Abstract: This study aimed to explore logistics routes planning between New Zealand and other trade partner countries with reference to trade data, travel data as well as city prosperity information. K-Means clustering tech has been employed to group trade partners so as to identify most important shipment routes between New Zealand and other trade partners. Findings from this study indicated the most valuable routes should set a destination to China, Australia, South-east Asia, West Europe, and North America.

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Introduction

Logistics plays a critical role in a trade-centered economy like New Zealand. However, starting a new logistics business or extending a current transportation network requires a massive investment, which means a certain level of risk. Obviously, it is not a good idea to determine new routes based on traditional experience, or tuition. To alleviate this situation, a data-driven method can be used to explore potential routes. This study intended to find out most values routes for a New Zealand-based logistics company. In other words, findings from this study would indicate the most prominent routes between New Zealand and its trade partners.

Data

The study involved four data sources, namely, international trade data (2018), travel and immigration data (2018), world main trade fair list from Wikipedia, and city trade prosperity information from FourSquare. Since this study was intended to find out the most important routes, trade of goods and services between New Zealand and other countries provided the most direct incentives for international transportation. Moreover, the development of tourism and the increase in immigration also required more logistics services. Meanwhile, the whole list of major world trade fair events is another clue of the most significant destinations of exporting and importing. When we meant to get a short list of transporting endpoints, the city information from FourSquare was a vital factor in planning logistics network. All the four types of data helped to shortlist the major nodes in the planned logistics network.

Methodology

The analysis covered two steps: exploratory analysis and statistical clustering with K-Means. The exploratory analysis step examined data quality and distribution. By this step, appropriate factors were selected for further clustering analysis. In detail, the exploratory analysis step consisted of 1) examining the raw data, 2) selecting shortlists for trade and travel data, 3) and studying data plots for understanding data features and trends.

The statistical clustering step was used to group up trade partners of New Zealand. New Zealand has many important trade partners, but they are not equally important. The data processed in the previous exploratory step were further treated with K-Means clustering, from which we learned sub-groups of those trade partners. This information contributed to design and plan a future logistics network.

Results and discussion

As one important indicator of the close relationship between countries, the number of visitors is the most direct and evident. Based on the exploratory analysis we listed the top 5 countries with most visitors to New Zealand in the following. In this list, Australia has the dominant role with 12.29 million visitors, which is even more than the sum of the rest countries. Following Australia, China brought the second largest group of visitors of 3.53 million. The United States of America and the United Kingdom, as conventionally ally countries, it is not surprised to record over 2 and 1 million visitors, respectively.

Table 1 Top 5 Visitors Original Countries (2018)

Country	Visitor Number (Million)
Australia	12.29
China	3.53
United States of America	2.49
United Kingdom	1.7
Japan	0.72

Figure 1 gives a better direct view of the different numbers of visitors by country.

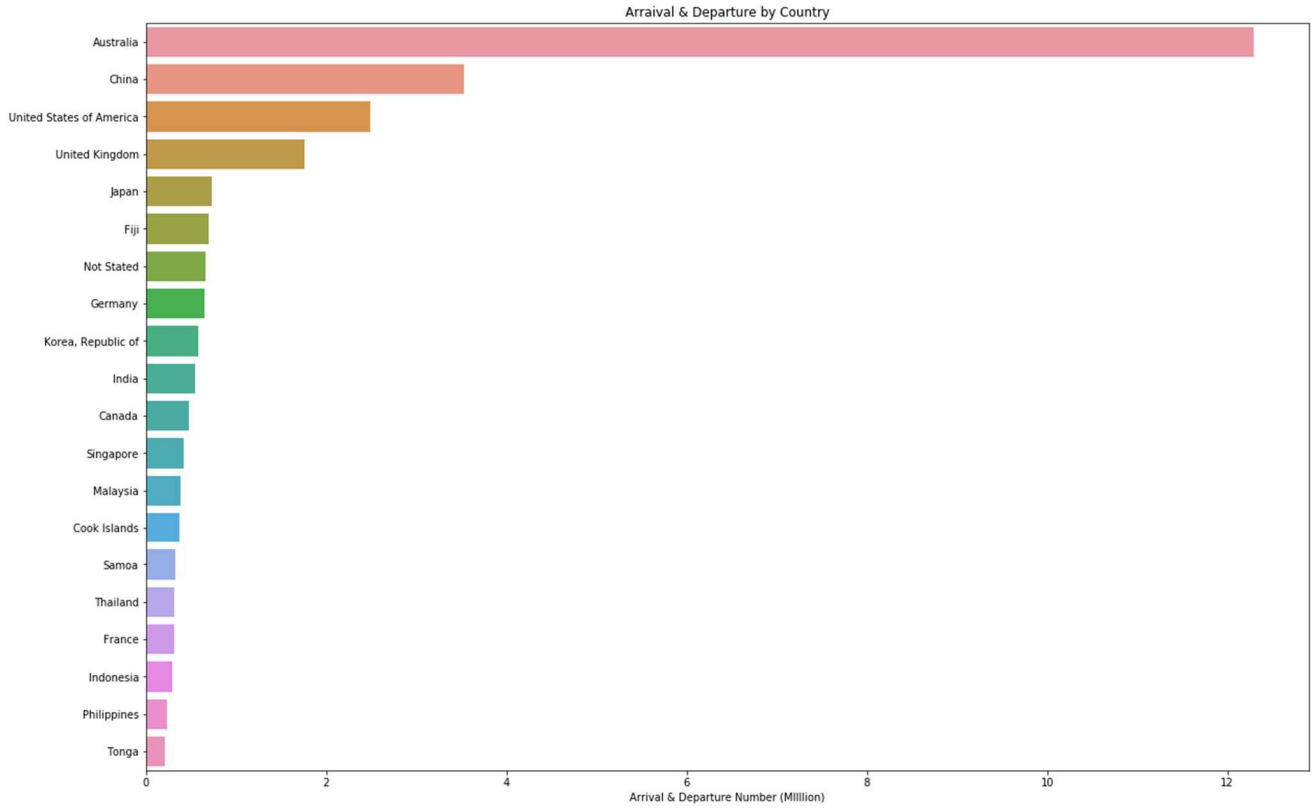

Figure 1 The number of visitors to New Zealand by Country (2018)

From the figure and the table, it is clear that these shortlisted countries have a very close connection with New Zealand with a huge number of visitors shuttling between these countries.

Apart from the number of visitors, the trade volume has the most explaining power about the tie between the two countries. Table 2 shows the top 5 trade partners of New Zealand in 2018. They are China, Australia, United States, Japan, and South Korea. The top country, China, had a 26.25 billion trade volume with New Zealand, which was over the sum trade value with Australia and the United States. This outstanding trade level indicated that China plays a unique and dominant role in international trade of New Zealand. Figure 2 illustrates better about the contribution of New Zealand's main trade partners.

Table 2. Top 5 Trade Partners (2018)

Country	Import & Export Total (Billion New Zealand Dollars)
China	26.25
Australia	14.66
United States of America	10.70
Japan	7.05
Korea, Republic of	4.16

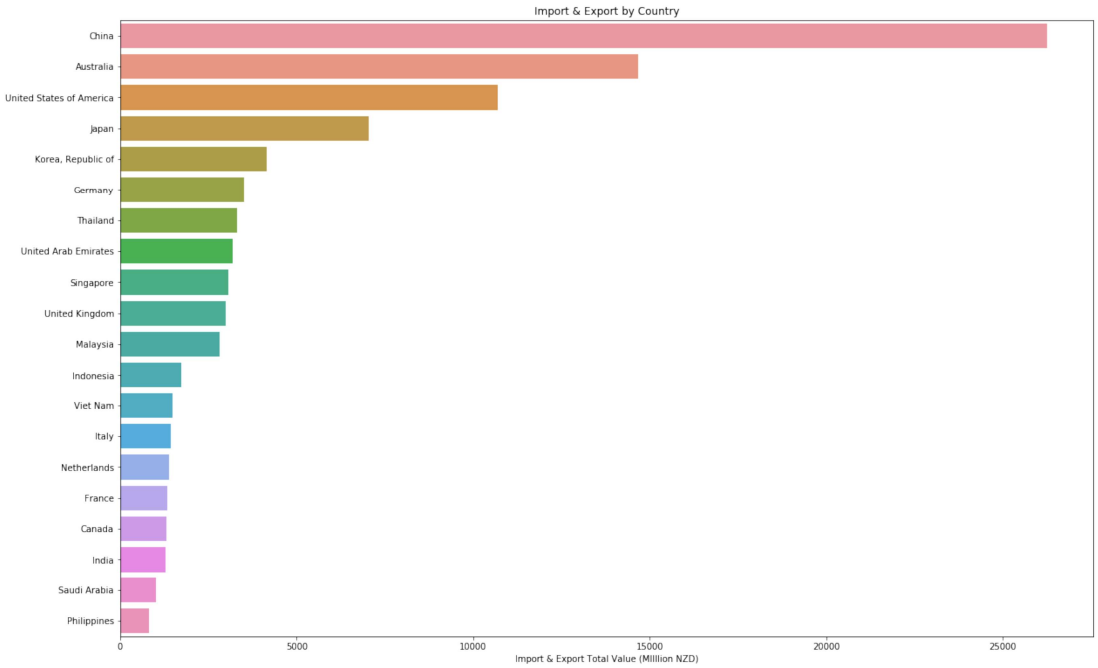

Figure 2 Main Trade Partners of New Zealand (2018)

It is a common sense that main world trade fair events are usually held at those important trading center cities. Therefore, when planning new logistics network these cities are inevitable nodes. In other words, planning such a network needs to take those major world trade fair events into condensation. As Table 3 presents, Germany has the most trade fair events, followed by Italy and the United States.

Table 3. Main World Trade Fair Events Distribution

Country	Trade Fair Event Number
Germany	28
Italy	12
United States	11
France	7
Spain	6

Then Figure 3 gives more details on countries holding these trade fairs. It is noticed that these trade fair events are not evenly distributed at the global level.

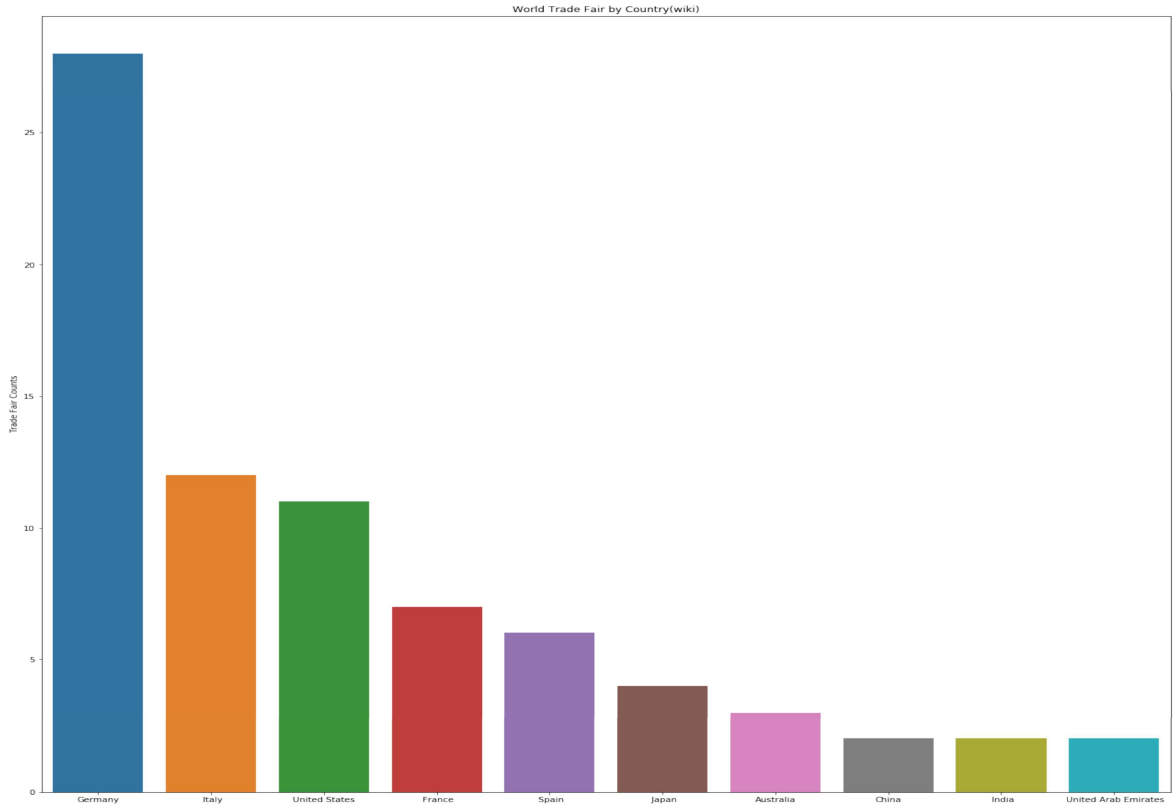

Figure 3 Main World Trade Fair Events Distribution

In addition to checking major trade fair events, the study also examined the number of international trade companies of cities of New Zealand's main trade partners. This type of data were extracted from API services provided by FourSquare, from which we can obtain the number of venues featured with "International trade". Since this API is only able to give 50 venues at a given address, this study thus defined a trade city as one having 50 or over international trade venues. In detailed operation, the study got a list of major cities of each country in this main trade partner list. By the returned values from FourSquare API service, trade city number was populated in the following Table 4.

Table 4 Overall Data of Main Trade Partners of New Zealand

Country	Visitor Number (Million)	Trade Total (Million NZD)	Trade Fair Number	Trade City Number	Clustering Group
Australia	12.29	14662.25	3	7	4
China	3.53	26248.92	2	16	1
United States of America	2.49	10701.52	11	4	2
United Kingdom	1.76	2986.54	2	2	3
Japan	0.72	7048.81	0	7	2
Germany	0.65	3514.28	28	8	3
Korea, Republic of	0.58	4155.47	0	23	3
India	0.55	1290.02	0	2	0
Canada	0.48	1306.89	0	17	0
Singapore	0.42	3074.43	0	12	3
Malaysia	0.38	2813.27	0	1	3
Thailand	0.31	3302.24	0	2	3
France	0.31	1331.88	0	7	0
Indonesia	0.29	1721.52	0	7	0
Philippines	0.23	811.67	0	24	0

Thanks to the trade data, visitor data, trade fair events information and the number of trade city, the main closely-related countries were grouped by K-Means clustering. Such kind of clustering information filled the clustering group column in Table 4. The following map shows the different trading group and their major trade cities. Based the distribution of these trade groups and trade cities, the main logistics routes can set endpoints in China and Japan, as the Asian line, Australia line with its special geographical location, United States and Canada, as the North America line, and the United Kingdom and Germany, as the West European line.

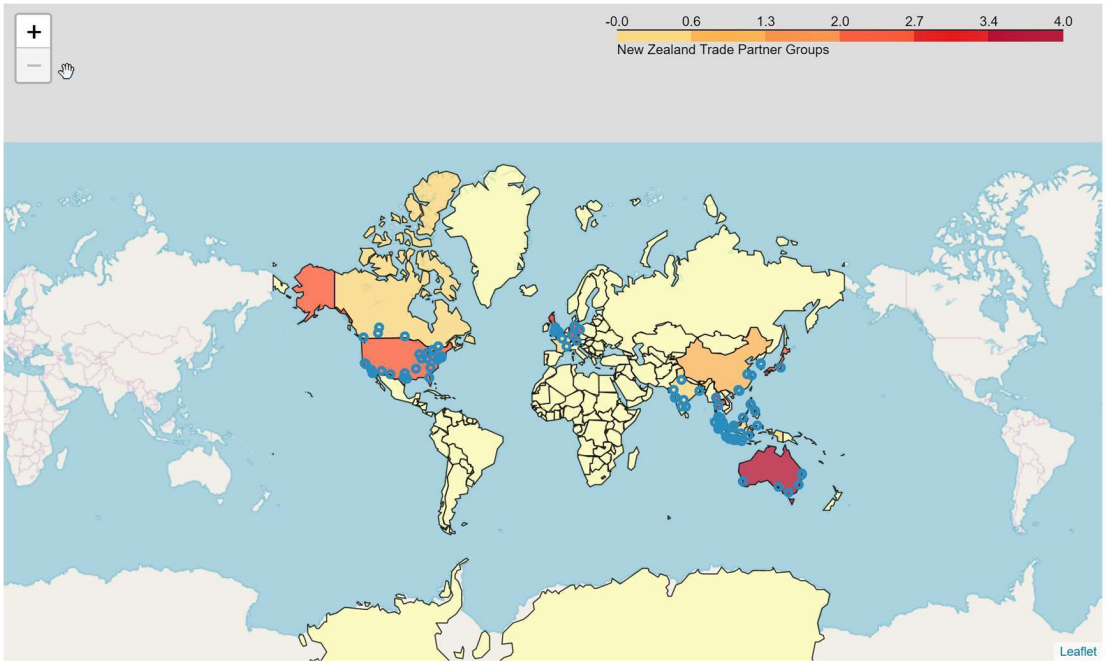

Figure 4 Distribution of top trade partners and their major business cities

Conclusion

With the help of exploratory analysis and clustering analysis, this study used trade data, visitor data, world trade fair list, and trade cities information and concluded the four most valuable logistics routes between New Zealand and her main trade partners. The four main transportation routes, Australian line, Asian line, North America line, and West European line, can connect New Zealand with her main overseas markets. Of course, for a final decision on specific routes, there is still much more work to do to collect more details and information on target cities.