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Executive Summary

This report contains the company report of the Japanese company "Company Report: Toyota Jidosha Kabushiki Kaisha And, the analysis of the Dataset: USPTO_2012_5. Toyota's products is one of the most reliable in automobile industry. This only possible as company stressed on continuous development through technological innovation. From the given data, it is noteworthy to mention, company has significant connection within the network and local advantages due to the production plant in various location across the globe.

1 Brief of the Company

Toyota Motors Crop is one of the giant companies and their main business is car manufacturing. They export their cars all over the world. This is a Japan-based company and their business model depends on three types of business these are automobile business, finance business and other business. their basic business is manufacturing cars this include sedan, sports utility vehicles, truck, 4WD and other cars. On the other hand, the finance segment is about the vehicle leasing business and related kinds of stuff. Their business is spread is all over the world and they have multiple manufacturing companies. They also work with AI-based cars and automatic driving systems. Overall Totota is an unbeatable giant in the mass car manufacturing business.

Key Facts

According to FY21, 3,66,283 employees worked in their company across the world. In the 2021 FY, they sold 2332262 vehicles and earned about 27.2 trillion yen. They continue their business in over 170 countries in the world.

2 Discussion on Company's Internationalization Strategy

2.1 KAIZEN strategy for globalization

One of the most effective and common strategies for Toyota globalization is the KAIZEN strategy. This strategy is continuous development and implementation strategy for the company. Depending on the strategy the company improve its quality, productivity and competitiveness. Their production quality is one of the leading causes for their business globalization (Senthil and Muthukannan, 2021). They recently developed a Hybrid car which is a half electric car technology to reduce fuel use. This is a clean car technology and helps the company to a global market. The Hybrid solution is the most effective solution to make a green machine by Toyota. They developed concepts like CS&S roadster powered by a Hybrid Synergy Driven system (Gulati, 2007). Their fabricated engine is one of the most effective manufacturing technology their engine is designed for high performance and longevity. They developed different engine types for different international markets like VV-i, VVT-i, D-4D, D-CAT. They develop this technology for perspective countries which is a great strategy for business internationalization (Turner, 2021).

2.2 The publication of a supplier's handbook.

A new worldwide business strategy is being implemented, to further localize (overseas) and increase imports of vehicles manufactured in other countries (in Japan). The New Sienna, manufactured by Toyota in Kentucky, USA, was one of the strategies implemented (Kutnjak and Lučić, 2021). Another globalization strategy was the publication of a supplier's handbook to give first-time

suppliers a better knowledge of Toyota's purchasing processes and offer guidelines on how to market Toyota supplies. Toyota devised a new strategy in 1997, providing online services that make requesting vehicle components from international suppliers easier. Toyota has 34 foreign businesses and affiliates, as well as 150 distributors in five continents and 25 countries, as of March 1998. This suggests that Toyota has made a successful entry into the international market (Free and Hecimovic, 2021).

2.3 Overseas subsidiary and joint venture production plants.

The foundation of item plants was the following methodology carried out. The oil emergency was the essential driver of Toyota's choice to execute this methodology, which expanded the number of units sold of Toyota's merchandise. Toyota Motor Corporation was framed in January 1982 when Toyota Motor Company (TMC) and Toyota Motor Sales (TMS) amalgamated. This rebuild and consolidation had the motivation behind boosting Toyota's benefits. Toyota had been in a joined endeavour with General Motors (GM) beginning around 1981 when an intentional prohibition on Japanese commodities to the US was forced. This came after an unfortunate joint endeavour with Ford Motor Company (Bhattacheryay, 2021). As an outcome, Toyota will be permitted to layout its offices in the United States of America. The advantages of this plan were bringing down gambles and acquiring experience in neighbourhood creation (Bartlett and Beamish, 2018). Toyota additionally chooses to make fabricating units in arising nations, with an emphasis on metropolitan regions like Shenyang and Tianjin in China. Toyota purchased Tianjin Motor Group in 1998 and renamed it Tianjin Toyota Motor Engine, which was answerable for providing Daihatsu and later delivered to Japan (O'Reilly Media, 2009).

3 Findings from the Data (Analysis)

3.1 Neetwork Analysis

From the provided USPTO_2012_5_proj.xlsx dataset it can be seen that there are 399 companies in the network. Moreover there are in total 298 connections betwork the companies in the network. And Toyota Jidosha Kabushiki Kaisha had a degree of 14 which means the comapny has 14 direct connections to the other companies in the network.

[ ]:
```
import networkx as nx
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt

proj_df = pd.read_excel("/content/drive/MyDrive/Colab Notebooks/assignment/
 ↪final/lipi/USPTO_2012_5_proj.xlsx",names=['From', 'To'])
company_graph = nx.from_pandas_edgelist(proj_df,source="From",target="To")
Toyota_Jidosha_Kabushiki_Kaisha_degree = company_graph.degree('Toyota Jidosha␣
 ↪Kabushiki Kaisha')

print("Number of companies in the network = %d" %company_graph.
 ↪number_of_nodes())
print("Number of connections in the network = %d"  %company_graph.
 ↪number_of_edges())
```

```
print("Number of Degree of Toyota Jidosha Kabushiki Kaisha = %d" ␣
 ↪%Toyota_Jidosha_Kabushiki_Kaisha_degree)
```

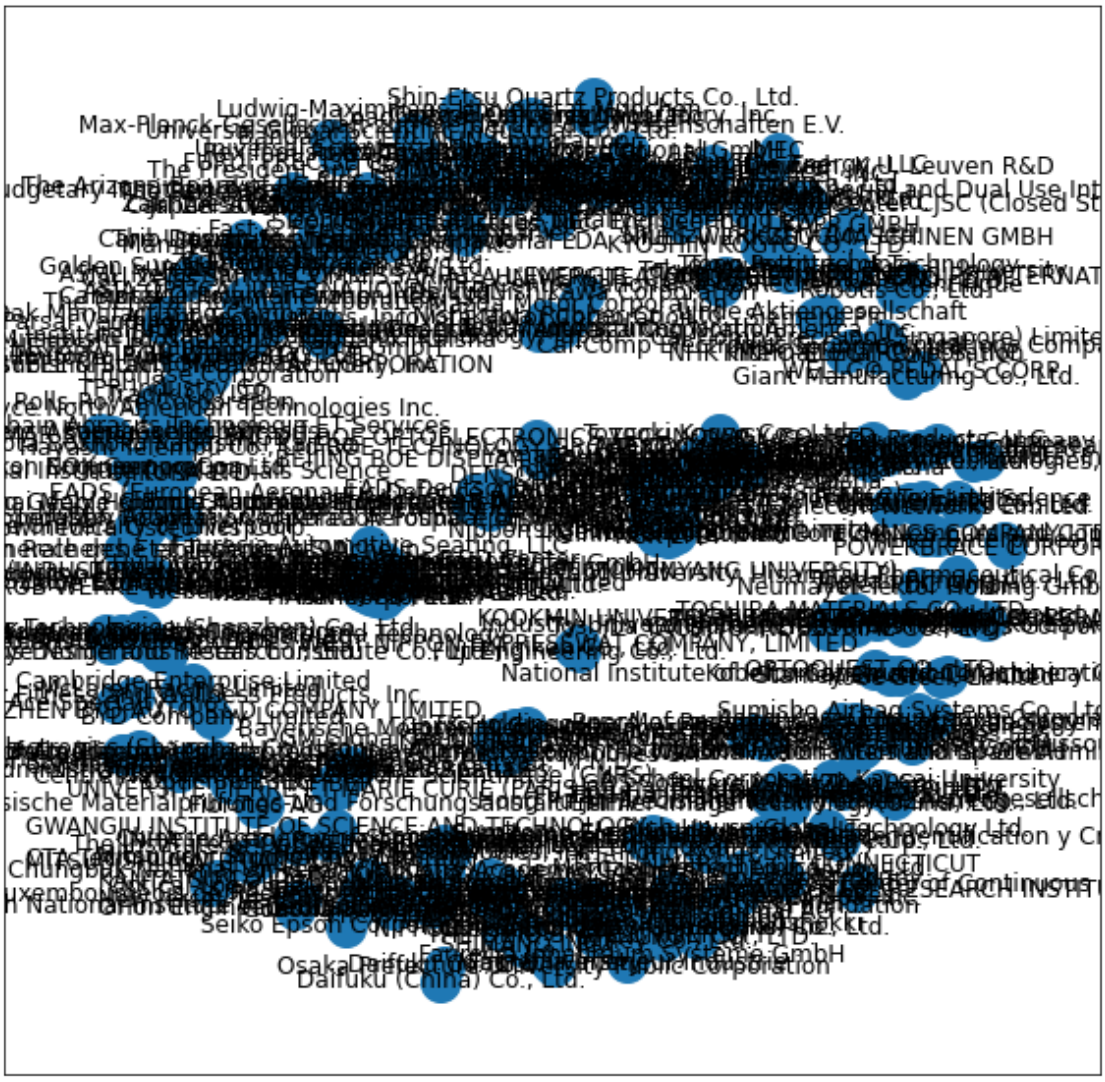
```
Number of companies in the network = 399
Number of connections in the network = 298
Number of Degree of Toyota Jidosha Kabushiki Kaisha = 14
```

Figure 1 showcases the visualization of network with all the companies(399) and its edges(298). From the network it can be seen that the companies are densely connected to each other.

[ ]:
```
def draw(company_graph):
  if company_graph is not None:
    plt.figure(figsize=(10,10))
    pos = nx.spring_layout(company_graph)
    nx.draw_networkx(company_graph, pos=pos,node_size=399)
    plt.title('Figure 1. Network Analysis Visualization')
    plt.show()

draw(company_graph)
```

Figure 1. Network Analysis Visualization



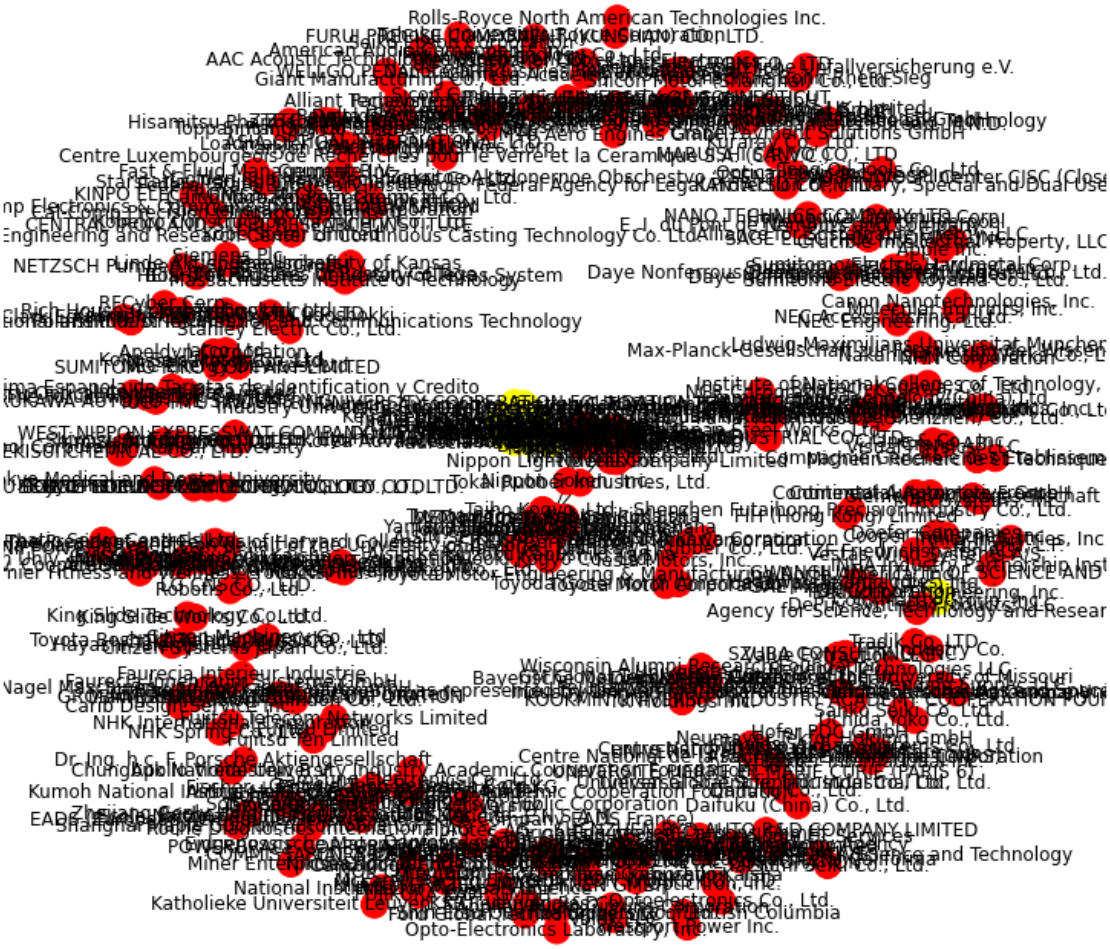
It will be quiet difficult to analyse the netwotk based on the figure 1. So, Community detection was performed to the network to detect the distinct communities and their networks. From Figure 2 we can see that the network has two communites ie. Red and yellow. Though most of the companies lie in the red community but some companies are also in the yellow region. Community detection was performed using Louvain pertition method to find the best pertition of the network.

[ ]:
```
from community import community_louvain
import matplotlib.cm as cm
from thresholdclustering import best_partition

cluster_function = community_louvain.best_partition
partition, alpha = best_partition(company_graph,␣
 ↪cluster_function=cluster_function)
```

```
cmap = cm.get_cmap('viridis', max(partition.values()) + 1)
plt.figure(figsize=(10,10))
nx.draw_networkx(company_graph, partition.keys(), node_size=300,
                        cmap=cmap, node_color=list(partition.values()))
plt.title('Figure 2. Community Detection Algorithm Implimentation')
plt.show()
```

Figure 2. Community Detection Algorithm Implimentation



3.2 Measurement of Centrality

Centrality is a critical metric since it indicates that node occupies a critical position within a network. When a business achieves a higher centrality, it moves closer to the network's heart. Companies with a higher centrality score have more power and influence, sway, and ease in the

network. There are three common degree centrality measures: 1. **degree centrality:** The importance of a node may increase in direct proportion to the number of other nodes that can be reached from it. The degree of centrality can be used to quantify significance of a company in the network. Higher degree of centrality of a company indicates that the company has higher number of connections to the other companies than the average connections. In our case Hyundai Motor Company with a degree centrality of 0.05778894472361809 had the highest score. Which means they have highers connections. And Toyota Jidosha Kabushiki Kaisha with a score of 0.035175879396984924 is the 3rd highest connected comapany.

2. Eigenvector centrality: The concept of Eigenvector centrality is a more advanced interpretation of the centrality. It is possible for connections to have a variable value due to the Eigenvector centrality property, which means that connecting to some vertices is more beneficial than connecting to others. A business with few connections can have a very elevated eigenvector centrality if those few links are to other businesses that are extremely well connected. Hyundai Motor Company with a score of 0.626896526062543 had the highest eigenvector centrality.Toyota Jidosha Kabushiki Kaisha had a relatively lower score with 0.00012555810714333897.

3. Betweenness centrality: The importance of an individual company in a social network is measured by their betweenness centrality. Toyota Jidosha Kabushiki Kaisha has the highest betweeness centrality (0.005025125628140704) in the network which means they have a great influence on how information flows through the network. The removal of them from the network will have the greatest impact on communication systems between other businesses and they're the most well-connected businesses in the network.

4. Closeness centrality: The degree to which a company is connected to all other companies in a network is measured by its closeness centrality. Hyundai Motor Company (0.0578894472361809) is the most closely connected comppany in the network. And Toyota Jidosha Kabushiki Kaisha (0.04274846454494696) is the 2nd most closely connected company.

3.3 Interpretation of the Findings

From the (appendix 6) it can be seen that Toyota Jidosha Kabushiki Kaisha has patent industry number 5, patent count of 9120, Turnover layer of 276669260, Turnover of 234351491 in 2012, total asset of 376880705 , 333498 employees. They can be also seen investing 8576251 on R&D and lies in Country code 4.

[ ]:
```
Toyota_Jidosha_Kabushiki_Kaisha = df[df['ID']=='Toyota Jidosha Kabushiki␣
↪Kaisha']
```

[ ]:
```
                              ID  Patent_industry  University  Patent_count  \
4  Toyota Jidosha Kabushiki Kaisha                5           0          9120

   Turnover_lay  Turnover_2012  Total_assets_2012  Employees_2012  R&D_2012  \
4     276669260      234351491          376880705          333498   8576251

   Country_code
4             4
```

Figure 3 suggests the correlation matrix of the dataset which indicates turover is highly correlated

with Turnover layer, total asset and number of employees.

```
[ ]: # Ploting correlation matrix

import seaborn as sns
corrmat =␣
 ↪data_frame[['Patent_count','Turnover_lay','Turnover_2012','Total_assets_2012',␣
 ↪'Employees_2012','R&D_2012']].corr()
f, ax = plt.subplots(figsize=(10, 5))
plt.title("Figure 3 Corerelation Matrix for the variables");
sns.heatmap(corrmat, annot=True, square=True,cmap= 'coolwarm');
```

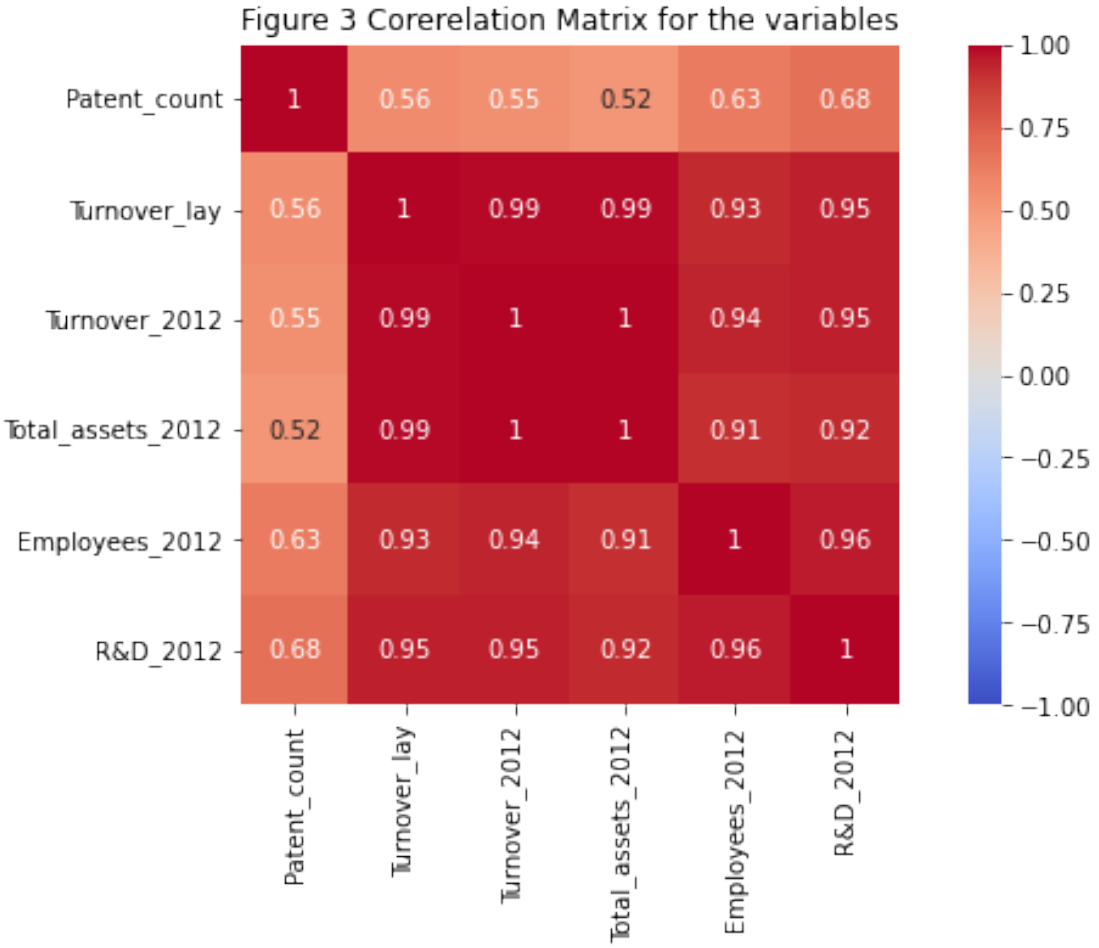


Figure 4 suggests the Correlation of Turnover with turnover lay, total asset and employee number. From the figure it can be seen increase in Turnover would result in increase of turnover layer, total asset and number of employee.

```
[ ]: pair = [['Turnover_lay','Total_assets_2012','Employees_2012']]
```

```
for i in range(1):
  sns.pairplot(df[['Turnover_2012']+pair[i]])
```

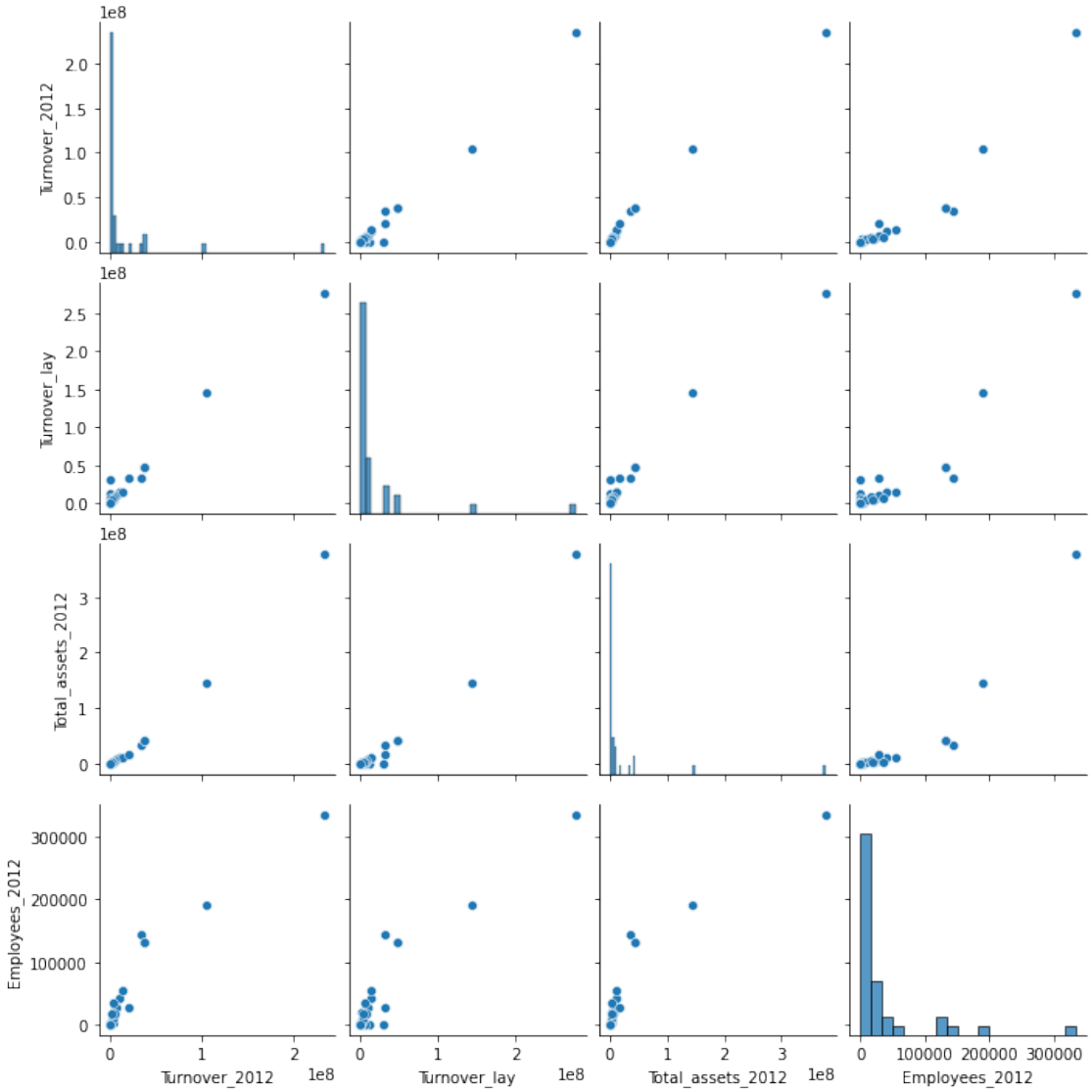


Figure 5 indicates the patent count of each comapny. From the figure we can see Toyota Jidosha Kabushiki Kaisha has the 2nd higehst patent count in the network.

[ ]:
```
plt.figure(figsize=(12,5))
sns.barplot(x='ID',y='Patent_count',data=df)
plt.xticks(rotation='vertical', size=8)
plt.title(" Figure 5. Patent count for each company");
```

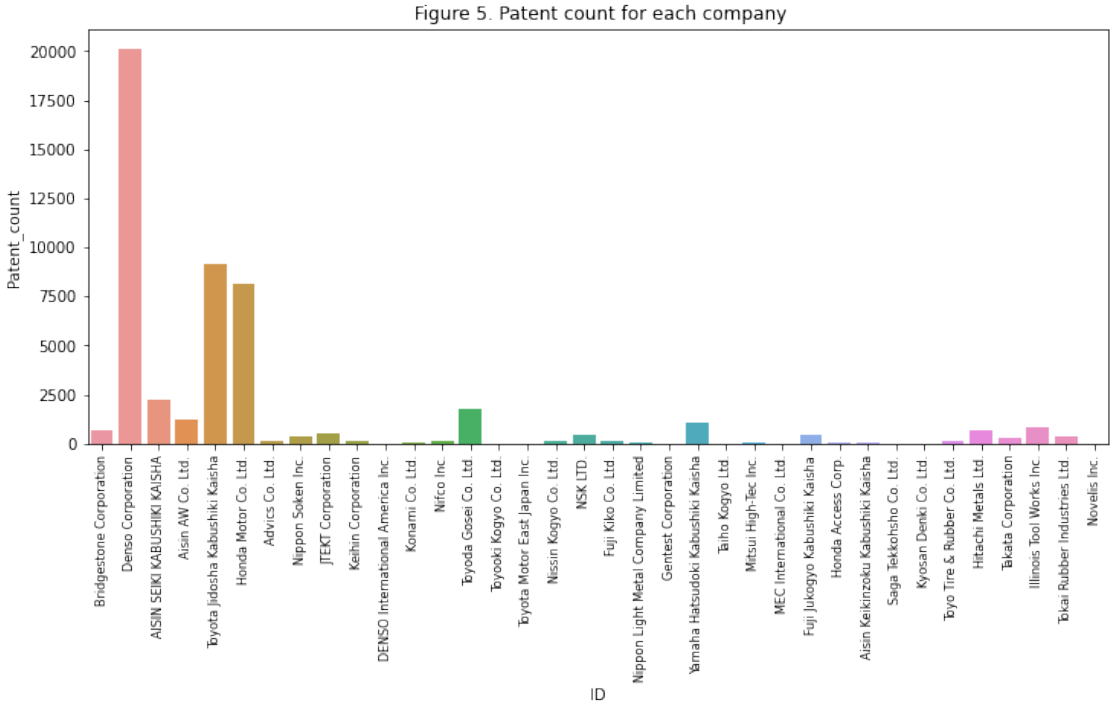
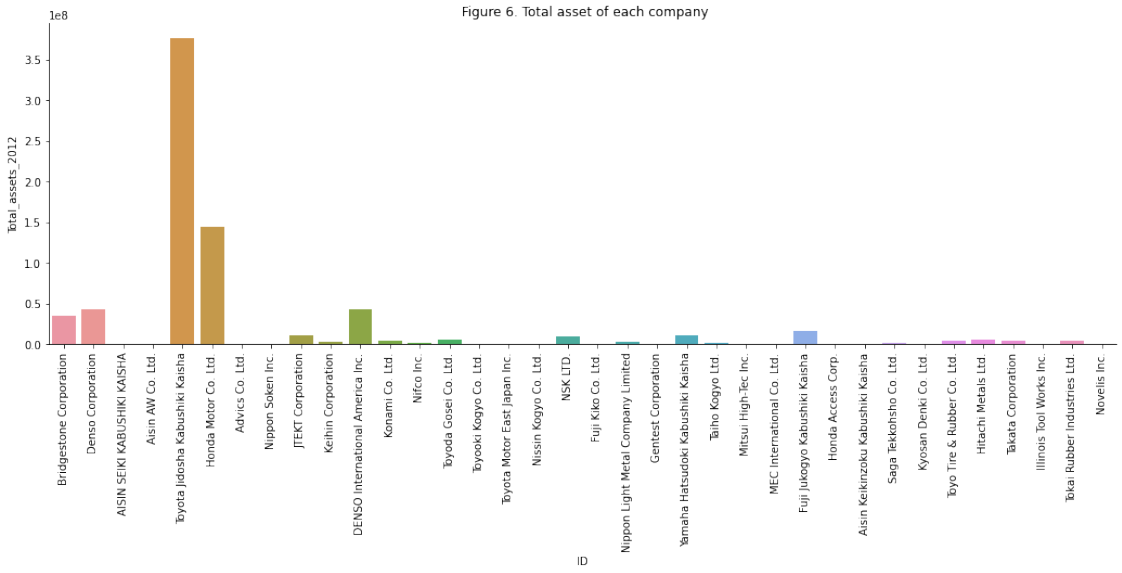


Figure 6 indicates to the total asset of each company in the network. The figure suggests Toyota Jidosha Kabushiki Kaisha has the most asset in 2012.

[ ]:
```
g = sns.factorplot(x='ID', y='Total_assets_2012', data=df, kind='bar', aspect=3)
g.set_xticklabels(rotation=90)
plt.title(" Figure 6. Total asset of each company");
```

```
/usr/local/lib/python3.7/dist-packages/seaborn/categorical.py:3717: UserWarning:
The `factorplot` function has been renamed to `catplot`. The original name will
be removed in a future release. Please update your code. Note that the default
`kind` in `factorplot` (`'point'`) has changed `'strip'` in `catplot`.
  warnings.warn(msg)
```



4 Innovation Strategy Adopted by the Company

Research and Development (R&D)

The "Exploration and Development Center," situated in Kyowa, Obu City, Aichi Prefecture, is liable for cutting edge improvement of key innovations that will be the establishment for all divisions' future items, as well as cutting edge research and the advancement of materials and different advances that will fill in as the normal establishment for all divisions (Chun et al., 2021). They are developing different kinds of car technology like hybrid technology, automatic car, electric car technology and much-advanced technology for the automobile. This new and advanced technology helped Toyota to lead the international market. Toyota Industries teams up with Toyota Central Research and Development Laboratories, Inc., a Toyota Group R&D office zeroed in on essential exploration, as well as colleges, other external R&D establishments, and producers, to further develop innovative work productivity and present state of the art advancements (Ayad et al., 2021). The most up-to-date simulation software and analytical tools are used to conduct top-level research (Orecchini et al., 2021).

Innovative Organisation Culture

We learn that innovative managers are imaginative, comfortable with change, and tenacious from the Middle Manager as Innovator article in the readings. Innovation thrives in businesses when territories overlap, individuals interact across functions, information flows easily, and a large number of employees enjoy budget surpluses (Mahmoud et al., 2020). Managers are also in an open-ended position to assist in the creation of an innovative environment within the firm. A similar methodology is followed by Toyota's core R&D facility. The majority of senior executives have a technological background and have been with the company for an average of 20-30 years. Since June 16, 2011, Mr Akira Imura has served as Chairman of the Board and Representative Director of TOYOTA INDUSTRIES CORPORATION. He started working for the company in April 1968. He has also held the positions of President and Director of a subsidiary (Kaneko et al., 2021). In

comparison to automotive R&D industry standards, the funding allocated to the Toyota central R&D lab is likewise relatively large. A total of 3 billion yen has been invested in the project.

5 Conclusion

Toyota is a leading car manufacturing company. Most of their cars are produced for international exporting. They export a wide range of cars in the sector of the automobile business. they follow different kinds of strategies to stay unbeatable in the global market. Their research and development centre is one of the main reasons for their business innovation. They are spreading their business in the different international markets using some strategies like establishing production plants in different countries to reduce the production cost, innovating new technology like green car etc. Overall in the market of car manufacturing, they are unique for their strategy and business model.

6 References

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