Case Studies in Data Science (COSC2669) Final Report-WIL Project

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Abstract

With an elevated debt and a higher unemployment rate, Australia is currently in the stage of emerging from the COVID-19 pandemic. This paper describes and discusses the pandemic impact in Australian economy in high level on emerging trends and policy responses.

Introduction

The global economy impact from the covid-19 pandemic vary wildly, but the end results are expected to be negative. We will see heightened global disparity in countries' economic performance in the future depending on the strategy chosen to face the pandemic. With restricted movements of people and supply chain disruptions in Australia, the impact was firstly seen in domestic businesses relied on movements of people (student migration and tourism etc.).

After 1974, Australia is in its first recession with a 7% drop in GDP [1] by the end of June 2020. The economic recovery has been delayed further by the almost three months lock down in Melbourne from Aug 2020, the nation's second largest city with approximately 5 million people.

Purpose

Economy of a country decides the quality of the living standards. Economic growth creates higher tax revenue and reduce debt to GDP ratios. Pandemic hit has reflected in the economic downturn in many countries and some have been severely impacted than others. The purpose of this project is to investigate the pandemic impact on Australian economy in general.

COVID-19 Pandemic

The COVID-19 pandemic [2] is the current global health crisis during our time. By October 2020, virus has spread across every continent except Antarctica reaching over 1 million deaths. Much more than a health crisis it has become an unprecedent socio-economic crisis creating devastation social, economic, and political effects. World bank estimates a USD 110 billion decline in remittances in 2020 where more than 800 million people will not be able to meet the basic needs.

1. Problem Statement

Australia's economic recovery from pandemic is underway. The bitter aftermath includes the increase in unemployment and increase in government debt. The problem this project seeks to address is what economic trends we can see currently see and what we can expect in Australia during a post pandemic world.

Shifts in stock market can affect the value of individual savings and pensions. In response to stock falls, central banks in many countries including Australia slashed interest rates making borrowing cheaper and encouraging to spend more to boost the economy. The travel industry has been severely damaged while the demand for oil dried up worldwide. Many people have lost their jobs and the income is cut due to the COVID-19 pandemic. IMF predicts that the economy will shrink globally by 3% by the end of year 2020 where we can expect a worst decline since last great depression of year 1930.

Looking at these impacts in a larger scale, our analysis can help anyone who lives in Australia to understand the current and emerging trends within the industries to prepare themselves for upcoming challenges as well as opportunities in a world suffering and trying to recover from COVID-19 pandemic.

2. Methodology

The analysis was carried out on below three topics.

- COVID-19 cases by Socio-economic index in Australia
- COVID-19 visible impact on Australian economy
- Selected industry analysis

We have analysed publicly available datasets, papers and survey results conducted on pandemic impact to world and Australia in general.

Then we analysed the currently available data on all industries within Australia to find out the level of impact per industry using the employment data and chain volume measures. The Industry selection to provide more insights in this paper was based upon the availability of granular level data and not by the level of impact from the COVID-19 pandemic. The analysis of Socio-Economic (SE) influence on Covid19 spread has been limited to Victoria due to the low number of Covid-19 cases in other states.

Finally, a PowerBI dashboard was created to showcase the findings in general. You can visit the dashboard using this provided link (*Go to PowerBI Dashboard*).

2.1 Data pre-processing

The three categories in the project were distributed among different team members in the team to be completed by agreed time frames. We had less than 6 months' worth of data on pandemic during the commencement of the project.

2.1.1 COVID-19 cases by Socio-economic index in Australia

The Victorian Covid-19 case data has been obtained from Department of Health and Human Services web site [3], where case updates are published daily.

- Data Set: Victorian Active Cases by Postcode Data [3]
  Attributes: (Postcode | Population | Total-Cases | Active-Cases | Rate | New Cases)

The Socio-Economic Indexes for Areas (SEIFA) data has been obtained from Australian Bureau of Statistics web site [4].

- Data Set - Socio-Economic Indexes for Areas 2016 by Postcode [5]
  Attributes: (Postcode | Index Decile | Population)

There were four different SE Indexes included in this data set and the values of each indexes were ranged from 1 (lowest) to 10 (highest) [6].

- IRSD – Index of Relative Socio-economic Disadvantage
- IRSAD - Index of Relative Socio-economic Advantage and Disadvantage
- IER - Index of Economic Resources
- IEO - Index of Education and Occupation

A generalized SE index is defined by taking the mathematical average of the decile index value of each SE index mentioned above.

$$Generalized\ SE\ Index = \frac{(\mathrm{IRSD} + \mathrm{IRSAD} + \mathrm{IER} + \mathrm{IOE})}{4}$$

Based on the "*Generalized SE Index*" value, the postcodes have been categorized into three classes where Low : *Generalized SE Index* <= 5.5, Middle : 5.5 < *Generalized SE Index* < 8 and High : *Generalized SE Index* >= 8.

This figure is intended to represent the SE status of each postcode. This means if the "*Generalized SE Index*" is low, then the respective postcode possesses "Low" SE standards in a broad sense. Also, as a part of pre-processing, the postcodes have been categorized to three classes based on the number of Covid-19 cases reported. (Low: *Number of Cases* <= 20, Middle : 20 < *Number of Cases* < 100, High : *Number of Cases* >= 100)

This measure is intended to depict the severity of Covid-19 spread based on the number of reported cases. The rate of Covid-19 reported cases based on the population of each postcode is defined as,

$$Rate\ of\ Cases = \frac{\text{Total Cases}}{\text{Population } 100{,}000}$$

The postcodes without SE indexes have been excluded from the data set. These postcodes are dedicated for special facilities such as educational or health (Example – Postcode 3010 for University of Melbourne, Postcode 3086 for La Trobe University) therefore, it is meaningless to consider them for this particular analysis. Finally, the Australia's postcode to suburb mapping (updated to May 2020) is obtained from a freelance project [7].

These main data sets (Covid-19 cases by postcode, SE Indexes by postcode, and Postcode to Suburb mapping) have been merged keeping the postcode as the primary key. The pre-processed and combined data set looks as: (Postcode | Population | Suburb | Total Cases | Total Cases – Class | IOE | IER | IRSAD | IRDS | SE Class | Rate - Total Cases | Report Date).

The pre-processed data is loaded into Power BI and built a data model to analyse any correlation of SE standards to the extent of Covid-19 spread. The merged SE and Covid-19 data have been visually analysed by implementing advance filtering and slicing features in Power BI report to investigate any correlation between the two. An auto zooming map view is implemented using the TopoJSON shape file that had been converted from Australia's post code shape ArcGIS ESRI file [8].

2.1.2 COVID-19 visible impact on Australian Economy

The analysis for the impact on Australian economy by covid-19 used data related to Employment, Consumer Price Index (CPI) and GDP from Australian Bureau Statistics.

The data for analysing the change in GDP chain volume measures were obtained from the Australian Bureau of Statistics website [9] . The data was filtered to include all quarters from June-2015 to June-2020.

- Dataset – Australian National Accounts: National Income, Expenditure and Product

  Attributes – (Quarter | GDP Chain Volume Measure)

The data for analysing the change in CPI due to COVID-19 was obtained from the Australian Bureau of Statistics website [10]. Data from June-2016 to June-2020 was used for the analysis.

- Dataset – Consumer Price Index, Australia

  Attributes – (Quarter | Category | CPI Value)

For the purpose of analysing the change in employee numbers, the dataset for Employees were obtained from the Australian Bureau of Statistics [11] . The period used for this analysis is from June-2015 to June-2020.

- Dataset – Labour Force, Australia

  Attributes – (Month | Category | Value)

2.1.3 Selected industry analysis

The industry wise analysis was carried out mainly using seasonally adjusted ABS data on labour inputs and chain volume measures. Data extracted from year 2000 to 2020 on 18 industries categorised in ABS publications [9] [12] [13] on industry analysis for Australia.

The Gross Domestic Product at chained volume measure is a statistic used to calculate the effect of inflation. The reason to have chain volume or constant price estimate is to provide time series of expenditure and production aggregation which are direct effects of price changes [14].

- Data Set: Australian national Accounts: national income, Expenditure and Product [9]
  Attributes: (Chain volume measure/Gross value added |Industry)
  Series Type: seasonally adjusted
  Duration: Year 2000- 2020
  Frequency: Quarterly

The main industries analysed in primarily were Agriculture/forestry and fishing, Mining, Manufacturing, Electricity/gas/water and waste services, Construction, Wholesale trade, Retail trade, Accommodation and food services, Transport/postal and warehousing, Information media and telecommunications, Rental/hiring and real estate services, Professional/scientific and technical services, Administrative and support services, Public administration and safety, Education and training, Health care and social assistance , Arts and recreation services, Other services.

For labour inputs data we have used the ABS data classified for employee jobs which is full time and part time based on the employer's perception of whether the person has been engaged on a full time or part time basis. The analysis was conducted separately for each industry mentioned above.

- Data Set: Labour Force, Australia, Detailed, Quarterly [10]
  Attributes: (Total persons | Full-time persons | Part-time persons)
  Series Type: seasonally adjusted
  Duration: Year 2000- 2020
  Frequency: Quarterly

	Usually works less than 35 hours	Usually works 35 or more hours
Actually worked less than 35 hours	Part-time	Full-time
Actually worked 35 or more hours	Full-time	Full-time

Table 01: Employment data categorisation

3. Impact and significance results

The focus on this project was to provide analysis and insights on Australian economy and its upcoming trends and policy responses by the impact of COVID-19 pandemic. A healthy economy is one of the biggest impacts of long-term growth of a country. National income directly impacts the level of employment and the standard of living.

3.1 COVID-19 cases by Socio-economic index in Australia

The correlation between the extend of Covid-19 spread and SE standards of the suburbs has been investigated using the visualization model built with Power BI. Identifying such relation will be useful in,

- obtaining insight on failures on current regulations on stopping the spread
- to fragment the overall economic impact to smaller geo-economic areas

- developing much effective area-based or community-based policies for curb spread and economic recovery
- planning educational and community programs for similar future health crisis or pandemics
- applying insights or findings to other states for early prevention

Using the distribution plots of “Average total cases per suburb” by SE Index value indicates a relatively higher number of total cases for the low & medium SE suburbs. Further, it shows a declining trend of “Average total cases” as the SE standards are increasing. The higher amount of spread shown in “low” and “middle” SE suburbs could be an aggregated result of the illiteracy, ignorance, and working community with higher mobility.

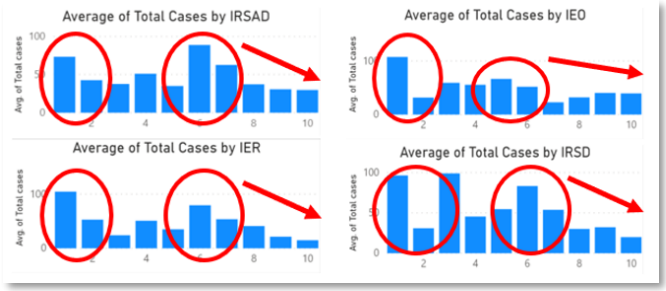

Figure 01: Overall socio-economic trends in Victoria, Australia

It was observed that the “Low” and “Medium” SE suburbs constituted a significant proportion of high spread of the virus. In contrast, the majority of the “Low” spread suburbs have been constituted by “High” SE suburbs.

3.2 COVID-19 visible impact on Australian economy

Even though the pandemic is still with us, the effects have started to reflect nationwide. The consumer confidence has been lower than the Global Financial crisis as per ANZ-Roy Morgan Consumer Confidence Index on March 2020. The business confidence severely affected since early March but bounced back during June and dropped again during Aug with the second wave hit in Melbourne.

3.2.1 GDP

GDP is the Gross domestic product which is the standard measure of the value added created through the production of goods and services in a country during a certain period. It measures the income earned from the production, or the total amount spent on final goods and services (less imports). Therefore, GDP is a measure of country’s net output.

According to research, the COVID-19 pandemic could reduce the Australia’s GDP by 34.2 billion dollars. In other terms, GDP decreased by 7.6% in current price measures from Mar 2020 – Jun 2020. Because countries with relatively higher service sectors, higher consumption as well as rely on imports and exports suffer relatively more under the COVID-19 pandemic [15].

3.2.2 Impacted Industries

Under this pandemic situation, most of the industries have downed to the ground, highly disrupting the Australian economy. For example, arrivals in tourism to the country has dropped by 99.1% from December 2019 to June 2020 [16].

Industries such as accommodation and food services and health care and social assistance were greatly impacted, while industries such as construction, manufacturing and professional, and scientific and technical services had less than half of its businesses affected.

3.2.3 Benefitted Industries

Even though COVID-19 pandemic significantly disrupted most of the industries across Australia, a few of lucky industries are set to outperform in these difficult economic conditions. Such as, data storage services, online

food ordering and delivery platforms, childcare services, electronic retailing, IT for education and remote work and social platforms. The revenue growth of those industries in Australia were, data storage services – 12.7%, online food ordering and delivery platforms – 26.5% and childcare services – 3.1% [17].

Also, there are industries to be benefitted with this pandemic. Such as, Iron ore mining, alumina production, liquefied natural gas production and medical and surgical equipment manufacturing [18].

3.2.4 Unemployment

COVID-19 pandemic has affected most businesses by reducing their cash flow and demand for their goods. Many businesses have cut off their staff and staff hours. According to social surveys, 30% of the businesses have reduced their staff numbers due to the pandemic. Businesses have reduced their staff by 28% in average. Accommodation and food services businesses have reduced their staff by 62% while construction businesses were the least likely to reduce the staff which was 14%.

Also, businesses have reduced their staff hours too. Accommodation and food services have reduced staff hours by 69% and health care and social assistance businesses have reduced that by 52%. The least staff hours reduction was happened in the businesses in the professional, scientific, and technical services and it was 38% [19].

3.3 Selected industry wise analysis

The broader analysis was completed for 18 industry categories within Australia as stated in the section 2.1.3 in this paper. To limit and narrow down the focus for the project, we have selected few industries to include in detail in this section. The selection was based upon the availability of granular level data and resources and not by the impacted percentage by pandemic.

3.3.1 Construction Industry

Construction industry represents almost 10% of the Australian economy and employees about 1.2 million in over 390,000 businesses in Australia [20].

The strength of the housing market can be assessed by using the number of building permits issued, and the number of construction jobs. An increase in this statistic reflects an improving economy because increased buildings provides money into the economy not only through new home sales but also through sales of furniture and appliances to furnish these buildings/houses [21]. As per Figure 02, the pandemic has impacted to a significant drop in both residential and non-residential building jobs in Australia. The Figure 03 reflects the significant drop in employment with reducing building jobs from Feb 2020 onwards.

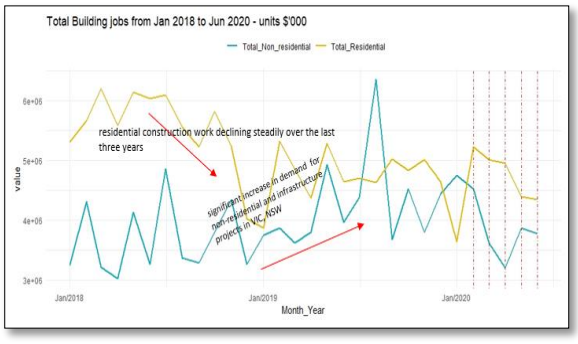

Figure 02: Total building jobs Australia

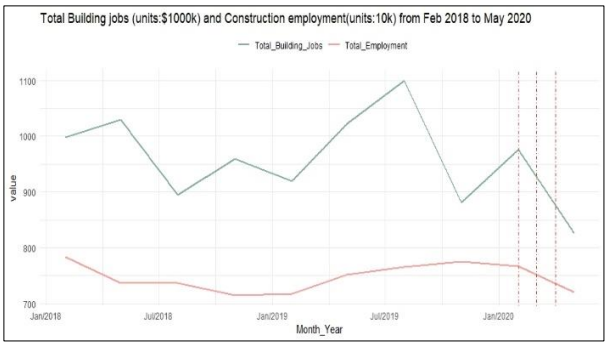

Figure 03: Total building jobs & employment Australia

3.3.1.1 Pandemic impact to Construction industry

- The non-essential services shutdown has not applied directly to construction sites in Australia. Since this industry heavily relies on labourers who are unable to work on sites due to curfew/ quarantine requirements this has the potential to delay current and future projects

- Production chain volume measures for construction industry decreased by 12.9 % due to restriction measures
- Expenditure chain volume measures reflects a 9.5% rise in furnishing and household equipment and 6.8% decrease in dwellings during Mar-20 to Jun-20
- The demand for new commercial and residential building construction has negatively affected the industry with low confidence consumers. This has affected construction employment drop from Feb-2020 onwards in Australia for both full-time and part time. There was a 2% drop in employment from Jun-19 to Jun-20 calendar year
- The Australian Performance of Construction Index (PCI) has dropped by 16.3 points to 21.6 in April 2020
- Australia launched $470 million stimulus package for construction sector to revive from pandemic effect where the YoY construction jobs volume dropped by 2% from Mar-19 to Mar 20 and dropped by 6% from Jun-19 to Jun-20

3.3.1.2 Emerging trends and forecasts in Construction industry

- The publicly funded projects are anticipated to perform well since the Federal government has identified this industry can be ramped up to boost employment. This could be clearly visible from data as there was an increase in public non-residential building jobs after Mar-20. The category uptick included the Retail and wholesale trade building jobs and Transport building jobs.
- According to ACIF, the current measures placed during pandemic, can potentially raise the building and construction activity by $66 billion over the next five years which is a positive news for employers, employees, and investors in this industry

3.3.2 Education and Training Industry

International students inject $32 Billion a year into Australian economy and directly supports almost 130,000 jobs within Australia. There was an increase of higher education enrolments and commencements of overseas students since year 2013. Since the disruptions for visa granting and travel restrictions number of students have been significantly decreasing since Mar-20. The international student market may slow to recover, therefore higher education institutes should focus on the online and local demand in the immediate future.

As per Figure 04, the overall employment (both full-time and part-time) drop from Feb-20 to May-20, but Territory education has got an increase in employment (both full-time and part-time) for the same period. The assumption made here is the increased is driven by the contract employment to support the online platforms for the new norm.

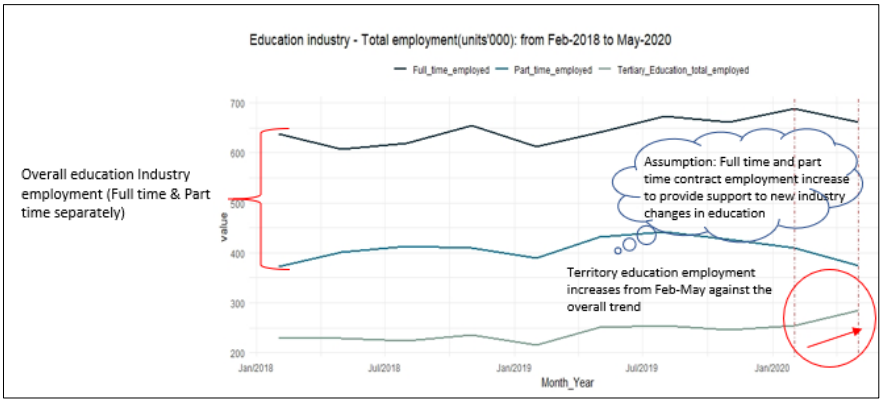

Figure 04. Education overall employment Vs Territory education employment subset - Australia

3.3.2.1 Pandemic impact to Education and Training Industry

- Overall employment drops in Education sector from Feb- May 2020 in both full time and part time.
- The overall trend aligns with both Preschool and school education and Adult, community, Other education sub sectors except for Territory education.

- There has been an increase in employment in full time and part time for Territory education during Feb-May 2020

3.3.2.2 Emerging trends and forecasts in Education and Training Industry

- Less preference to undertake international education and growing interest for online education
- Certain degrees and programs will be less attractive, and some will be highly preferable Automation, data analytics, data science and online systems are likely to be increased while Accounting likely to decrease
- Government capacity likely to be dropped in investing in higher education and research
- Casual staff/ short term contractors may be forced to seek employment outside the sector
- The role for expertise in assisting government on recovery and reconstruction presents an important opportunity for universities in current situation
- A number of strategies for growing revenue and activity, such as philanthropy, transnational education and commercial research contracts will be less viable [22]

3.3.3 Housing and real estate Industry

The thriving residential property market in Australia has supported homeowners with great returns on their real estate investment over the years. The estimated revenue of real estate agencies in Australia is $8.8 billion and the house price to income ratio is 106%.

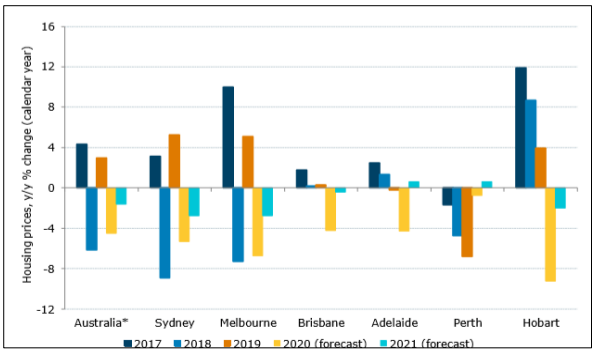

Figure 05: Housing price by capital city Vs Overall Australia

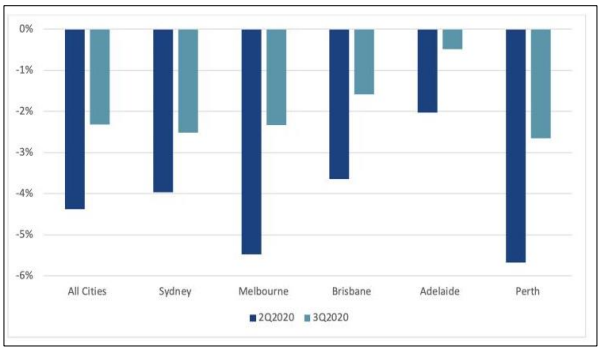

Figure 06: Predicted quarterly growth rates in properties

3.3.3.1 Pandemic impact to Housing and real estate Industry

- Media reports suggest that an estimated one million Australians could be tipped into unemployment, and this figure may prove to be conservative. Our work has shown that insecurely employed households have five-times greater odds of experiencing housing affordability stress [23]
- Pre-COVID, Australia already had an estimated 1.6 million low-income people struggling to meet their housing costs; these are estimates we have worked out using data from the Household, Income and Labour Dynamics in Australia (HILDA) survey. This number will almost certainly rise
- The implications for rental affordability are a little less clear, but there are promising discussions occurring at the Commonwealth and State levels that are likely to provide some level of protection against rent increases and evictions
- Before the COVID pandemic, around 1.31 million Australian households received some form of government-provided rent assistance payment. If unemployment will almost certainly more than double, the number of households requiring urgent assistance to pay their rent will increase dramatically
- A sizeable, and perhaps surprising, proportion of Australian households contain no adults with permanent or fixed-term employment (1.7 million), and in the past, it was possible for these households to meet rent and mortgage payments, according to our estimate from the HILDA survey

3.3.3.2 Emerging trends and forecasts in Housing and real estate Industry

- At the highly vulnerable end of the housing system, it is estimated on any one night in Australia, more than 200,000 people are living in places like homelessness hostels, caravans, improvised homes, boarding houses or sleeping rough
- It is expected that that residential property prices across all capital cities will fall by 4.4% over the June quarter and by another 2.3% in the September quarter of 2020
- Sydney prices are predicted to fall by 4% in the June quarter and about 2.5% in the September quarter
- Falls in prices in Brisbane and Adelaide are tipped to be less severe but in Melbourne and Perth, falls of around 5.5 per cent and 2.5 per cent in the June and September quarters, are expected respectively
- The proportion of households vulnerable to housing precariousness (where all adults in the household are unemployed or reliant on one person's job to meet their housing costs) will rise.
- A rapid post-COVID rise in unemployment causing a shift in the distribution of households with two jobs to one job, and one job to unemployed households, could result in around one quarter of households with mortgages having only one employed adult and eight per cent having none

3.3.4 Manufacturing Industry

Australia's manufacturing sector contributes about $100 billion a year to the national economy, accounting for roughly 5% of GDP and employs around 900,000 within Australia. Now, a revitalised manufacturing industry could provide a road out of the recession created by the coronavirus pandemic. But the types of products made on Australian soil in the future will be different to what was made in the past.

3.3.4.1 Pandemic impact to Manufacturing Industry

- The disruption of supply chains slowdowns and deepens the impacts for the sector by inability to access these inputs
- The manufacturing sector already has visible shortages, with many household goods including appliances, clothing and footwear produced in China [24]

3.3.4.2 Emerging trends and forecasts in Housing and real estate Industry

- Decline to around 6 % of GDP
- Global supply chains are still severely restricted, and the forecasting indicators suggest the manufacturing sector will not recover any time soon
- The new orders index in the Australian PMI hit the lowest level since 2013, suggesting weak demand into the future
- Manufacturing Production in Australia is expected to be -1.5% by the end of the current quarter [25], Projections for 2021 is 0.8% and 1% in 2022
- If the Australian government keeps on investing in the local manufacturing industry instead of relying on imports the manufacturing industry can be revived
- The low valued Australian dollar makes our locally manufactured goods more competitive overseas, and the lack of supply from China gives us the opportunity to fill this gap in the international market
  This is already being seen in the healthcare and consumer goods area, with the likes of toilet paper, hand sanitizer, and healthcare goods such as x-rays. The large increases in production in these areas can largely be attributed to the coronavirus outbreak.

4. Project management approach

The Agile methodology has been applied during the management of every phase of the project. Agile methodology helped in break down the whole project into manageable tasks which are completed in short iterations throughout the project life cycle. The adaptation to the Agile methodology helped the team to work faster, adapt to changing requirements easily and optimise the workflow.

4.1 Team capability

As the initial step, once we found the required number of team members for the project, we had the first discussion on capabilities of each individual team member. A good mix of essential skills including problem solving skills, analytical skills, coding skills, data visualisation skills with an excellent teamwork capability led us to complete an exciting product.

4.1.1 Roles and responsibilities

The roles of analysts, coordinators, and leaders (for different project phases) have been rotated during the project to provide exposure to all roles for all team members.

4.2 High level planning

The team worked on tasks determined in the sprint planning meetings and moved forward until the analysis is completed. These tasks were adjusted in flight where required. Each sprint was conducted via Microsoft Teams while a chat group was created in WhatsApp for continuous communication. Microsoft Teams was the main collaboration channel for Sprints and file/data repository and sharing.

Virtual Stand-up meetings were conducted where necessary to ensure everyone is on track and informed. A virtual Kanban board / Agile board was maintained to track the progress of tasks been distributed among team members.

We have avoided using story points during the project but whoever working the story owned the story hence the owner was able to break down the task if it was too large. This allowed the team to complete daily/weekly committable work and everyone could see how the work moved across the Kanban board.

- Sprint 1- Team set up
- Sprint 2- Finalise the subject/dataset for the project from the options
- Sprint 3- Sprint 3.6 – Pilot and Release 1.0 (Project Milestone 01) and Release 1.1 (the presentation)
- Sprint 4-Sprint4.2- Release 2.0 (Final report and PowerBI dashboard)

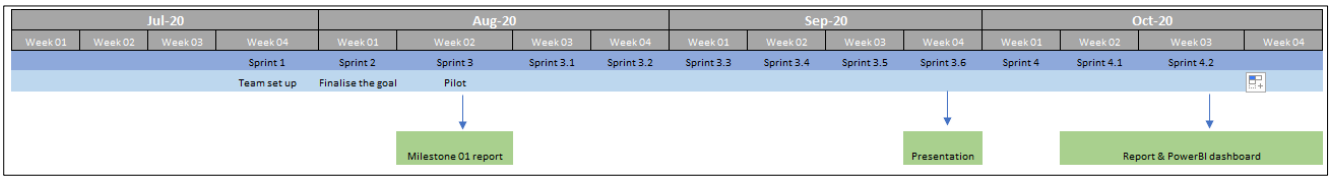

Figure 07: High level sprint plan

4.3 Plan Execution / Operating Rhythm

The virtual team stand-ups have been conducted on Sundays and each team member took turns on discussing the achievements from last week, plans for next week and discussed on roadblocks. The stand-ups strengthen the team and given the opportunity to learn from each other's work and to learn from each other's experiences.

Some key issues and roadblocks faced during the project:

- Data/resources were not up to date or yet to be released which has been a roadblock in the project, but we decided to look for more data sets/ resources continuously while working with the available data
- Project scope was revised few times and finally agreed upon the COVID-19 Economy impact in Australia since we had to narrow down the scope to a level which was manageable to analyse a large amount of data
- PowerBI development skills were vary among the team members and everyone had to learn and apply during the project

Student ID	Student name	Contribution (%)
s3729411	Rasika Abeysekara (main Lead)	20%
s3791147	Pasindu De Silva	20%
s3400652	Udeshika Dissanayake	20%
s3812893	Eraj Goonewardena	20%
s3833151	Nikhil Sharma	20%

Table 02: Team member contribution

5. Conclusion and Next steps

While Australia is currently at a recession on record, we are not performing bad as some other countries suffered worse from the outbreak of Covid-19. Two-thirds (67%) of the work force have been impacted by COVID-19 pandemic by the end of August with a hard hit on Victoria , New South Wales and Tasmania [26].

This analysis includes a wider economic view on multiple industries. The full extent of the economic impact of COVID-19 is yet to be known once detailed sector surveys and impact quantifications are completed. The time frame of recovery is uncertain since the world is still battling with the virus.

Our analysis has been focused only on the economic cost. The broader social cost of such a loss of life should not be overlooked.

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