there are two methods:

1.Top-down (quantitative methods) e.g., **input-output trade**, input-output innovation and **labour pooling**

- Economic activity in related industries
- Comprehensive across the economy
- **Data-driven definitions**

2. Bottom-up (qualitative methods) e.g., Surveys, specialization indicators such as location quotient (LQ)

- Focused on **case studies** - often in locations e.g., technology (Silicon Valley, Boston), finance (London, NY), or movies (Hollywood).
- **ad-hoc** and **does not support comparisons across locations**

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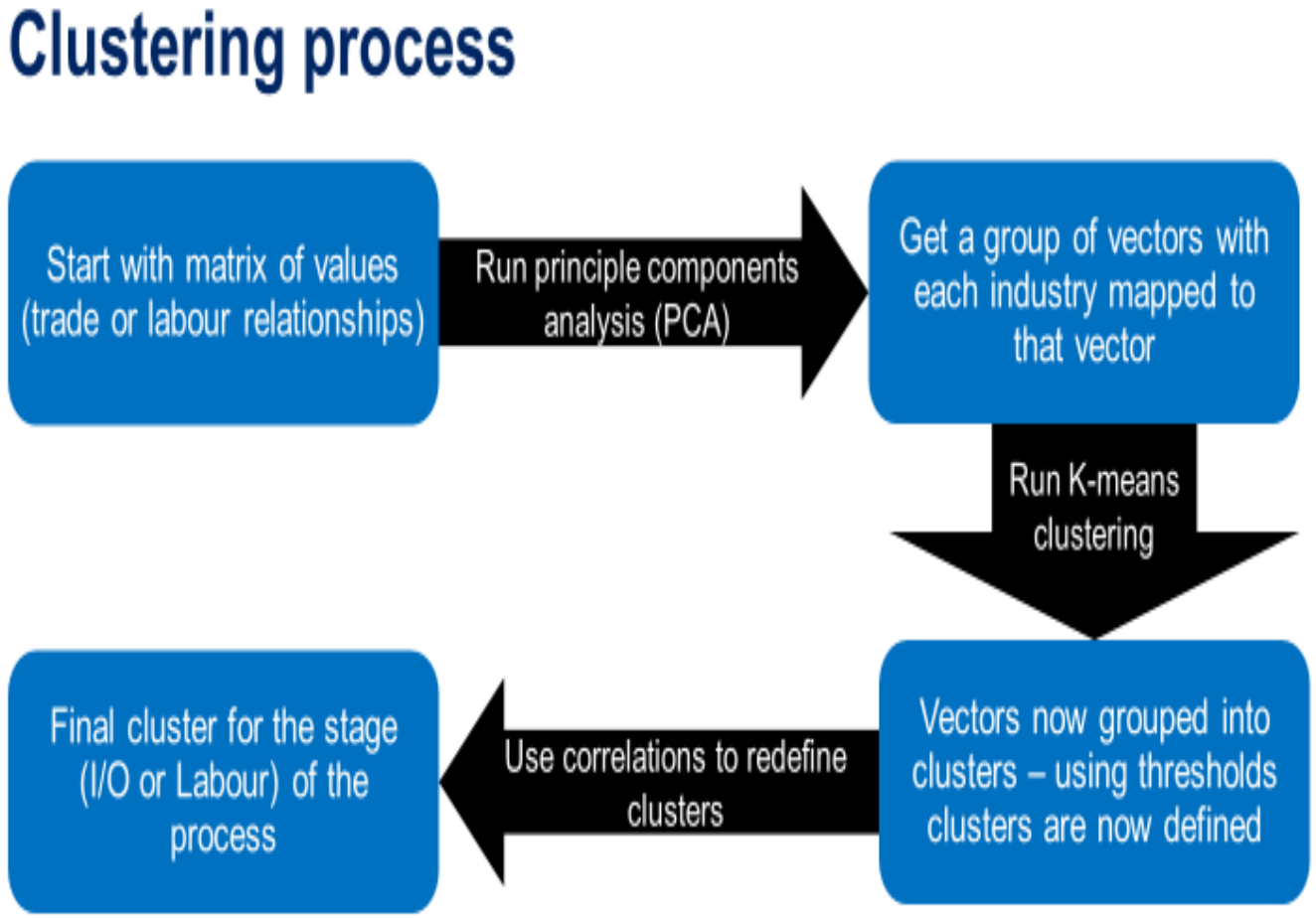
Our Approach – Input-Output Cluster Mapping

Our Approach – Mapping industry Clusters

Top-down (quantitative methods)

1. **Input-Output clustering**
- NSW input Output table
- 114 industries

2**. Labour pooling**
- **2016 Census data**
- 2-digit ANZSIC Industry Employment-Occupation data



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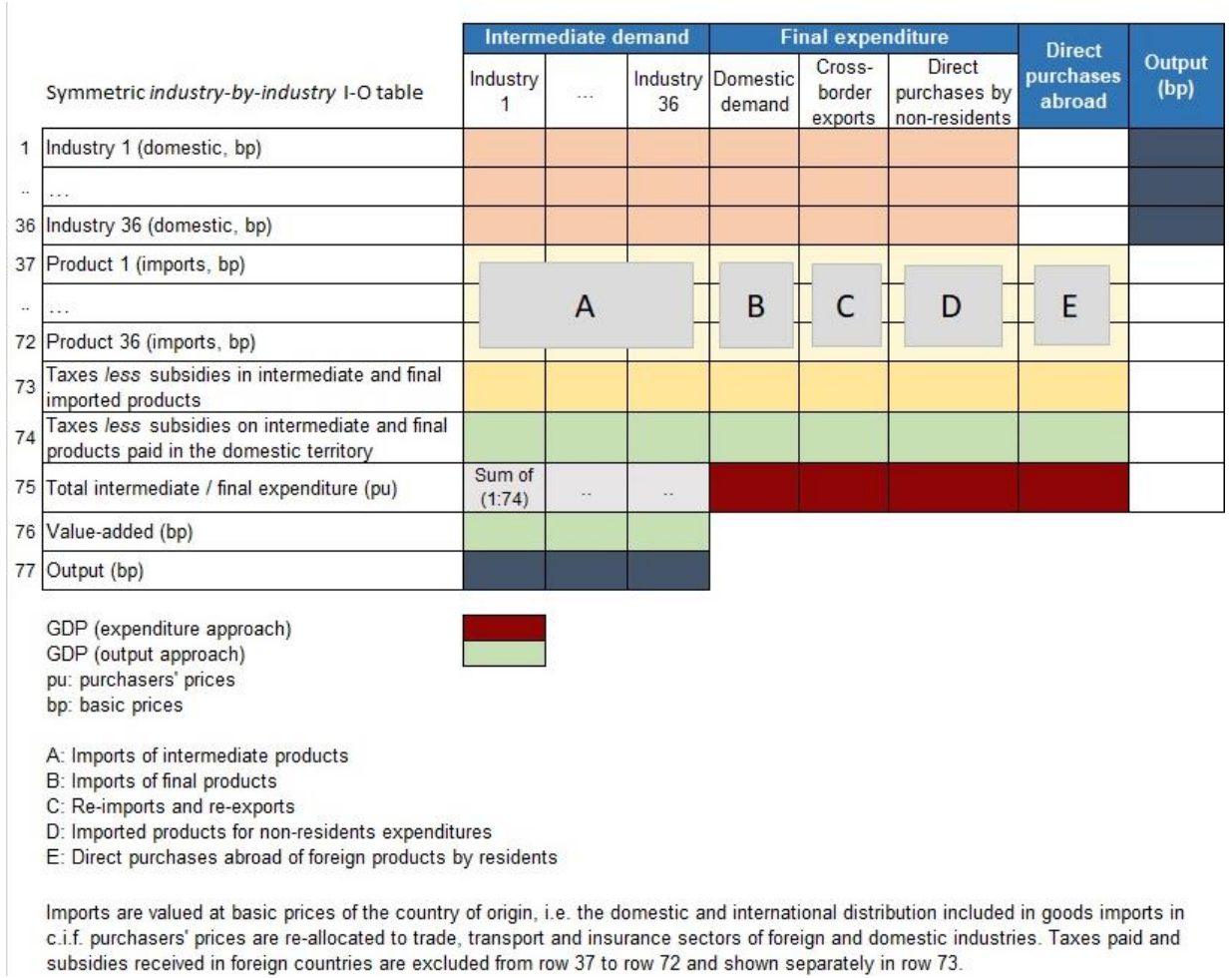
Input-Output Clusters

1. Construction trade relationships between industries using an NSW IO Table

- Purchases and sales data for industries from the IO table was extracted
- Calculated **four technical coefficients** which highlight the **interdependence between industries**
- Applied **Pearson correlation** to produce **four correlation coefficients** describing t**he degree to which industries have similar purchasing and selling patterns**
- A **new matrix** was developed using the highest correlation coefficient of the four.



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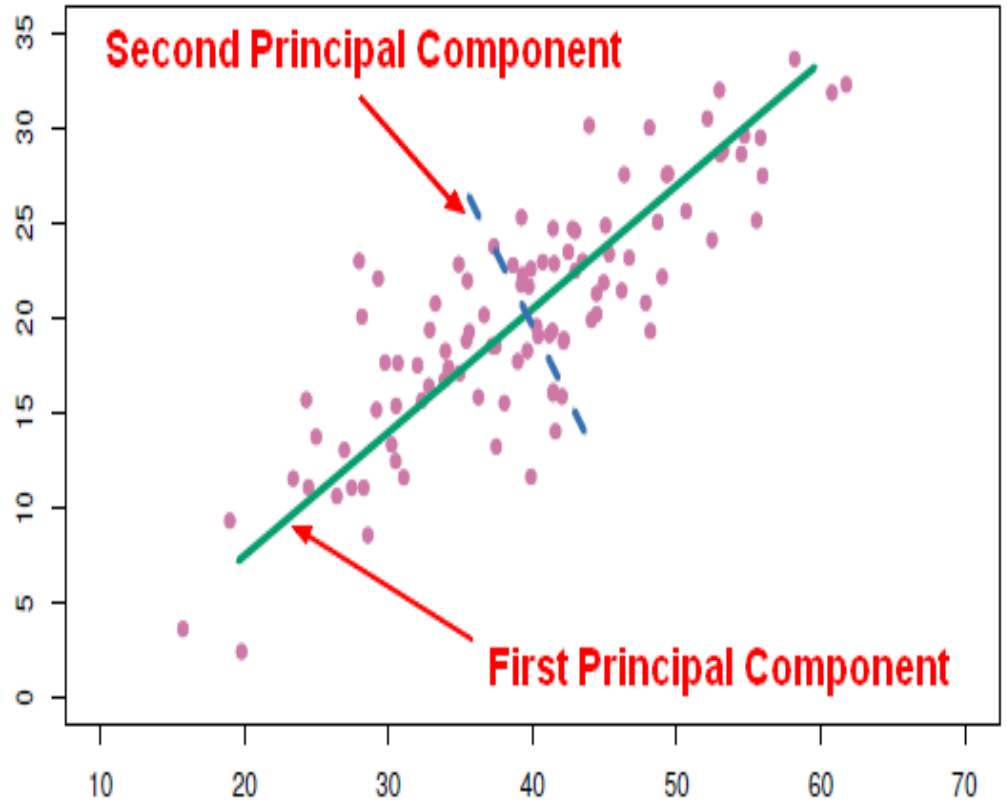
Input-Output Clusters

2. Applied PCA to explore common variation among multiple variables

1. Used the correlation coefficient from the IO Table matrix as variables

2. **PCA highlight the linear combinations of these variables matter the most**.

- Reduce number of dimensions in data
- Find patterns in high-dimensional data
- Visualise data of high dimensionality



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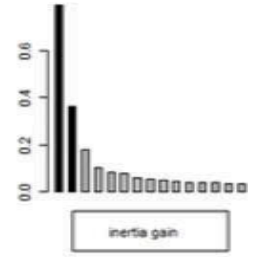
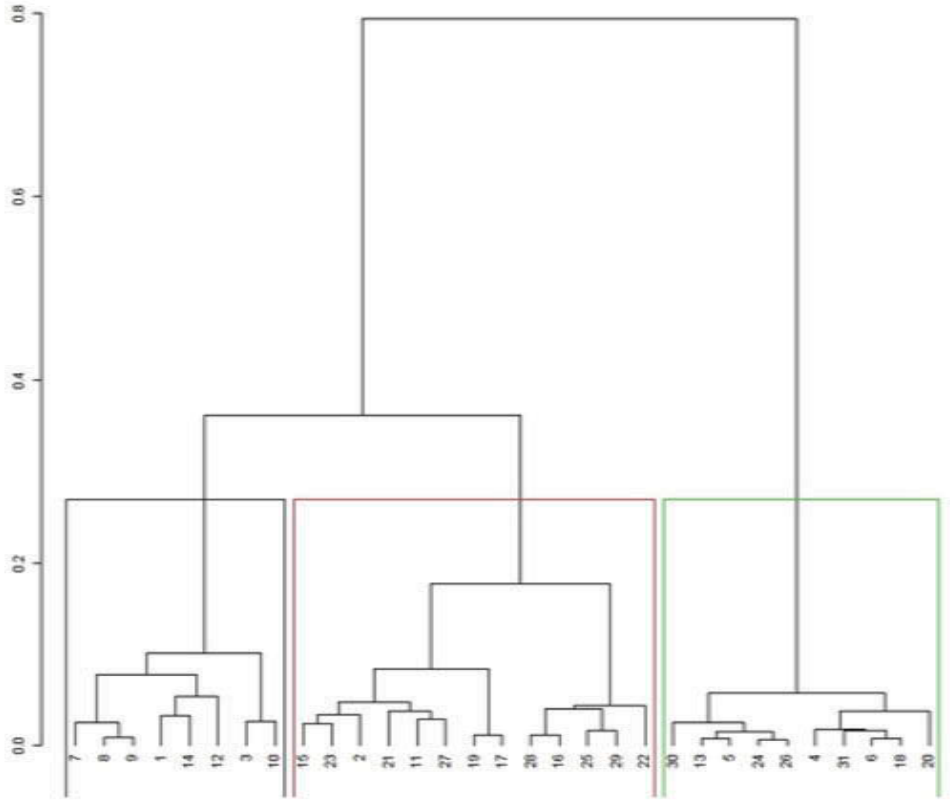
Input-Output Clusters

3. Applied Hierarchical clustering to better highlight patterns or groups of similar industries within the data set produced by PCA.



How does Agglomerative Hierarchical Clustering

- Start with each point in its own cluster.
- Identify the two closest clusters. Merge them.
- Repeat until all points are in a single cluster.
- **Used the dendrogram to visualize the clusters and choose the number of clusters**



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Clustering using IO Table and Cluster Analysis

Hierarchical Clustering produces a correlation matrix which can be used to assess the strength of linkages between industries

	Library etc	Finance	Insurance	Aux fin & ins	Rental hiring	Non-res & real estate	Cluster
Insurance	0.145	**0.848**	**0.878**	0.449	0.379	0.628	18
Comp systems serv	0.233	0.629	0.599	0.625	0.314	0.430	18
Defence	0.172	0.582	0.526	0.487	0.227	0.401	18
School Education	0.275	0.681	0.655	0.601	0.377	0.529	18
Tertiary Education	0.325	0.457	0.587	0.560	0.404	0.582	18

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Our Approach – Labour Pooling Clusters

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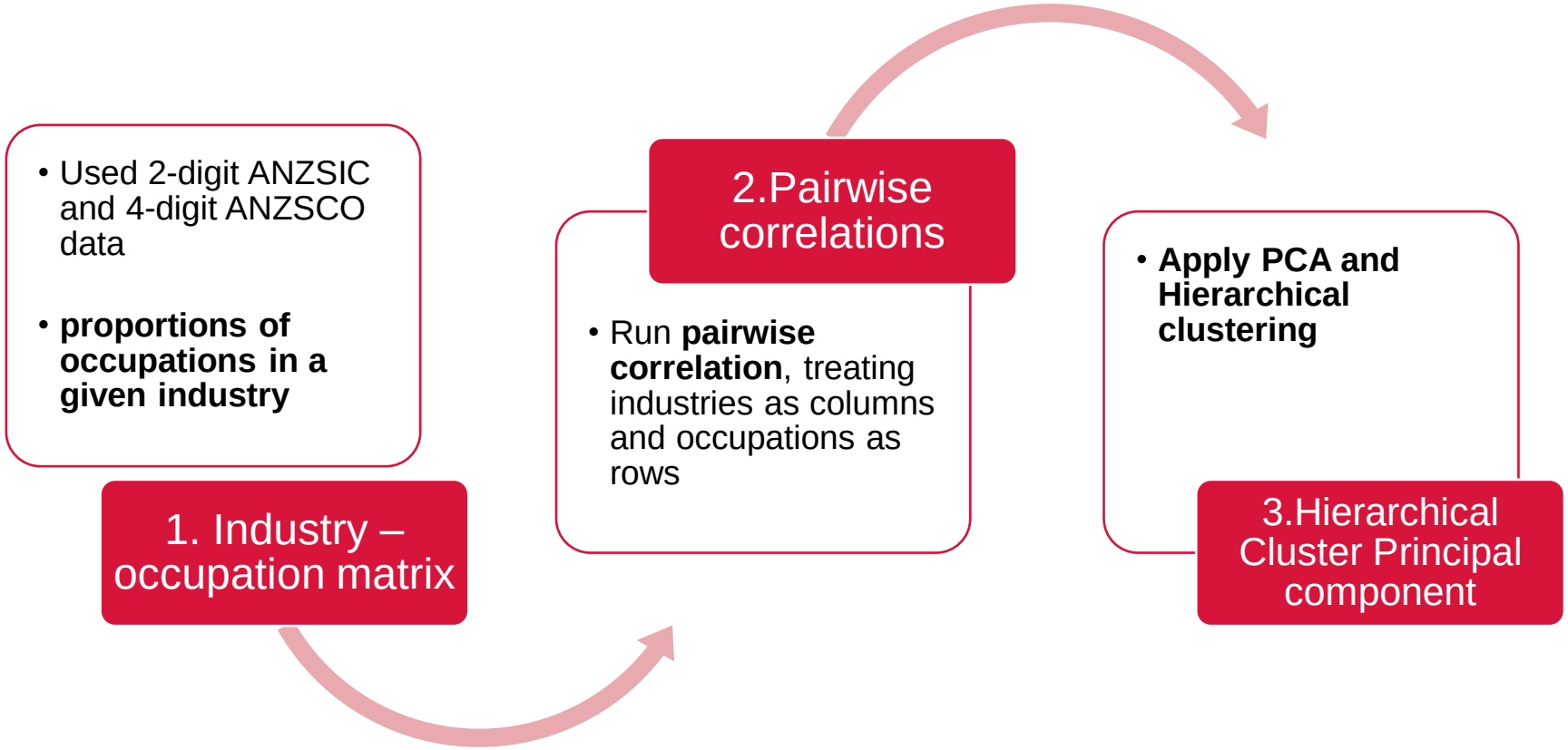
Labour pooling clusters

- Similar analytical process used in the IO clustering process is followed here, **except industry-occupation employment data is used**.
- **Labour pooling clusters** - **industries that share similar type of skills forms an industry cluster**



Creating our final cluster list

To produce a final cluster list (**28 industry clusters**)

- IO clusters and labour pooling clusters were compared to identify similarities and differences.
- The manufacturing, construction, agriculture, and mining industries were well defined in both clusters
- **Service-related industries** (e.g., Professional services and Finance) were well defined in the **Labour pooling cluster list** but not in the IO Table clusters because those industries are highly aggregated in the IO Table.
- Labour pooling clusters was used to break the IO Table service clusters into sub-clusters.
- Doing so, a **cluster list that is based on both IO Table and Labour Pooling data was created**.

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Examples of identified industry clusters

Computer Systems & Telecoms	Motion Picture & Broadcasting	Financial services	Food & Beverage Manufacturing
ISP, Web Search Portals and Data Processing Services (**59**)	Broadcasting (except Internet) (**56**)	Finance (**62**)	Agriculture, Forestry and Fishing Support Services (**05**)
Telecommunications Services (**58**)	Internet Publishing and Broadcasting (**57**)	Insurance and Superannuation Funds (**63**)	Beverage and Tobacco Product Manufacturing (**12**)
Computer System Design and Related Services (**70**)	Motion Picture and Sound Recording Activities (**55**)	Administrative Services (**72**)	Basic Chemical and Chemical Product Manufacturing (**18**)
		Computer System Design and Related Services (**70**)	Food Product Manufacturing (**11**)
		Professional, Scientific and Technical Services (Except Computer System Design) (**69**)	
		Commission-Based Wholesaling (**38**)	
		Public Administration (**75**)	

Note: 2-digit ANZSIC industries code in brackets

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Examples of identified industry clusters

Forestry and Wood Product Manufacturing	Mining
Forestry and Logging (**03**)	Coal Mining (**06**)
Furniture and Other Manufacturing (**25**)	Exploration and Other Mining Support Services (**10**)
Pulp, Paper and Converted Paper Product Manufacturing (**15**)	Metal Ore Mining (**08**)
Wood Product Manufacturing (**14**)	Oil and Gas Extraction (**07**)

Note: 2-digit ANZSIC industries code in brackets

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Next Steps

Spatial industry clusters mapping

Step 1

Spatial mapping of identified clusters using firm location data. Which regions are these clusters concentrated in?

Estimate clustering and agglomeration metrics

Step 2

Use available data to estimate proxy variables for clustering and agglomeration. Feed into econometric modelling

BLADE and modelling

Step 3

Merge clustering and agglomeration variables with BLADE, calculate the effect of agglomeration on firm productivity

Analysis and consultations

Step 4

Analyse the results and consult with clients for feedback. Based on feedback, repeat steps 2, 3 and 4

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Questions and Comments?