

This book is a solid guide navigating modern businesses, a professional compass for decision makers, a popular textbook in top-level business schools, a key reference for business scholars and analysts, and an understandable public commercial work.

The content of this book is well written and understandable for all kinds of business readers. Junior managers, analysts, and business school students (including MBAs) are encouraged to refer to these articles for relative works. In all, if you are interested in the business world, this book can greatly benefit you, no matter your current position and background.

### International Business Analysis



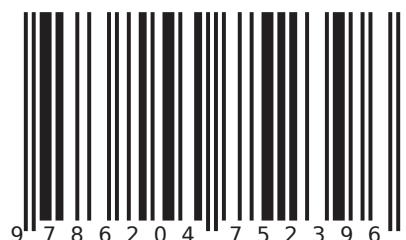
Xuan Feng

# International Business Analysis

An Essay Guidebook for Business Professionals



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# Preface:

To all readers:

Today's business has a focus on sustainable development and technology innovation. The business models have changed significantly throughout the decades. This book gives an overview of the prevalent business studies, based on a selection of the articles about modern and/or sustainable business.

This book covers seven chapters. Each chapter is an independent article that analyses a frontier business topic. Chapter 1, an industry analysis based on the UK automotive industry, is a great template to conduct industry analysis. Chapter 2 is a detailed case study of how to evaluate a project before launching. Chapter 3 provides readers an example of how to propose an innovative business idea and how to transfer an idea to a feasible blueprint. Chapter 4 is an article that analyses leadership. Chapter 5 provides a guidance for entrepreneurs to realize and analyses potential changes in their firms' human resource management. Chapter 6 focus on evaluating the cost-benefit and sustainability of a new business model – using autonomous vehicles for urban delivery. Chapter 7 is a little bit advanced – it is a data science article that conduct a series of text mining jobs on Congress speeches and newspaper titles in order to analyse the changing hotspot issues over time.

The content of this book is well written and understandable for all kinds of business readers. Junior managers, analysts, and business school students (including MBAs) are encouraged to refer to these articles for relative works.

In all, if you are interested in the business world, this book can greatly benefit you, no matter your current position and background.

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# Chapter 1: A Strategic Perspective on the UK Automotive Industry

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## **Abstract**

UK automotive industry is facing unprecedented challenges as well as attractive opportunities. The PESTLE analysis framework is helpful for understanding the macro-environment in a higher perspective. UK automotive makers are under an unfriendly environment these years partly because the Brexit has triggered a series of political, economic, and legal impacts on the environment of the UK automotive industry. The uncertainty of the Brexit is decreasing foreign investors' confidences, and if the 'no deal' scenario happens, the UK will face potential high tariffs. The UK economy is suffering from low GDP growth and the depreciation of pounds. More rigorous environmental laws have raised more requirements for UK automotive manufacturers. The attractiveness of the UK automotive manufacturing industry is medium, and the result is concluded by conducting Porter's Five Forces analysis. Although most UK automotive manufacturers have already undertaken significant corporate social responsibilities, they should continue transforming and evolving to deliver a sustainable future.

The strategic analysis is also subject to two main restrictions and constraints. One is the interconnection of the factors when performing PESTLE analysis. Because the six factors are generic and separately described, to interpret the interrelationships or interdependences among variables and to find the critical driver of change only by PESTEL analysis are challenging (Burt 2006). Therefore, scenario analysis is recommended. In Porter's Five Forces analysis, the powers of each 'force' are qualitatively defined as weak, medium, or strong. However, the definition of the extent of weak or strong is subject to subjective judgment. To measure the industry attractiveness more precisely and to make the attractiveness forces of different sectors available for comparison, a more quantitative analysis framework can be created or introduced. For example, build a measurement system that can rationally score each power from 1 to 10.

## **1. Introduction**

UK automotive industry is facing great transformation towards digitalization and decarbonisation. Meanwhile, new entrants, such as electric and driverless carmakers are changing the competition pattern. UK car production decreased to 92158 units in August from 108239 units in July of 2019 (Trading Economics 2019).

Despite various political risks and technology shocks, the manufacturing sector has been experiencing steady growth. Having achieved a turnover of £82 billion, the UK automotive manufacturing contributed £18.6 billion to 2018 UK economy and £44.4 billion to 2018 UK exports (SMMT 2019). The EU, USA, China, Japan, and Turkey constitute the largest five oversea customer markets.

## **2. The Macro-environment Analysis of the UK Automotive Industry**

Subject to some restrictions as well as constraints, the PESTEL analysis provides an overview of the six critical factors to influence the macro-environment of the UK automotive industry: political, economic, social, technological, ecological, and legal (Johnson et al. 2018: 68).

### **2.1 Political**

The UK government's failure to provide Brexit certainty is disappointing Japanese manufactures who occupy the largest share in UK automotive output (BBC 2019). The political uncertainty brings foreign investors more risks and therefore forces risk-avert Japanese corporations to invest in mature and stable markets in Southeast Asia. If the 'no deal' scenario happens, the UK will face billions of tariffs on vehicles exported to the EU market (SMMT 2019).

In the mid-1980s, the UK attracted Japanese carmakers looking for access to European markets. However, earlier this year, the EU and Japan struck a trade agreement that lowers tariffs on both parties' car exports to zero (BBC 2019). Building automotive plants in the UK is no longer attractive to Japanese producers that can shift to Asia to enjoy cheaper labour and higher efficiency.

## **2.2 Economics**

The growth of the UK economy remains sluggish, with a negative GDP growth rate of -0.2% in the second quarter of 2019 and a rising inflation rate of 1.7% in 2019 September (Financial Times 2019). During the recessional period in an economic cycle, more people delay or curtail spending on cars; the UK carmakers will suffer.

Declining 16.5% against the US dollar after the results of the 2016 Brexit referendum (European Business Magazine 2018), the depreciating pound is in favour of exports for UK manufacturers. However, the benefit is hard to offset the impact of increasing crude oil prices, which prompt a lower car demand and harm the automotive manufacturing industry.

Besides, as the third-largest consumer market (SMMT 2019), China's stagnant economy and emerging local competitors, to some extent, lower the demand for UK high-end brands.

## **2.3 Social**

In mid-2018, the UK's population continues to grow at a slow rate of 0.6%, with the population aged grows fastest (Office for National Statistics 2019). The situation indicates a diminishing demand for petrol vehicles but enlarges the market for autonomous (Deloitte 2019) or unique designed cars for the aged.

Culturally, the low-carbon lifestyle is becoming popular due to the awareness of global climate change, driving people away from traditional fuel vehicles and increasing needs for electric or new-energy vehicles.

## **2.4 Technological**

Depending on the breakthrough innovation on car batteries, the safer and cleaner electric automobiles are reconfiguring the automotive manufacturing industry.

Conventional car manufacturers are facing unprecedented challenges not only from electric unicorns, such as TESLA, but also from internet giants, including Google and Apple, who have invested billions in technology research and development (R&D) of autonomous and new-energy vehicles. Between 2009 and 2015, Google spent over \$1.1 billion on developing its self-driving vehicles (Business Insider 2017). Owning thousands of patents and developing several prototypes, the Googles have begun smart cars' road-tests.

## **2.5 Ecological**

The pressure to minimize the direct pollution of exhaust prompts manufacturers to develop more ‘green’ automotive technologies.

However, environmental protection also means carmakers are responsible for dealing with the seemingly indirect pollutions, for example, the industry wastes produced during manufacturing, assembling, and painting processes. These pollutions can be easily overlooked.

Over the past five years, the number of vehicles abandoned in England and Wales has increased by 228% (Auto Express 2019). So manufacturers should consider how to recycle and safely dispose of the abandoned vehicles, especially the electric parts and poisonous materials that are environmentally harmful.

## **2.6 Legal**

Introduced across Europe in 2015, the new emission-rules raise new requirements for automotive producers to develop cleaner diesel technologies fitted to Euro 6-compliant models (Auto Express 2019).

Furthermore, because the EU is the largest export destination for UK cars (SMMT 2019), the more rigorous rules will create remarkable compliance costs, which can lead to a drop in demand by consumers and a squeeze on the UK manufacturers’ profits.

Overall, the UK automotive industry is facing a challenging macro-environment. All six factors are presented as discrete areas with defined focuses, while, in practice, they overlap and interact in ways that cannot be detailed. For example, the Brexit, a political factor, also has an impact on economic components, such as tariff and exchange rate. For a better understanding of the interconnections of those factors, scenario analysis can be conducted (Burt 2006).

# **3. Industry and Sector Analysis of UK Automotive Manufacturing**

Porter’s five forces framework offers a comprehensive way to identify the attractiveness of the UK automotive industry according to five competitive forces. The stronger forces mean that the industry is less attractive to enter because the industry’s costs are higher (Johnson et al. 2017: 64, Magretta 2012).

### **3.1 Competitive rivalry: strong**

The high investment in R&D, manufacturing lines, and marketing forces carmakers to cut unit prices as a way to improve their sales and to amortize the substantial fixed cost. Cutting price is always followed by more competitors and finally leads to price wars and more intense competitions (Johnson et al. 2018: 111). As a result of the enormous initial investment, exiting is difficult for manufacturers, which, otherwise, will bear devastating losses, thereby increasing the level of rivalry.

Since 2010, more players have come into the car manufacturing industry, and the annual number of enterprises' death is smaller than those birth (Statista 2019), intensifying the competition. However, with a growth rate of 4.56% in 2018 and 2.2% expected in 5 years (Statista 2019, SMMT 2019), UK carmakers can capture new growth opportunities and still make profits.

### **3.2 The threat of entry: weak**

The threat from entrants is subject to several limitations. In 2013, Rolls-Royce spent \$\\$ 75 million only to launch a manufacturing laboratory (Asian Scientist 2013). The considerable investment in plants, equipment, and daily operations are high barriers for new brands. New entrants are impossible to achieve the economic scale that needs decades of accumulation. Likewise, they are difficult to access supply or distribution channels, with the tendency to be charged more. The unpopular brand image and lack of reputation also challenge new entrants. Moreover, increasingly harsh laws create another barrier to entry. Consequently, new players cannot challenge the advantages of incumbents who have developed over the past decades.

### **3.3 The threat of substitutes: medium**

Although there are several substitutes for transportation, such as buses and trains, the advantage of automobiles cannot be fully hedged. Owning a car can allow people to travel 'from point to point', offer more flexible time, and, to some extent, represent one's prestige.

However, commuters in big cities tend to choose public transportations because they are cheaper and more convenient, and high-speed trains are safer for long journeys. Furthermore, new energy and electric brands, such as TESLA, are challenging the traditional automotive manufacturers (Deloitte 2019).

### **3.4 The power of suppliers: weak**

Automotive suppliers' bargain power is low. There are plenty of vendors such as GKN for components and BP for lubricant oil. Many international competitors, including Bosch and Continental (Spotlightmetal 2019), produce similar products without significant differentiation. Leading UK manufacturers, such as Bentley, Rolls-Royce, and Land Rover, can switch from one supplier to another at low costs, because raw materials, auto parts, and labours are always available.

So, suppliers must play according to carmakers, who have real clout to build the market rules. Although few vendors control the core high-tech components or rare materials, such as Hyperbat expert in battery systems (Automotive Logistics 2018), they are often small in size. Thus the threat caused by most suppliers doing forward integration can usually be ignored.

### **3.5 The power of buyers: strong**

Influential buyers include the vast individual buyers that buy single vehicles and the governments as well as large corporations, such as Uber, Gett, and Wincanton, who purchase fleets of automobiles. Both of them are price-sensitive and can turn to a new brand without high switching costs (Pratap 2019). Thus, the buyers always try to bargain for a lower price, compressing the profit space of carmakers.

Large corporation customers also cause a threat of backward integration. For example, multinational logistics groups and car-rental companies tend to merge manufacturers to get rid of the procurement limitation and realize economic scales. A travel agency or a hotel group can buy a car brand to broaden its services for ultimate customers.

In all, the UK automotive industry shows medium attractiveness, accompanied by strong buyers' power and intense rivalry.

## **4. Corporate Social Responsibilities (CSR) of the UK automotive industry**

The World Bank Group defines CSR as 'the commitment of business to contribute to sustainable economic development, working employees, their families, the local community and society at large to improve quality of life, in ways that are both good for business and good

for development' (Word Bank 2003). Although the formalization, main actors, and specific aims of CSR vary among different firms, the core idea of CSR is doing some 'good' things (Kotler 2005) beyond the basic economic and legal requirements and out of ethic or philanthropy.

CSR is not a new concept. Since the Industrial Revolution, UK carmakers have tried a lot to ensure labour working conditions, provide accommodation or healthcare, and donate to charities. In the 1960s, corporations began to pay more attention to environmental problems. At the same time, a series of apocalyptic ecological literature were published, such as *Silent Spring* (Carson 1962). However, contemporary CSR requires corporations to address their roles in society more coherently, comprehensively, philanthropically, and professionally (Crane, Matten and J. Spence 2014: 3). Figure 1, below, compares the up-to-date CSR with the traditional CSR (Crane, Matten and J. Spence 2014: 66).

	<i>Traditional CSR</i>	<i>Contemporary CSR</i>
<b>Focus</b>	Risk	Reward
<b>Drivers</b>	Image, Brand, Public Acceptance	Performance, Markets, Products
<b>Actors</b>	Corporation, unilateral philanthropy	Corporation + Multi-stakeholder networks, collaborative value creation
<b>Relation to the bottom-line</b>	No direct contribution: CSR is value distribution	Integral goal: CSR is value creation
<b>Orientation</b>	Reactive	Proactive
<b>Motto</b>	'CSR is bolt-on'	'CSR is built-in'

Figure 1. The evolution of CSR (Crane 2014: 66)

CSR is helpful for increasing sales and market share. Over the last two decades, the UK automotive manufacturers have undergone tremendous growth and transformation, while they have successfully balanced the economic growth with social responsibilities and environmental requirements. Such agile responsiveness has helped the industry to thrive through the economic recessions many times, with vehicles becoming the UK's most exported product, occupying nearly 10% of total UK exports (SMMT-Trade 2019).

UK automotive industry constantly focuses on environmental protection and resource efficiency, having saved 8.9 million tonnes of CO<sub>2</sub>, 7 million MWh of energy, 53.6 million M3 water usage, and over half million tons of waste from landfill (SMMT-Sustainability 2019) since 1999. Less energy and resource use means lower costs and more profits for manufacturers.

Being responsible and 'green' can link a brand with moral sprits, enhance the corporation's positive public image, strengthen the brand reputation as well as market position, and attract more investments in sustainable development. The UK automotive sector has been long

dedicated to deliver energy efficiency and decarbonisation; for example, BENTLEY has achieved generating all electricity needed by solar power or other green energies (SMMT-Sustainability 2019).

Employees are the most critical stakeholders, and more care on employees can bring corporations more loyalties, more working enthusiasm, and higher retention rate. During the last 20 years, UK automotive manufacturing has greatly improved employees' satisfaction. More job opportunities were created, the industry's average wage increased by 85% against the whole UK economy by 61%, and the number of incidents per employee dramatically decreased. Meanwhile, to adapt to digitalization, the number of formal training days per employee has increased by 61% (SMMT-Sustainability 2019).

Many stakeholders expect more than minimum. UK government shows great ambition in its 'Road to Zero' strategy, which targets that by 2040, all new cars will achieve absolutely zero-emission (SMMT-Sustainability 2019). Even though the gender pay gap in UK automotive manufacturing is close to that in manufacturing overall, the automotive council launched a program last year to pursue more inclusivity and diversity (SMMT-Sustainability 2019).

In conclusion, CSR is not just a matter of senior policymakers. However, the staffs' ethical behaviours and the managers' focuses on employees' safety, well-being, and gender diversity are driving ASTON MARTIN to deliver a sustainable future by constant innovation (ASTON MARTIN 2019).

## 5. Conclusion

UK automotive industry is under an adverse macro-environment, but the corporations can still make profits, aligned with the weak entrants' threat, the weak suppliers' power, and the medium substitutes' threat. Along with the popularity of driverless technology, more cross-industry players will crowd into the industry and create more substitutes, consequently intensifying the rivalry; but the powers from customers and suppliers will not be substantially changed.

To prepare better for the industry digitalization transformation, UK carmakers should build strategic alliances (Johnson, Whittington and Scholes 2012: 218) with players from other

industries, such as Google from AI or Inter from the chip industry. Manufacturers are also responsible for developing more energy-efficient technologies to reduce water use, recycle wastes, and extend vehicles' lifespans.

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# Chapter 2: Project Management for Business

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# **Part 1 - Project Initiation Document**

## **Introduction**

The Kamino Multi-Purpose Stadium project is part of the Kamino Street Masterplan and is designed to be finished in 2 years with a budget of £2.1 million. The project initiation document includes a project scope statement, a project schedule (Gantt-chart with milestones), a project stakeholder assessment, and a project risk assessment.

The well-designed WBS, Gantt-chart, stakeholder analysis, and risk register are critical tools for achieving project objectives successfully.

## **1. Project Scope**

Pinto (2019) defines project scope as ‘everything about the project – work content as well as expected outcomes’. A clear scope definition is critical to project success (Mishra et al. 2011). However, a poor definition of scope often has an adverse effect on project performance (Lawson and Gray 2014). Furthermore, the ‘scope creep’, where project performance is altered due to changes made to the project process (Meredith and Mantel 2010), should be avoided, because it may waste resources and hinder the achievement of project objectives.

Project Scope Statement and the WBS (Work Breakdown Structure) are two most important tools for project scope management.

### **1.1 Project Scope Statement**

Project Scope Statement defines the major tasks that need to be performed to accomplish the project objectives (Gido, Clements, and Baker 2018).

A scope statement includes the important assumptions and constraints, objectives, key deliverables, works included, and works excluded, whose definitions are listed in table below.

Components	Definition
Objectives	A concise overview of the project and how the results or end products will be used (Pinto 2019).
Assumptions	Factors expected to be in place or to be in evidence (PMI 2017). Factors that, for planning purposes, are considered to be true, real, or certain without proof or demonstration (Pinto 2019).
Constraints	Any restrictions that may affect project development (Pinto 2019).
Deliverables	Any measurable, tangible, verifiable outcome, result, or item that must be produced to complete a project or part of a project (Pinto 2019).
Inclusions	A description of tasks, items, and actions that are specifically “included” in the project scope (PMI 2017).
Exclusions	An identification of what activities is excluded from the project (PMI 2017).

The scope statement of the Kamino Stadium project:

1. Project objective:
  - To finish the construction of the Kamino Multi-Purpose Stadium, the installation of the security and access control system, and the staff training for using the system under a budget of £2.1 million within 2 years.
2. Assumptions:
  - The required resources will be acquired on schedule.
  - Sponsors approve the agreed-upon budget and the schedule as baselines.
  - Key stakeholders will review the scope statement and reach consensus.
3. Constraints:
  - The project needs to be completed in 2 years.
  - The budget approved by the city of Kamino is £2.1 million.
  - Limitation of the number of workers.
  - Local laws' requirements on working hours.
4. Deliverables:
  - Cleaned site for construction.

- Purchased resourced and relevant contracts.
  - A finished Multi-Purpose stadium with amenities, including a community center, shops, a gym and a parking garage.
  - A high-end security and access control system.
  - A training course for staff to use the security & access system.
5. Inclusions:
- Acquire human and physical resources required for the project.
  - Construct the stadium according to the project baselines.
  - Install the security and access control system and train security staff.
  - Build a community center, shops, a fitness & martial arts gym and a parking garage.
  - Manage change requests according to the approved change control system.
  - Manage risks and execute risk responses.
  - Close the project when finished and release resources.
6. Exclusions:
- The assessment of project feasibility and of environment and social impact.
  - Prepare business case and get it approved.
  - Daily operation after the stadium opening to the public.
  - Negotiate with sports brands and music companies, and sell tickets.
  - Maintenance for the security and other electric systems after all the project deliverables being accepted and validated.

The scope statement should be updated and detailed according to the principle of ‘progressively elaborated’ (PMI 2017: 155); the immediate works should be detailed at the beginning, while works beginning in the future can be detailed later as necessary.

## 1.2 WBS

WBS is the hierarchical breakdown of all works that need to be conducted to achieve the project objectivity and create required deliverables (APM 2012). WBS defines the whole border of the project scope. Associated with a WBS dictionary, the WBS and the approved Project Scope Statement constitute the Scope Baseline.

For performing the Kamino Multi-Purpose Stadium project, a WBS needs to be created. Figure 1, demonstrates a WBS, whose second level is major deliverables.

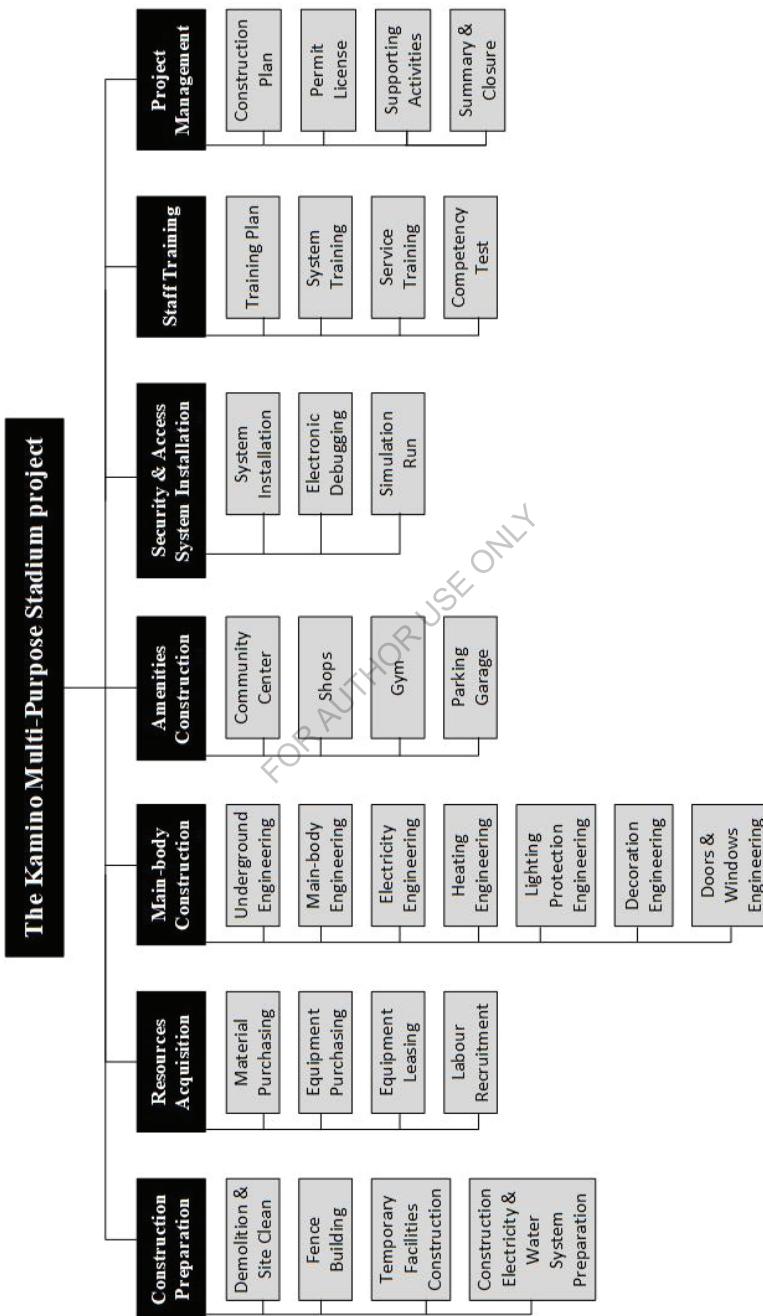


Figure 1 : WBS (PMI 2000)

An adapted model of the WBS

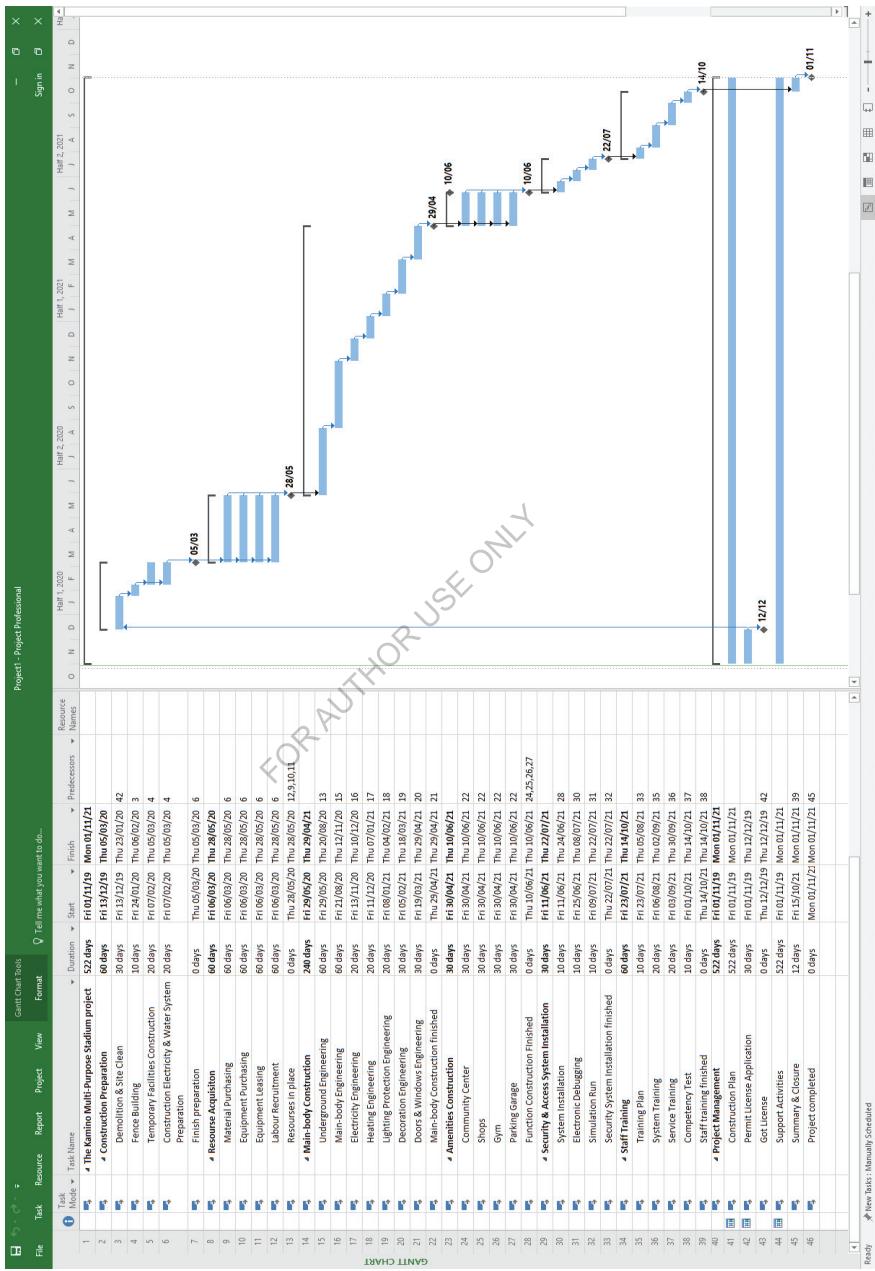
## **2. Project Schedule**

Scheduling a project should be based on the dependency relationships among all works (PMI 2017). The WBS is an important input for scheduling because it defines all works that need to be finished.

As shown below, the Gantt-chart shows the logical sequence of all the activities. There are seven work packages displayed as the second level of the WBS, and then they are broken into lower-level activities. Some activities can be conducted simultaneously.

With the duration time of zero, the milestones are some key points, which mean that certain important work activities have been finished. The milestones are shown as small rhombuses in the Gantt-chart below.

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### **3. Stakeholders Management**

Stakeholders are individuals or institutes that can impact the project or can be affected by the project (APM 2012). A stakeholder is defined as ‘any party with an interest in the project process or outcome’ (Maylor 2010: 77). There are two kinds of stakeholders: Primary stakeholders who can directly influence or invest money in the project, and secondary stakeholders who have relationships with the project but usually not directly engage in the project (Savage et al. 1991: 62).

For managing the stakeholders effectively, a four steps framework can be used: identification, power/interest analysis, communication management plan, and engagement plan (APM 2012).

#### **3.1 Identify Stakeholders**

The stakeholders involved in the Kamino Stadium project can be identified and listed in the table below.

<b>Internal Stakeholders</b>	<b>External Stakeholders</b>
<ul style="list-style-type: none"><li>• Project sponsor</li><li>• Senior managers</li><li>• Project team members (engineers, labours, etc.)</li><li>• External temporary experts (e.g. auditors)</li></ul>	<ul style="list-style-type: none"><li>• Financial Manager</li><li>• Functional / Resource Managers</li><li>• Government of Kamino city</li><li>• Human Resource Manager</li><li>• Labour union</li><li>• Material and Equipment suppliers</li><li>• Potential customers (brands, athletes, etc.)</li><li>• Potential visitors (the public)</li><li>• Public media of Kamino city</li><li>• Regulatory institutions</li></ul>

#### **3.2 Stakeholder Mapping**

Stakeholder mapping identifies stakeholder expectations as well as power and helps in understanding political priorities (Johnson et al. 2017). As shown in Figure 2, the

Power/Interest grid/matrix is useful for analyzing the stakeholders by classifying them into four quadrants according to their level of authority (power) and concern about the project (interest).

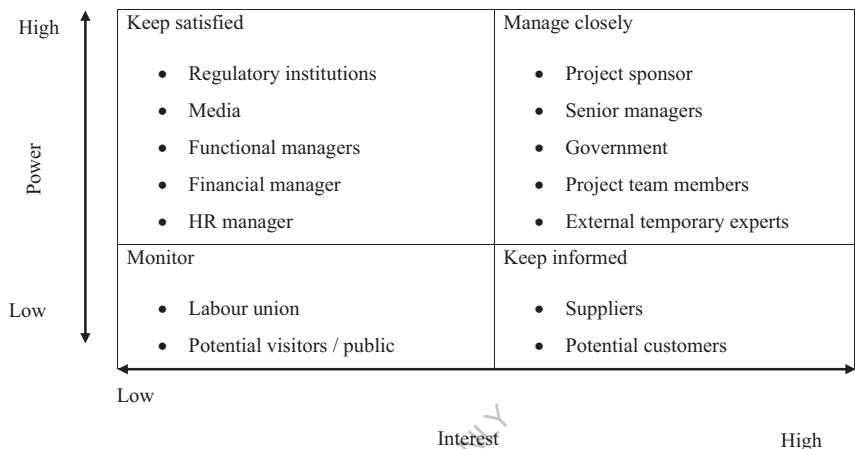


Figure 2: Power/Interest Matrix (Johnson et al. 2014)

An adapted model of the power/interest matrix

Stakeholders in different quadrants should be managed through different strategies.

Stakeholders Type	Strategy
high power and high interest	Manage closely because they are very important to the final success of the project.
high power but low interest	Keep satisfied. Despite of low interest in the project, they may negatively influence the project and the final outcomes if they are unsatisfied. For example, a functional manager may refuse to provide resources and lead to a delay of the project schedule, or a renowned media may publish a negative report on the project and cause the sponsors' divestment or workers' strike.
low power but high interest	Keep informed because they are interested in the project.
low power and low interest	Only monitor because they usually have few influences on the project.

However, the level of power and interest of a stakeholder is dynamic and can be changed over time. More objective methods, such as statistical study, can be used to better justify the power/interest level (Karlsen 2002: 22).

### **3.3 Communication Management**

Communication is vital for achieving project success (Zulch 2014). Due to the diversity of the stakeholders, different communication methods should be applied.

In the project of the Kaino Stadium, communication among stakeholders can be planned according to various natures, as shown in Figure 3 below.

Information	Stakeholder	Communication Methods	Frequency	Provider
Project team discussion	Team members and project manager	Meetings	Whenever necessary	Project manager
Approved change requests	Project team, project manager and senior managers (e.g. PMO)	Formal emails, register, and PMIS	Whenever change requests were approved	PMO or project manager
Project periodic summary	Team members and project manager	Meetings	Once a month	Project manager
Milestone complete report	Sponsors, senior managers, project manager and team	Meetings, email, and hard copies	Whenever a milestone is achieved	Project team
Purchasing contract negotiation	Project manager, business manager, and suppliers	Meeting, email, and formal contracts	When there is purchasing needs	Business manager
Project status monitoring	Project manager and project team	PMIS, meetings and hard copies	Once a week	Project manager
Issues reports	Project team members	emails	Once a week	Team members

Project news	Project team, the potential customers, and media	Websites and newspapers	Once a week	Project team
Regulatory auditing and reports	Project manager and team, government, and regulatory institutes	Interviews, meetings, websites, and hard copies	Half a year	Project manager
Conflicts between team members	Project manager and the conflict members	Private talk	Whenever a conflict occurs	Project manager
Project closure and summary	Sponsors, senior managers, project manager and team	Meetings, email, questionnaires, and hard copies	At the end of the project	Project manager

Figure 3: Communication Management Plan (Larson and Gray 2014)

An adapted model of the communication plan

### 3.4 Manage Stakeholder Engagement

According to the power/interest matrix, stakeholders' expectations can be managed more effectively. More attention should be paid to underlying interests and cultural misunderstandings. The change of stakeholders should also be considered; for example, a critical stakeholder may leave the project or become no longer important.

Besides, the team chapter and ground rules should be set to clarify the expected behaviours for all stakeholders, with regard to stakeholder engagement (PMI 2017). Some interpersonal and team skills should also be used, such as negotiation, observation, and political awareness, etc.

Furthermore, the Stakeholder Engagement Assessment Matrix, as shown in Figure 4, can be introduced to assess the engagement level of stakeholders. The C represents the current level of engagement of each stakeholder, and the D represents the desired/expected level (PMI 2017). Minimizing or closing the gap between current and desired engagement levels is the main task for managing stakeholder engagement to achieve the project objectives.

<b>Stakeholder</b>	<b>Unaware</b>	<b>Resistant</b>	<b>Neutral</b>	<b>Supportive</b>	<b>Leading</b>
Stakeholder 1	C			D	
Stakeholder 2			C	D	
Stakeholder 3				DC	

Figure 4: The Stakeholder Engagement Assessment Matrix (PMI 2017)

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## 4. Project risk assessment

A risk has an effect on at least one project objective. The ‘effects’ can be either positive (potential opportunities) or negative (potential threats) (Gardiner 2005). The project risk assessment process can be decomposed into three steps: identification, analysis, and response.

### 4.1 Risk Identification

Some analysis frameworks, such as the PESTLE (Johnson et al. 2018), can be used for identifying risks according to risks’ sources.

In Figure 16, R1-R5 represent negative risks (threats), and R6-R10 represent positive risks (opportunities).

	Identifier	Risks
Negative Risks	R1	Long-term bad weather affects construction and causes schedule delay
	R2	Suppliers delay to deliver construction materials or equipment
	R3	Bad quality causes reworking
	R4	Labours are negative and therefore low efficiency
	R5	Scope creep leads to cost overrun and schedule delay
Positive Risks	R6	Labours are experienced and devote to finish the project successfully
	R7	Advanced equipment are used and lead to more efficiency and ahead of schedule
	R8	Most stakeholders are positive and support the project
	R9	Suppliers delivery materials and equipment in advance
	R10	Less bugs or faults when testing security system

## 4.2 Risk Analysis

Figure 5 demonstrates a matrix to assess a risk according to two dimensions: the impact on project and the probability of occurring.

		Threats					Opportunities						
Probability	Impact	Very High 0.90	0.05	0.09	0.18	0.36	0.72	0.72	0.36	0.18	0.09	0.05	Very High 0.90
		High 0.70	0.04	0.07	0.14	0.28	0.56	0.56	0.28	0.14	0.07	0.04	High 0.70
		Medium 0.50	0.03	0.05	0.10	0.20	0.40	0.40	0.20	0.10	0.05	0.03	Medium 0.50
		Low 0.30	0.02	0.03	0.06	0.12	0.24	0.24	0.12	0.06	0.03	0.02	Low 0.30
		Very Low 0.10	0.01	0.01	0.02	0.04	0.08	0.08	0.04	0.02	0.01	0.01	Very Low 0.10
		Very Low 0.05	Low 0.10	Moderate 0.20	High 0.40	Very High 0.80	Very High 0.80	High 0.40	Moderate 0.20	Low 0.10	Very Low 0.05		
Negative Impact						Positive Impact							

Figure 5: The risk assessment matrix (PMI 2017)

The two values can be multiplied to provide a probability-impact score for each risk as its risk rating, which can represent a risk's priority and be helpful for finding the most significant ones, as defined in table below.

Risk Rating	Risk Priority
$\geq 0.24$	High
$\geq 0.08 \text{ and } < 0.24$	Medium
$< 0.08$	Low

## 4.3 Risk Register

Risk Register							
ID	Risk Description	Impact	Probability	Risk Rating	Priority	Response Strategy	Proposed Responses
R1	Long-term bad weather affects construction and causes schedule delay	0.4	0.1	0.04	Low	Mitigate	Build more flexible construction plan and conduct expediting when available
R2	Suppliers delay to deliver construction materials or equipment	0.4	0.5	0.20	Medium	Transfer	Sign detailed contract to clarify the suppliers' duties and delivery time, and file a suit if necessary
R3	Bad quality causes reworking	0.8	0.1	0.08	Medium	Avoid	Use high-quality materials and conduct the construction quality auditing periodically
R4	Labours are negative and therefore low efficiency	0.4	0.3	0.12	Medium	Mitigate	Set up performance rewards and use leadership skills to inspire members
R5	Scope creep leads to cost overrun and schedule delay	0.8	0.7	0.56	High	Avoid	Clarify requirements and the project scope, and monitor scope periodically
R6	Labours are experienced and devote to finish the project successfully	0.4	0.7	0.28	High	Enhance	Set up performance rewards and inspire members towards higher efficiency
R7	Advanced equipment are used and cause more efficiency and ahead of schedule	0.8	0.9	0.72	High	Exploit	Keep purchasing or leasing the advanced and high-quality equipment
R8	Most stakeholders are positive and support the project	0.8	0.7	0.56	High	Accept	Maintain effective communication and continuously monitor stakeholder engagement

R9	Suppliers delivery materials and equipment in advance	0.4	0.5	0.20	Medium	Accept	Build long-term cooperative relationship with these reliable suppliers for further use
R10	Less bugs or faults when testing security system	0.2	0.5	0.10	Medium	Enhance	Recruit more skilled experts and purchase high-quality system and parts

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## **Part 2 - Evaluate current issues in project management**

### **Introduction**

Impromptu teams differ from other project teams because they emerge due to unexpected events and self-selected team formation (Jacobsson and Hällgren 2016). The impromptu teams can be seen as one kind of emergency-management systems, which are usually formed when facing incidents and must be organized rapidly under demanding circumstances (Bigley and Roberts 2001).

Another important characteristic is that impromptu teams are temporary organizations. ‘Temporary’ means impromptu teams cannot exist forever (Chae, Seo, and Lee 2015). When a serious situation happens, impromptu teams are often formed in the voluntarism-based membership, without advanced assignment. For example, clients and guides were no longer strictly subject to their original teams and quickly formed a new team to maximize their chance of surviving when the weather suddenly deteriorated at Mount Everest (Jacobsson and Hällgren 2016). However, when they were finally rescued and returned to camps, the team no longer exist.

### **Advantages**

Impromptu teams have some inherent strengths. Impromptu teams increase the chance of overcoming severe problems, especially in three situations. Firstly, impromptu teams can minimize the negative impact when the designed leader suddenly cannot work. For example, if the joint commander was killed during a battle, soldiers must reorganize quickly and re-plan the operational dispositions to win the fight. If no impromptu teams were formed, there is a great chance to lose. In the case of the 1969 Mount Everest disaster, after Scott Fischer (leader of Mountain Madness) and Makalu Gau (leader of the Taiwanese team) were left at the summit, their team members reorganized for better solutions.

Besides, impromptu teams combine and centralize the remaining resources when original organizations cannot handle extreme events. As the weather became worse, some members were left, the original teams were broken, and the remaining members from different teams were formed as a new team to stay warm and to take care of each other (Kayes 2004).

Furthermore, voluntary impromptu teams are helpful for those in big troubles in light of humanitarianism and philanthropy. After the storm on Mount Everest, the IMAX and other teams at base camp were reformed as a rescue team volunteered to aid others. Although they have no duty to do so, the temporary rescue team contributed its manpower. When the 1999 Taiwan Chi-Chi earthquake happened, ad hoc emergency medical assistance teams were formed by experts and staff from different institutions out of voluntary (Hsu et al. 2002). Their fast response saved thousands of victims.

## **Disadvantages**

However, the weaknesses of impromptu teams cannot be ignored. Firstly, when forming impromptu teams, some members may be negative or refuse to provide help because there are no formal and compulsory obligations. For example, the South African team refused to share batteries with others (Jacobsson and Hällgren 2016). Without upper management, members' private interests may deter the objective of impromptu teams. Secondly, the impromptu teams usually include members from different organizations or counties with different cultures. The misunderstanding due to cultural differences and low-efficient communication can lead to conflicts and more time waste (APM 2012), which can be fatal to the success of impromptu teams that need rapid responses.

The uniqueness and inimitability of impromptu teams also cause some inevitable weaknesses. One problem lies that the success of impromptu teams relies on the experience and competency of some key members. If there are no remaining guides and team leaders who provided effective and scientific guidance, other members might face more difficulties. Furthermore, because the occurrence of extreme events is unpredictable and rare, the members' characteristics and numbers in each impromptu team are different. Each accident and each impromptu team are both unique, and the impromptu teams cannot be formed before the emergence of accidents. Therefore, facing unexpected events and being subject to time limitations, it is impossible to establish an impromptu team only by referring to other impromptu teams' models (Jacobsson and Hällgren 2016).

## **Conclusion**

In conclusion, impromptu teams can be used to guide business success in many aspects. One important application is in the risk management area. Although organizations usually devote a lot to reduce threats, hazards, and vulnerability to extreme events, these events will occur (Harrald 2006). As accidents happen, one main function of impromptu teams is to integrate the remaining resources to fulfil the urgent needs that cannot be satisfied by the status quo. Thus, although organizations cannot identify unknown risks and make responses, they can build rational time/budget/resource reserves in advance to meet the requirements of extreme events (PMI 2017).

Besides, the knowledge-sharing is highly effective in impromptu teams under great pressures. Knowledge-sharing is the behaviour by which a member provides his or her experience for other members (Ryu, Ho, and Han 2003). So impromptu teams' high efficiency and rapid response to incidents are worth to consult, especially for conducting agile projects and managing communications. Encouraging knowledge-sharing can facilitate communication and align members' objectives (Faraj and Xiao 2006).

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# Chapter 3: A Career Training Platform for Stimulating the Nigerian Economy

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## **1. Introduction:**

As the 8<sup>th</sup> goal of the 17 sustainable development goals (SDG) listed by the United Nations, the ‘decent work and economic growth’ mainly aims to promote inclusive and sustainable economic growth, employment and decent work for all, especially for people in the least developed countries (LDCs) (UN 2019).

The goal is mainly about reducing the unemployment rate and stimulating the economy by encouraging quality jobs and innovations while not harming the environment. However, a series of challenges hinder the achievement of this ambition. Firstly, unemployment and non-decent jobs block sustainable economic growth. The real GDP growth rate in LDCs is less than the SDG target; the global unemployment rate in 2017 was 5.6%, while over half the workers were engaged in informal employment in 2016 (UN 2019). Furthermore, in 2018, over 20% of the world’s youth were not engaged in education, employment, or training (UN 2019), leading to more unemployment and lower levels of economic productivity.

As detailed in section 2, the unemployment problem in Africa is more severe and worth more concerns. Nigeria, Africa’s most populous country, is facing enormous challenges caused by unemployment, especially youth unemployment. The youth unemployment is a particular pressing socio-economic issue in Nigeria, as its youth unemployment rate is 36.5% in 2018, higher than the rate of Nigeria nation (Trading Economics 2019).

## **2. Problem Clarification**

The ingenuity process (Kirkham, Mosey, and Binks 2011) is used for analysing the unemployment problem in Nigeria; the youth people are affected most by the problem.

### **2.1 Who is affected by the youth unemployment in Nigeria**

The youth people in Nigeria are most affected by the unemployment problem. In the Nigeria context, the National Youth Development Policy (2001) defines youth as people aged between 18 and 35, who are citizens of the Federal Republic of Nigeria. If unemployed, the youth can be easily induced into criminal activities at their most vulnerable.

With more than half of the Nigerian people under 30 years of age and widening youth bulge (Bloomberg 2016), Nigeria shows significant social instability because young people are not well employed (McKinsey Global Institute, 2012).

## 2.2 Where does the problem occur?

The unemployment problem is prevalent in Nigeria. Nigeria's population (182 million) is the largest in Africa and ranks 7<sup>th</sup> worldwide (Worldometers 2019), but the unemployment rate of Nigerian rose to 23.10% in September 2018 and ranks 10<sup>th</sup> globally (Trading Economics 2019). The local labour force participation rate is 55.2% in 2019, significantly lower than the rates of comparable countries (CEIC 2019).

## 2.3 When the problem occur?

Unemployment, especially youth unemployment, is increasingly severe in Nigeria. As shown in figure 1, the unemployment rate of Nigeria has dramatically increased from less than 7.5% to 23.1% since 2012; the causes are explained in section 2.2.

**View Nigeria's Unemployment Rate from Mar 2012 to Sep 2018 in the chart:**

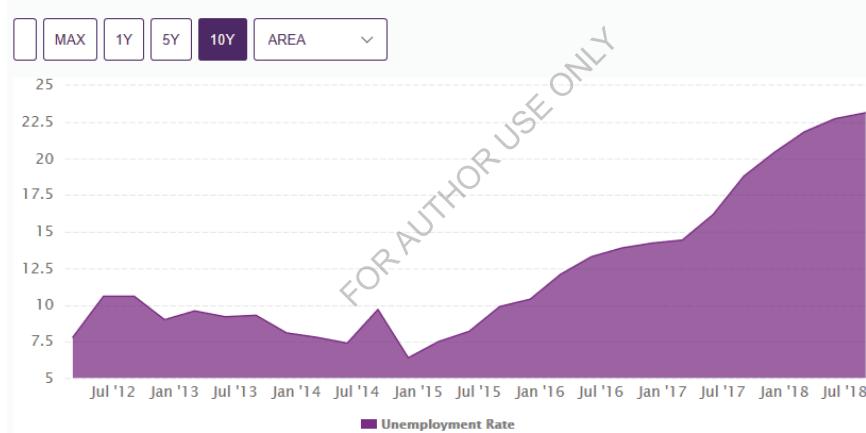


Figure 1: Nigeria's Unemployment Rate (CEIC 2019)

## 2.4 Reasons of youth unemployment in Nigeria

A PESTEL (political, economic, social, and technological, environmental, and legal) framework (Johnson et al. 2017) can be introduced to analyse the causes of youth unemployment in Nigeria from these six areas.

#### **2.4.1 Political**

Nigeria is the 4<sup>th</sup> most corrupt country in the world (LISTWAND 2019); the corruption issue impedes the country's development. More job opportunities are distributed to those who have politic relationships or background but no competencies. The political culture of Tribalism and Nepotism in Nigeria also lead to discrimination among different tribes (Ene et al. 2013), exacerbating inequality and unemployment.

#### **2.4.2 Economic**

Due to the adverse political environment, few foreign investors are willing to invest in Nigeria, where corrupt people will swallow their capital and blame a monkey or a snake (SuperSEO 2019). Lack of enough investment is aligned with fewer jobs and innovation opportunities, which are essential drivers for economic growth.

#### **2.4.3 Social**

Overpopulation in Nigeria leads to fewer job opportunities, with an influx of rural-urban migrants into cities and thereby an increase in unemployment in the cities (Tartiyus, Dauda, and Peter 2015). Besides, the lack of quality educations causing general incompetency also leads to a high unemployment rate (Uddin and Uddin 2013).

#### **2.4.4 Technological**

Nigeria fails to provide the necessary technologies and infrastructures, such as the stable power/electricity supply (Ohajianya et al. 2014). Because electricity is the fuel of business in the modern world, lack of sufficient power supplies makes indigenous companies and entrepreneurs dependent on others to make ends meet. Due to the high cost of power access, many local companies have to fold up or cut jobs, causing more labours unemployed.

#### **2.4.5 Environmental**

The environmental pollution caused by oil exploration in Nigeria over the past 50 years is destroying the local agriculture and fishery industry (Kadafa 2012), leaving more youth unemployed.

#### **2.4.6 Legal**

The incomplete legal system in Nigeria (Afolabi 2015) makes it hard for businesses to maintain their labours and, therefore, intensifies unemployment. The lack of systematic principles on business discourages foreign investors and partners, and the weak labour law provides few protections of workers' rights. Both situations are increasing the unemployment rate.

### **2.5 Effects of youth unemployment in Nigeria**

The unemployment problem in Nigeria can lead to a series of negative consequences (Yu, 2012), which include the following five aspects.

#### **2.5.1 Income inequality**

Nigeria's national wealth and job opportunities are concentrated in a few individuals, while many are in abject poverty (Ewubare and Okpani 2018). The high youth unemployment rate intensifies poverty among most young people and the income inequality in Nigeria due to few incomes.

#### **2.5.2 Terrorism and crime**

Without jobs, the unemployed and poor young people in Nigeria tend to engage in criminal activities. Unemployment has resulted in an increase in terrorist activities, such as Boko Haram in the north of Nigeria (USMAN 2015).

#### **2.5.3 Decline in quality of life**

Facing the responsibilities of taking care of the elderly and children, the young people contribute the most to a family's income. However, the increasing unemployment is reducing the family incomes, tensing the daily expenditures, and declining the generic life qualities in Nigeria (Uddin and Uddin 2013).

#### **2.5.4 Decline in attractiveness for tourists**

Caused by the high unemployment rate, the terrorist activities, and the unsafe society in Nigeria are driving tourists away (Uddin and Uddin 2013).

### 2.5.5 Decline in Nigeria economy

The significant youth unemployment problem in Nigeria means the labour resources, one kind of critical economic resources, are not effectively used. According to the Cobb-Douglas production function shown in figure 2 and the Solow's growth accounting equation shown in figure 3, less effective use of labour resources can finally lead to the decline of the total production and its growth rate.

$$Y = AL^\beta K^\alpha$$

Where:

- $Y$  = total production (the real value of all goods produced in a year)
- $L$  = labour input (the total number of person-hours worked in a year)
- $K$  = capital input (a measure of all machinery, equipment, and buildings; the value of capital input divided by the price of capital)
- $A$  = total factor productivity
- $\alpha$  and  $\beta$  are the output elasticities of capital and labour, respectively. [These values are constants determined by available technology.]

Figure 2: Cobb-Douglas production function (Cobb and Douglas 1928)

$$\log(Y_t) = \log(A_t K_t^\alpha L_t^{1-\alpha})$$

$$\log(Y_t) = \log(A_t) + \log(K_t^\alpha) + \log(L_t^{1-\alpha})$$

$$\log(Y_t) = \log(A_t) + \alpha \log(K_t) + (1 - \alpha) \log(L_t)$$

The Total Production's Growth Rate =

Technical Progress Rate +  $\alpha \times$  Capital Increase Rate +  $(1 - \alpha) \times$  Effective Labour Increase Rate

Figure 3: Solow's growth accounting equation (Shaikh 1974)

### 2.6 Solutions for solving the youth unemployment problem in Nigeria

According to the analysis of the leading causes of youth unemployment, some solutions, as shown in table 1 below, can be proposed to solve the problem.

No.	Solution Description	Main Focus
S1	Build a training platform to offer work-skills training to unemployed youths in Nigeria; then provide the labours to and gain money from multinational companies that have businesses in Nigeria.	Society (Training)
S2	Build a large career and innovation incubator/accelerator in Nigeria to introduce investors/VCs as well as to encourage local youths to innovate and turn ideas to the business. The formation of many start-ups can also provide a significant amount of working opportunities.	Economy (Innovation)
S3	Build a new solar power system to provide low-cost and stable electricity/power supply.	Technology (Energy)
S4	Launch a company to protect the environment and attract tourists. In the beginning, organize unemployed youths to clean the polluted areas and pay them salaries. After cleaning, the youths can work as guides or staff for tourists and generate money for the company and the whole economy.	Environment (Tourism)
S5	Build an online education system for children in rural and poor areas in Nigeria to learn basic knowledge, law, ethics, etc. Education at early age will reduce the unemployment rate and criminal activities in the future.	Society (Education)
S6	Build and popularize a transparent HR system for everyone to monitor the recruitment processes and reveal corruption in companies.	Politics (Anti-corruption)

Table 1: Solutions for solving the problem of youth unemployment in Nigeria

### 3. The DIFA analysis for solution 1 (S1)

Focusing on S1 listed in figure 4, a DIFA (Demand, Innovation, Feasibility, and Attractiveness) analysis (Rae 2014) can be conducted.

### **3.1 Demand**

The new business model (building a company-oriented training platform/incubator for unemployed youth in Nigeria) works as a platform connecting employers and labours more effectively. Therefore, there are two kinds of customers: unemployed youth and companies in Nigeria.

The target market for this solution is the companies that need labours with some specific skills and the youth who are unemployed but willing to work or change the status quo. As mentioned in section 2.1, youth refers to people aged between 18 and 35 in Nigeria (Oduwole 2015).

### **3.2 Innovation**

As one type of business model innovation, building a company-oriented training platform for unemployed youth in Nigeria is one kind of incremental innovation because the new training platform is a reform base on the current head-hunting and human resources companies.

However, the new business model has its uniqueness. Different from these traditional agencies, the new training platform is more company-oriented; the new platform first collects labour needs of different companies, then designs special training courses according to each companies' culture, skill needs, and other preferences, and finally trains the unemployed youth and send them to the employers. The refined process takes the employers' organizational culture and specific needs into consideration to minimize the gap between labours' skills and companies' requirements. Traditionally, career training platforms only focus on teaching generic ethics and work skills, which cannot meet an employer's specific requirements. The workers only having generic skills are oversupplied; they are facing intense competition and are easy to be unemployed. Besides, the new model can save money for employers because they usually invest a lot to train new employees.

The new business model shifts the market paradigm. Traditional human resources agencies consider more on training generic skills and providing employers with workers who need further and more in-depth training by employers. But the new platform optimizes the resources and focuses on targeted training and equipping qualified labours who can start to work once in position.

Therefore, the new platform is a transformational business model, with the employees' on-the-job training been forward integrated into the pre-job training.

### **3.3 Feasibility**

In order to successfully run the new training platform, three kinds of resources are needed. Firstly, a founder team should contain financial experts, law experts, operation specialists, and public relations managers. Specialists in developing training courses and trainers/lectures are also indispensable. Besides, physical resources, such as office sites and classrooms, and training equipment are necessary. Furthermore, initial investment from investors, such as angel investors or venture capitals, is needed to cover the expenditures at an early stage.

### **3.4 Attractiveness**

Through this new platform, companies in Nigeria can acquire qualified workers directly, without the additional time and cost to select and train new employees. After the targeted training for entering a specific company, the unemployed youth have more advantages for the company and are easier to be employed. Thus, the youth unemployment rate can be reduced.

The platform will charge low tuition fees for the unemployed; the low price can attract many young people. Once the unemployed youth get trained and have stable jobs, fewer people will engage in criminal activities, and the whole society will become safer.

From the perspective of an entrepreneur, the platform makes profit mainly by charge brokerages from companies who need qualified labours. For companies, the brokerages are far cheaper than the costs of independent training conducted by themselves. However, for the platform, the brokerage incomes will be much higher than the operating costs because of resources-concentration and scale economies effect. Besides, the low individual tuition fee can be offset by the huge number of students. The sustained growth in revenue will be attractive to more and more investors.

## **4. Justification**

### **4.1 Rationale for solution 1 (S1)**

The company-focused training platform/incubator demonstrates its superiority by providing targeted training for unemployed youth according to the needs of employers. By optimizing the human resources allocation, the platform can significantly reduce the unemployed rates of Nigeria; more youth will have decent jobs, and the country's economy will begin to take off. Figure 4 illustrates the business prototype of this solution.

As an entrepreneur, it is important to empathically rethink about the business model in the customers/end-users' shoes. Figure 5 demonstrates the process.

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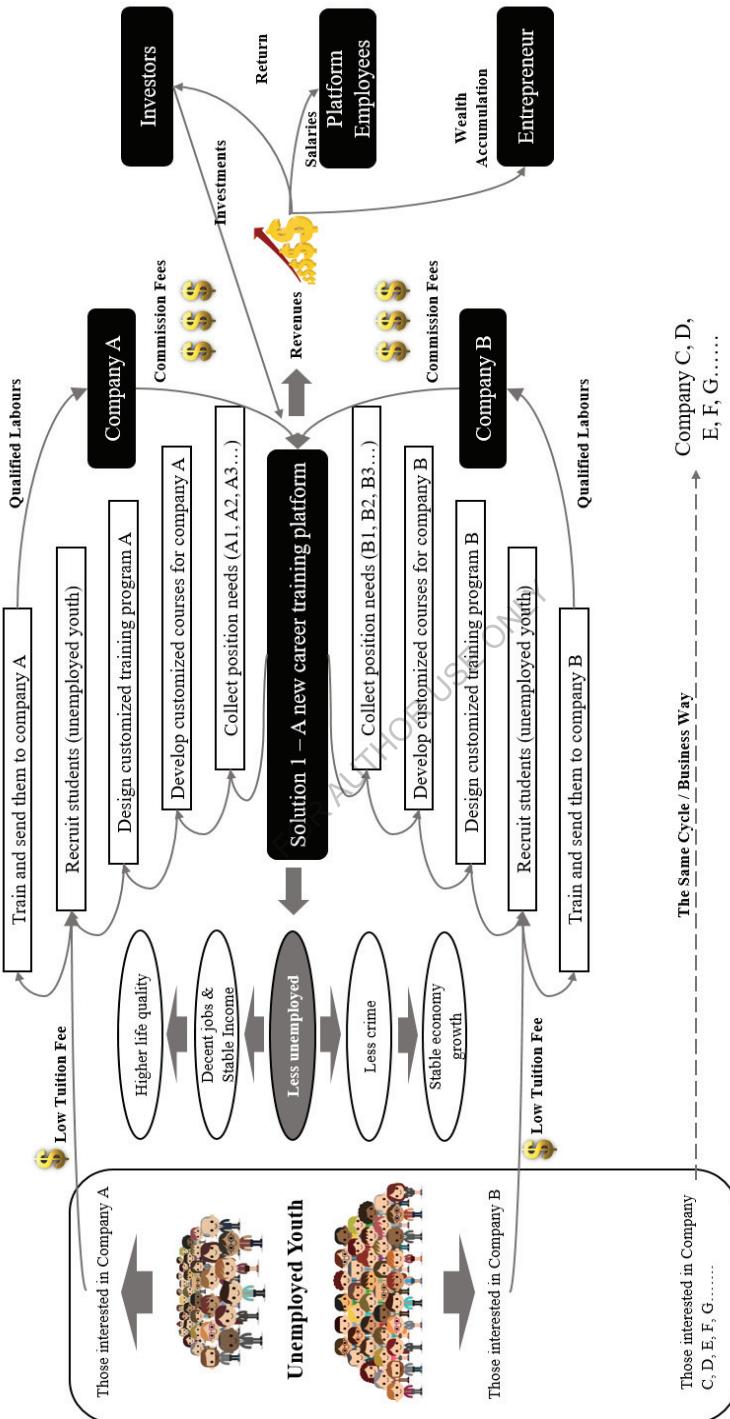


Figure 4: The business prototype of the solution 1

If the platform comes into service, what the customers will think ?

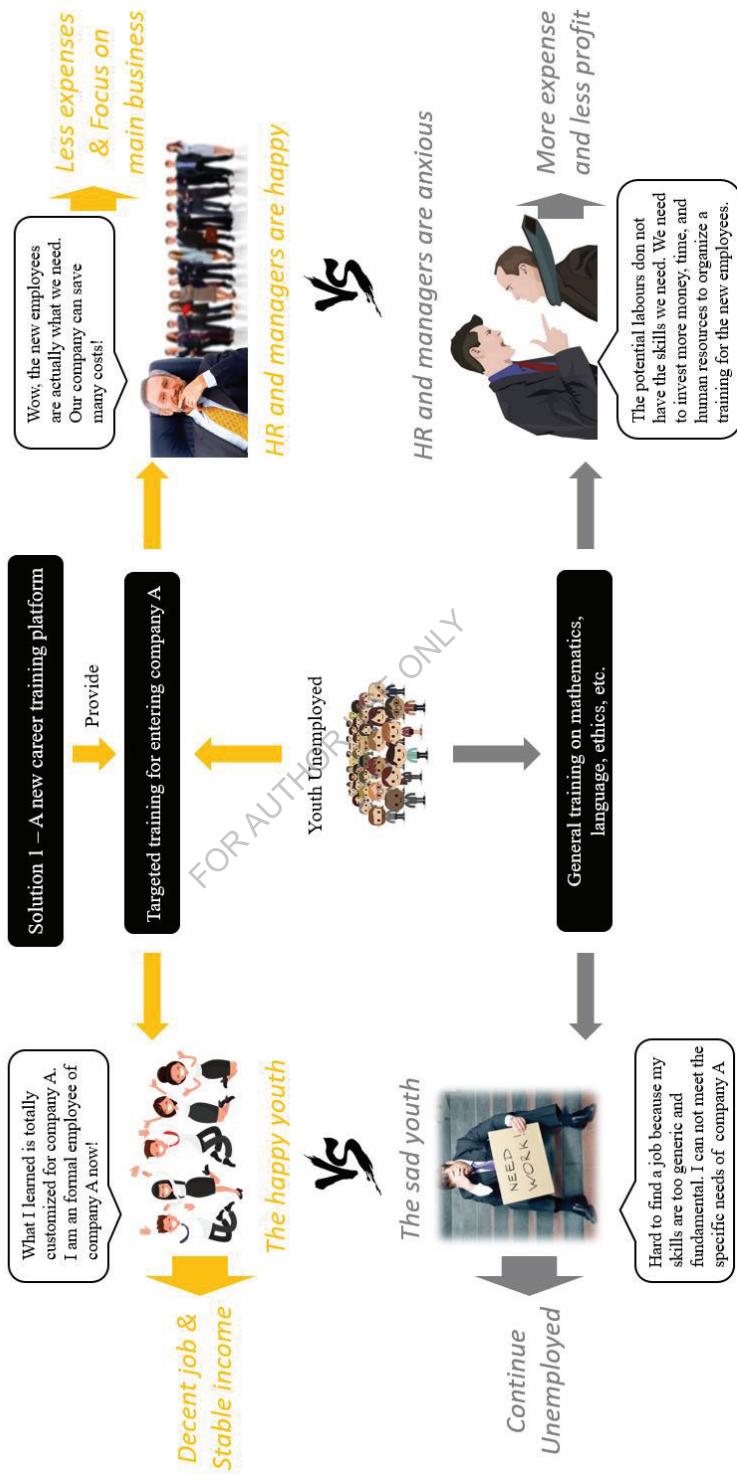


Figure 5: Empathic thinking in customers' perspective

## **4.2 Potential causes of failure**

Although the solution is attractive to investors and benefits to the Nigeria society, the plan may involve risks and uncertainties because they relate to events and depend on circumstances that will or may occur in the future. There are both internal and external potential causes of failure.

### **4.2.1 Internal causes**

The internal causes that may result in the final failure include but are not limited to the poor operation management, the lack of confidence and solidarity, and the difficulty of recruiting experts and employees.

### **4.2.2 External causes**

Many external causes can hinder the success of the program. Firstly, the local government may limit foreign investments or foreign entrepreneurs to run education-related businesses. Besides, the return uncertainty and unstable investment environment in Africa may lead to few or no investors who can bring the initial capital. Furthermore, wars and acts of terrorism may interrupt the regular operation of the business.

## **4.3 Preparation for potential failure**

In order to reduce the probability of potential failure, analysing the probability and the influence of each cause is necessary before making the response plans (PMI 2017). The quantitative results can be used to rank the priority of each cause and to find the most significant ones.

For solving internal causes, professional project management training should be provided for each member of the founder team. Team building activities can be organized periodically to improve members' confidence, solidarities, and sprits. In addition, well-designed and articulate career development routes and visions should be described and showed to potential team members during the process of recruitment.

After each series of funding, a certain proportion of reserves should be kept to response to the potential subsequent financing difficulties (APM 2012) rather than invest all money on operations. Moreover, joint ventures or business alliances (Johnson et al. 2018) with local businesses can be conducted to avoid the barriers set by the government. Besides, the platform should be located in big cities to minimize the impact of criminal or terrorist activities.

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# Chapter 4: A study on leadership of the Goldman Sachs' CEO in facing the challenge of gender inequality

Before this book, part or all of the content of this article has been published in following academic journal:

Xuan Feng (2021). Evaluate Human Resource Management challenges faced by Investment Banks: A case study of Goldman Sachs. *Journal of Chinese Human Resource Management*, Volume 12, Issue 1, 2021, Pages 50-64

## **1. Introduction**

### **1.1. About Goldman Sachs**

Headquartered in New York, Goldman Sachs is a leading global investment banking, securities, and investment management firm, which provides a broad range of financial services to a substantial and diversified client base that includes individuals, corporations, financial institutions, and governments (Goldman Sachs 2020). Founded in 1869, Goldman Sachs has experienced rises and falls and has survived through quite a few bad times over one and a half centuries (Cohan 2011). Nowadays, Goldman Sachs has become a major force on Wall Street and one of the most profitable organizations on this planet (Endlich 2000), with over 80 offices in all major financial centres around the world (Doyran 2017).

### **1.2. The CEO - David M. Solomon**

As the Chairmen and Chief Executive Officer (CEO) of Goldman Sachs since 2018, Solomon is both a professional manager and a great leader. As a manager, Solomon is responsible for satisfying the board and shareholders, accomplishing operating activities, and designing timetables and budget plans. (Bennis and Nanus 2007). As an ‘engaged and motivating leader’, Solomon is responsible for developing and articulating the firm’s strategic vision, enhancing the firm’s culture, and motivating all employees to achieve goals together (Goldman Sachs 2020).

Solomon has broken the popular stereotype of the Wall Street elites, because he ‘takes the subway to work, gets his own coffee, and has a side hustle as a DJ’ (CNBC 2019). According to these behaviours and from a personality perspective (Northouse 2015), Solomon’s leadership is a combination of unique characteristics – born ordinary, friendly, and energetic. Base on these approachable traits, Solomon motivates employees mainly by exerting referent power and showing charisma (Kudisch et al. 1995). Besides, From the process view of leadership (Bass 2008), Solomon is at the

centre of company change and embodies the will of the company, just as he said ‘Fundamental change takes time, but if we’re rigorous in our execution of incremental change, we will make it happen. We are committed to that.’ (Goldman Sachs 2018).

### **1.3 The Organizational Mission and Vision**

For the whole company, Solomon mentioned that Goldman Sachs’s goal is to be the employer of choice to all, because ‘it is important for our business, our clients, and our people’ (Goldman Sachs 2019).

For the gender issue, Goldman Sachs is devoted to improving the situation of women, including female candidates, women in the workplace, and external female entrepreneurs who will potentially be invested by Goldman Sachs. Firstly, as a global firm, the advancement of female employees in the workplace is top of mind for the management committee. Goldman Sachs is committed to ensuring that women occupy at least 30 percent of the senior positions (vice president and above) by 2023 (Goldman Sachs 2020). Secondly, during the 2020 annual university hiring in the UK, Goldman Sachs aims to achieve at least half of its new recruits to be women (Goldman Sachs 2020). Finally, Goldman Sachs promises to provide more female entrepreneurs with professional business education and access to capital (Goldman Sachs 2019).

### **1.4. Structure of the Essay**

The essay mainly discusses the leadership of David M. Solomon, the CEO of Goldman Sachs, in facing the challenge of gender gap/inequality. This chapter briefly introduces Goldman Sachs, its vision toward mitigating the gender gap, and Solomon’s leadership role. Following chapter 2 analyses Solomon’s leadership style and elucidates the challenge of gender gap/inequality. Then chapter 3 delineates how Solomon leads Goldman Sachs to deal with the challenge. Finally, some suggestions for Solomon regarding this challenge is presented in chapter 4 as the conclusion.

## **2. The Leadership Style of Solomon and the Challenge he faces**

### **2.1. The Leadership Style of Solomon**

Solomon's leadership style is complex and can be analysed through various theories. In terms of traits/characteristics, Solomon is an engaged and motivating leader who embodies the firm's culture, a strategic thinker with deep business insight and industry expertise, and a social expert by actively engaging with employees, clients, investors, and other constituents (Goldman Sachs 2020).

According to the skills approach (Katz 1955), Solomon's leadership relies more on human skill and conceptual skill against technical skill. As a CEO, Solomon need to create visions and strategic plans for the company, i.e., conceptual skill, and to create and maintain a comfortable and secure working environment where employees can feel motivated, i.e., human skill, but he need less technical skills because he can depend on skilled followers to handle technical issues (Northouse 2015).

Based on the situational approach (Blanchard et al. 2013), Solomon's leadership style is low supportive-low directive, i.e., delegating style. Solomon offers less support and direction to encourage employees' confidence and motivation toward achieving the goal, because employees at Goldman Sachs are all top talents who have graduated from top universities, passed several rounds of rigorous tests, and survived through fierce competitions (Endlich 2000). This means that the employees are extremely intelligent, full of energy, and competent for getting the job done the way they fit (Northouse 2015).

Furthermore, Solomon is an adaptive leader. Because he protects voices from below by welcoming colleges to knock on his door directly (CNBC 2019), and he believes that he is a good listener and that it is important to learn how to adapt when he gets something wrong (Business Insider 2019).

## 2.2. The Challenge that Solomon faces

One main challenge Solomon faces is the gender gap in leadership – a global phenomenon whereby women are disproportionately concentrated in lower-level and lower-authority leadership positions than men (Powell and Graves 2003). This gender gap embodies in two aspects – inside and outside of Goldman Sachs.

Internally, women are always underrepresented in senior positions of Goldman Sachs (Goldman Sachs 2020). Figure 1 shows the gender distribution across employees in two main entities of Goldman Sachs - Goldman Sachs International (**GSI**) and Goldman Sachs (UK) SVC. Limited (**GSUL**) - at the snapshot date, i.e., 5<sup>th</sup> April 2018. The employees are divided into four equally-sized quartiles according to their levels – quartile 4 includes the lowest-level analysts and associates, quartile 3 is mainly constituted by departmental vice-presidents (VPs), quartile 2 comprises regional managing-directors (MDs), and quartile 1 refers to those at the highest positions such as executive directors (EDs) and senior partners (Goldman Sachs 2019).

	GSI		GSUL	
	Women	Men	Women	Men
<b>Quartile 4 (lowest)</b>	57.1%	42.9%	52.1%	47.9%
<b>Quartile 3</b>	40.5%	59.5%	37.7%	62.3%
<b>Quartile 2</b>	30.0%	70.0%	34.7%	65.3%
<b>Quartile 1 (highest)</b>	18.1%	81.9%	22.4%	77.6%

Figure 1 - gender distribution across GSI and GSUL

Although women occupy more than half of the professional positions and medium-level management, they have fewer developmental opportunities at work than do men (Northouse 2015). Furthermore, the pay gap between women and men also exists at Goldman Sachs. Figure 2 shows the mean and median gender pay gap and bonus gap

for GSI and GSUL on 5<sup>th</sup> April 2018 (hourly pay) and in the 12-month reference period to 5<sup>th</sup> April 2018 (bonus) (Goldman Sachs 2019).

	GSI		GSUL	
	Mean	Median	Mean	Median
<b>Hourly Pay</b>	50.6%	35.5%	17.9%	19.5%
<b>Bonus Pay</b>	66.7%	68.9%	40.7%	35.8%

Figure 2 - the mean and median gender pay gap and bonus gap for GSI and GSUL

Externally, because investing and cultivating potential entrepreneurs is the main business for Goldman Sachs as an investment bank, the challenges faced by female entrepreneurs also need to be considered. Female entrepreneurs stimulate economic growth and create jobs, particularly in developing countries, where women own over one-third of small businesses. But their economic potential remains largely untapped – lots of women have no access to investments that their businesses need to thrive, and most banks lack the necessary strategy and expertise to meet the needs of women entrepreneurs (WEFO 2019).

### 2.3. The Consequences of the Challenge

Due to the gender gap, Goldman Sachs has a lower proportion of women than men in senior and management positions but a higher number of women than men in more junior roles (Goldman Sachs 2019). This issue leads to larger pay and bonus gap, strengthens the stereotype that women take care and men take charge (Hoyt and Chemers 2008), and causes the prejudice that women are less fit for the leadership positions. These gender biases are detrimental in the decision-making processes for selecting elite leaders. Because not only are the decision-makers influenced by the stereotypes that disadvantage women in the leading roles, but also they may succumb to homosocial reproduction – a tendency for the whole company to repeat and enhance

the prejudice (Kanter 1977). Besides, the gender gap can also directly affect women themselves – making women under significant pressure and be more aware of their gender and the accompanying stereotypes (Sekaquaptewa and Thompson 2003). Externally, the obstacles faced by female entrepreneurs limit the growth of their business and make Goldman Sachs miss considerable investment opportunities (WEOF 2019).

### **3. How Solomon Leads Goldman Sachs to deal with the Challenge**

Solomon has done a lot to improve the status of women since he took the CEO position. These efforts show his servant leadership – putting employees first and embracing their growth.

Firstly, he focuses on increasing the representation of women at senior-level positions where the real inequality lies (Goldman Sachs 2019). To solve this, Solomon pays attention to the earliest stages of recruitment to attract more women to the finance industry and ensure they have development opportunities as they progress through their careers (Goldman Sachs 2019). For example, he launched the Women's Leadership Camp - a multi-day camp introducing various opportunities at Goldman Sachs to women interested in the finance industry. The camp is targeting female undergraduates who are willing to join relevant career workshops, be familiar with the summer-intern recruiting process, and meet with members of the firm's Women Network (Goldman Sachs 2019). Solomon is devoted to improving the global proportion of women towards 50% across Goldman Sachs's global analyst intake by 2021 (The Washington Post 2019).

Secondly, Solomon insists on mitigating the gender pay gap by paying women and men in similar roles with similar performance equally. He requires that, at Goldman Sachs, the compensation is set by merit, not by gender or any other factor (Financial Times

2019). Solomon has led the human-resource team to spend significant time on this during the compensation process to ensure that their commitment to equal pay is upheld (Goldman Sachs 2019). Figure 3 provides the proportion of employees at GSI and GSUL who received a bonus in 2018 by gender (Goldman Sachs 2019). The outcome shows that, at Goldman Sachs, women have equal opportunity to gain bonus compared with men.

GSI		GSUL	
Women	Men	Women	Men
94.6%	93.9%	90.1%	89.5%

Figure 3 – proportion of employees who received a bonus in 2018

Besides, Solomon continues to hold himself responsible for creating a comfortable working environment where all employees can achieve their full potential and advance to the most senior positions in the firm (Goldman Sachs 2019). For women employees, he specially enhanced training on managing parental leave and introduced the availability of breast milk shipping for working mothers (Goldman Sachs 2019).

Furthermore, Solomon is leading Goldman Sachs to provide professional training, coaching, and social networking to female entrepreneurs. Solomon believes that investing in female entrepreneurs contributes to economic growth and stronger communities; therefore, he positively promotes the ongoing '10,000 Women' program, which aims to foster economic growth by providing worldwide female entrepreneurs with professional business education and access to capital (WEOF 2019).

#### 4. Suggestions

Solomon has led Goldman Sachs to achieve tangible progress in mitigating the gender gap and inequality. However, further methods can be taken to address this issue.

Firstly, it is essential to create a set of clear policies, procedures, and practices that inform all employees about the rules, help detect discrimination, handle women's complaints, and fairly discipline employees when necessary (Werner et al. 2016).

Secondly, the mentorship program – assign more women to senior positions and develop supportive mentoring relationships with junior-level female employees – can be useful for reducing the gender gap (Ensher and Murphy 2005). Related to the male-dominant finance industry, lots of female employees believe that having a senior female mentor is important to career success (Werner et al. 2016). A recent survey found that mentorship programs led by women are conducive to attracting female graduates (Gulf Intelligence 2014).

Besides, the company needs to provide professional training on enhancing women's negotiation power and restructuring negotiations to female advantage. At work, women should be trained to proactively negotiate for valued positions, bonus/benefits, resources, experiences, and job-protected maternity leaves. Additionally, training on how to negotiate for at-home issues is also necessary. Female employees need these skills to negotiate workload with husbands, team up with family members and friends, and even hire help when necessary (Bowles and McGinn 2005). To further balance the female gender role and the leadership role of women employees, training on building 'transformational leadership style' can be introduced for female employees. Because this style is not a markedly masculine style and links the leadership effectiveness with traditional feminine characteristics such as being supportive and considerate (Northouse 2015).

Finally, to help more female entrepreneurs, especially those who do not satisfy the investment requirements of Goldman Sachs, Goldman Sachs can help them to contact suitable external investment actively. When these businesses get external financing and grow large enough, Goldman Sachs can reinvest them to benefit both itself and the entrepreneurs (WEFO 2019).

## **5. Conclusion**

Gender inequality is a prevalent issue in the finance industry, where high-pressure and male-dominance are common. Since Solomon took his CEO position at Goldman Sachs, he has introduced a series of methods to improve the female status, mitigate gender gap, and help more female entrepreneurs. Although progress is being made, more actions need to be done. The company needs to offer more specialized training, for example, transformational leadership, towards women and to create further a more comfortable, fair, and non-bias working environment.

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# Chapter 5: Goldman Sachs: HRM Insight and Analysis

Before this book, part or all of the content of this article has been published in following academic journal:

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## **1. Introduction**

Goldman Sachs is a US-based leading global investment banking, securities, and investment management firm that provides a wide range of financial services to a substantial and diversified client base that includes individuals, corporations, and governments (Goldman Sachs 2020). The story of Goldman Sachs is a tale of international growth, entering new markets, and advancing economic opportunities for clients and communities around the world (Cohan 2011). Established in 1869, Goldman Sachs took its first step to becoming a global firm with London office opened in 1970. The firm began to open offices in several emerging markets in the 1990s, mirroring the expansion and integration of global financial markets. Officially opened in February of 1994, the firm's Beijing office marks the beginning of a permanent presence in mainland China (Goldman Sachs 2020). After having experienced various rises and falls and survived through many bad times over one and a half centuries, Goldman Sachs has nowadays become a financial giant on Wall Street and one of the most profitable organizations on this planet, managing 36,600 employees across 84 offices distributed in all major financial centers worldwide (Doyran 2017).

Goldman Sachs' human resource (HR) system can be described as polycentric, as it usually selects graduates from the best local universities for junior and medium positions from analysts to vice-presidents (VPs) and expatriates the best-experienced bankers and economists who have professional experience on Wall Street to their home countries for local senior positions such as managing directors (MDs) and executive directors (EDs). These directors regularly report to regional chairmen who are usually senior American partners (Yao et al. 2003). All Goldman Sachs' employees are extremely well paid and admired; for example, a Chinese VP's salary is nearly 100 times the average salary of Chinese white collars (Endlich 2000).

Although most of its employees are proud to say that 'I used to work at Goldman Sachs!' (Bidwell et al. 2015), Goldman Sachs is facing various challenges when managing its

human resources. Following chapters 2 to 5 separately elucidate four main issues with relevant recommendations/optimizing plans presented as the last section in each chapter. Finally, a general conclusion of this essay is drawn.

## 2. Issue-1: Work-life imbalance due to long working hours

### 2.1 Long working hours in Goldman Sachs

Goldman Sachs' employees, especially junior bankers, have long worked nearly 75 hours per week under extreme stress these years – a phenomenon that is ubiquitous in the investment banking industry, as shown in figure 1.

Average working hours by bank	2017	2018	2019	Percentage change
VTB	83	85	68	-18%
Moelis	83	84	81	-3%
Evercore	81	81	80	-1%
Perella Weinberg Partners	79	80	82	3%
Jefferies	78	79	78	0%
Rothschild	78	78	78	0%
Lazard	80	78	78	-3%
Credit Suisse	74	76	76	2%
Morgan Stanley	72	76	73	2%
Greenhill	74	75	76	3%
RBC Capital Markets	75	75	71	-6%
Goldman Sachs	72	75	75	-4%
PVT Partners	73	75	75	0%
Deutsche Bank	73	74	73	0%
Macquarie	75	74	74	-1%
Centerview Partners	75	74	79	5%
BAML	73	73	75	3%
UBS	73	73	73	0%
Barclays investment bank	72	73	72	1%
HSBC	73	73	74	1%

Source: Wall Street Oasis • Get the data • Embed



Figure 1: Average Working Hours by Banks (EFC 2020)

The situation was worse seven years ago – a ‘100 hours per week’ working culture is prevalent in Goldman Sachs (Daily Beast 2015). After a 21-year-old Merrill-Lynch intern in London died of an epileptic seizure after working 72 hours straight in 2013, Goldman Sachs began to pay attention to employees’ work-life balance – require all analysts and associates ‘go home before midnight, don’t come back before 7am, and to be out of the office on Saturdays (The Guardian 2015). Despite these efforts, Goldman Sachs’ current working pace – 75 hours per week – is significantly higher than the average working hours in any country, even tougher than the Chinese ‘996’ model, as shown in figure 2 below.

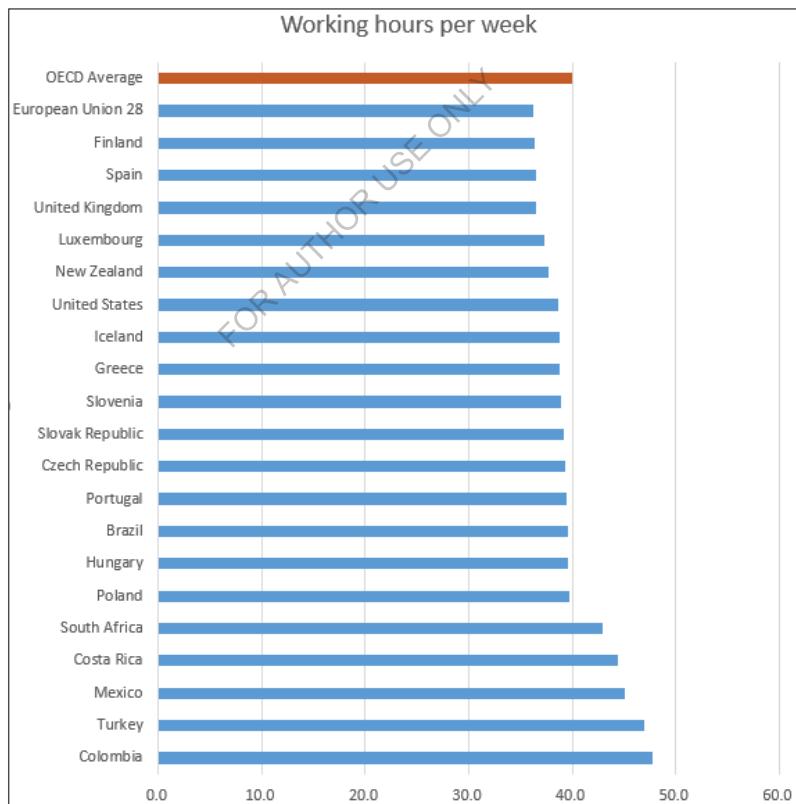


Figure 2: Average Working Hours per Week by Countries (OECD 2020)

The terrible work-life imbalance is causing exhaustion, sleeplessness, irregular diets, drug-addiction, mental problems, and even several deaths of these young employees barely in their twenties or thirties (Independent 2015). Although time is money in the investment banks, the unbearable 100-hours-a-week long working schedules, round-the-clock exhaustion, as well as mental and emotional diseases have started taking a veritable toll on this so-called tireless heart of this industry (DailyO 2015).

## **2.2 The importance of work-life balance**

Ensuring employees' work-life balance is critical for Goldman Sachs to remain competitive and attract more talents because the high pressure and subsequent mental or physical illnesses are causing absenteeism, high turnover, reduced motivation, and lower productivity (Wilkinson et al. 2017). In recent years, more and more talents leave Wall Street and choose to work at companies such as Google and Apple, where fertility treatments, on-site medical clinics, and health-tracking bracelets are offered as standard benefits (GOR 2018). Besides, work-life balance is becoming increasingly important as changes in the demographic structure have been significant, especially the greater participation of women in the labor market and the ageing of the population (Kodz et al. 2002). Furthermore, many governments have introduced a set of initiatives, policies, and laws to promote work-life balance (Kodz et al. 2002).

Despite the importance of work-life balance, Goldman Sachs is reluctant to go further to deal with this issue. The firm only made a weak attempt in 2013 to institute a new policy encouraging junior employees to leave the office by midnight and not to return until 7 am while also taking Saturdays off (The Guardian 2015). Employees at Goldman Sachs usually see themselves as 'slaves' of money, and the firm prefers to motivate and attract talents mainly by extremely higher pay, while this method is not always as efficient as it is thought to be (Gordon 2015).

### 2.3 Recommendations

To improve the level of work-life balance at Goldman Sachs, a work-life balance model can be introduced in figure 3. This model is based on the real-life good practices of successful organizations; these practices are grouped in the same tried and tested four principles framework of the Investors in People Standard, which has been used by thousands of organizations to improve their performance (IIP 2003).

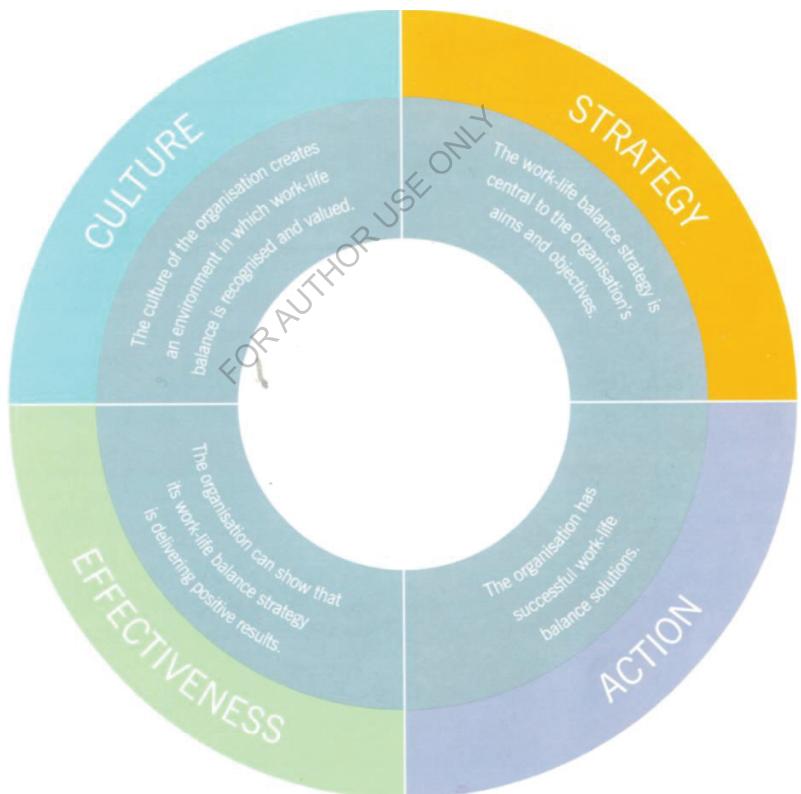


Figure 3: Work-life Balance Model (IIP 2003)

Referring to the four aspects in this model, the following recommendations can be adopted to address the work-life balance issue at Goldman Sachs.

### (1) Culture

Goldman Sachs' corporate value needs to incorporate work-life balance, which should be emphasized in global career fairs during recruitment and selection and be included in induction training.

### (2) Strategy

The work-life balance should be integrated into the firm's HR strategy and corporate strategy. It is essential to take account of all relevant parties when making these strategies and to ensure that the strategies reflect the different needs of employees across the company (IIP 2003). Only with the work flexibly available to everyone could the work-life balance become more than just rhetoric. In a survey conducted by IES, as shown in figure 4, most interviewees believe that work flexibility should be available to all employees rather than only to those with caring responsibilities such as working mothers and that work flexibility is conducive to improving the work productivity and the loyalty to employers (Kodz et al. 2002).

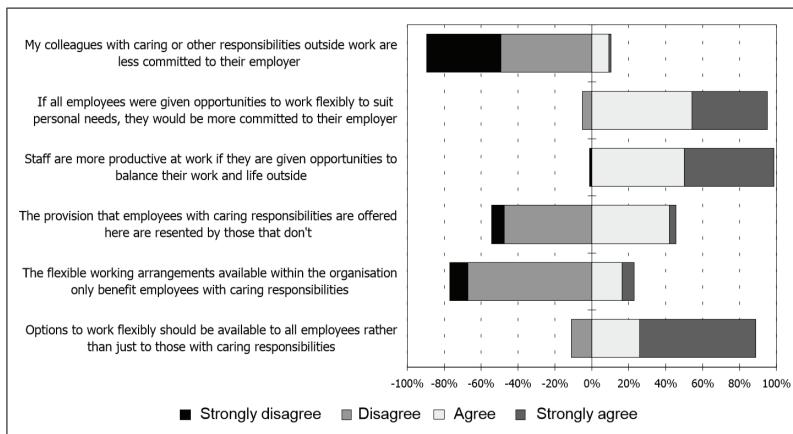


Figure 4: Views about employees taking up work-life balance and flexible working options (Kodz et al. 2002)

(3) Action

Goldman Sachs' HR department should provide sufficient training and guidance to line managers who are responsible for allocating workload to junior analysts and associates. A team's work-life balance level can be included in the performance-assessment system when appraising the line managers' performance (Kodz et al. 2002).

(4) Effectiveness

For maximizing the effectiveness of the work-life balance strategy, it is necessary to regularly monitor, evaluate, and adjust the selection, training, performance assessment, and compensation processes due to the possibility of unintended consequences when adding the complexity of the firm's HR system by including the work-life balance dimension (Werner et al. 2016).

### **3. Issue-2: The imminent culture clash in China**

#### **3.1 The culture clash faced by Goldman Sachs in China**

Goldman Sachs is a multinational corporation with employees increasingly comprised of various cultures and subcultures including diverse populations by nationality, religion, gender, age, etc. (Goldman Sachs 2019)). Goldman Sachs usually sends very senior American partners to be Chairmen in different continents as expatriates. But for senior positions under Chairman, Goldman Sachs usually recruits the third-country nationals (TCNs) or host country nationals (HCNs) who have work experience at Wall Street or London City (Endlich 2000). Although the HCNs are usually less expensive and more familiar with the social-economic, political and legal environment as well as business practices in the host country, they usually have communication difficulties in

dealing with home-office personnel and lack opportunities to gain promotion to headquarters. The TCNs are the best compromise between securing needed technical and managerial expertise and adapting to a foreign socio-economic and cultural environment as they are usually professional international business managers, but using TCNs is subject to the host country's sensitivity with respect to nationals of specific countries (Pinnington and Harzing 2015).

For the Chinese market, Goldman Sachs often recruits expatriates from the best Chinese investment bankers available in America; these expatriates usually graduated from a prestigious American university and have many-years of professional experience in global capital markets. However, most these expatriates are born in China and influenced profoundly by the Chinese working culture which is different from that in western countries. The culture clash is mainly caused by following three reasons (Yao et al. 2003):

- (1) The degree of shared beliefs, values, and norms are low.
- (2) The shared beliefs, values, and norms are highly localized within Goldman Sachs.
- (3) The shared beliefs, values, and norms lack a clear ordering.

These cultural differences are causing tensions, misunderstandings, and misinterpretations, which are harmful to Goldman Sachs and its relationship with China (Hodgetts and Luthans 2000). Therefore, one of the main challenges Goldman Sachs faces is how to keep its business going fluently in this non-English speaking and socialist country.

### **3.2 An overview of the corporate culture in Goldman Sachs**

The corporate culture is a set of shared values and beliefs that organization members have regarding the functioning and existence of their organization (Tushman and O'Reilly 1996). It is Goldman Sachs's superb corporate culture that sets the company apart from other rivals, attracts the best employees and clients, and creates a legend on Wall Street (Endlich 2000). Goldman Sachs's commitment to its clients, teamwork, professional excellence, integrity, and entrepreneurial spirits has its beginning in 1869 with the founder Marcus Goldman (Cohan 2011). Over 150 years, employees at Goldman Sachs have long take honesty and their responsibilities to the communities where they live and work very seriously (Mandis 2013). Additionally, Goldman Sachs's culture continues to evolve, and the '14 business principles' were introduced in the 1980s. As shown in figure 5 below, the fourteen principles comprehensively elucidate Goldman Sachs's corporate culture and work as a consistent measure for evaluating recruitment employees' performance (Goldman Sachs 2020).

1. **Our clients' interests always come first.** Our experience shows that if we serve our clients well, our own success will follow.
2. **Our assets are our people, capital and reputation.** If any of these is ever diminished, the last is the most difficult to restore. We are dedicated to complying fully with the letter and spirit of the laws, rules and ethical principles that govern us. Our continued success depends upon unwavering adherence to this standard.
3. **Our goal is to provide superior returns to our shareholders.** Profitability is critical to achieving superior returns, building our capital, and attracting and keeping our best people. Significant employee stock ownership aligns the interests of our employees and our shareholders.
4. **We take great pride in the professional quality of our work.** We have an uncompromising determination to achieve excellence in everything we undertake. Though we may be involved in a wide variety and heavy volume of activity, we would, if it came to a choice, rather be best than biggest.
5. **We stress creativity and imagination in everything we do.** While recognizing that the old way may still be the best way, we constantly strive to find a better solution to a client's problems. We pride ourselves on having pioneered many of the practices and techniques that have become standard in the industry.
6. **We make an unusual effort to identify and recruit the very best person for every job.** Although our activities are measured in billions of dollars, we select our people one by one. In a service business, we know that without the best people, we cannot be the best firm.
7. **We offer our people the opportunity to move ahead more rapidly than is possible at most other places.** Advancement depends on merit and we have yet to find the limits to the responsibility our best people are able to assume. For us to be successful, our men and women must reflect the diversity of the communities and cultures in which we operate. That means we must attract, retain and motivate people from many backgrounds and perspectives. Being diverse is not optional; it is what we must be.
8. **We stress teamwork in everything we do.** While individual creativity is always encouraged, we have found that team effort often produces the best results. We have no room for those who put their personal interests ahead of the interests of the firm and its clients.
9. **The dedication of our people to the firm and the intense effort they give their jobs** are greater than one finds in most other organizations. We think that this is an important part of our success.
10. **We consider our size an asset that we try hard to preserve.** We want to be big enough to undertake the largest project that any of our clients could contemplate, yet small enough to maintain the loyalty, the intimacy and the esprit de corps that we all treasure and that contribute greatly to our success.
11. **We constantly strive to anticipate the rapidly changing needs of our clients and to develop new services to meet those needs.** We know that the world of finance will not stand still and that complacency can lead to extinction.
12. **We regularly receive confidential information as part of our normal client relationships.** To breach a confidence or to use confidential information improperly or carelessly would be unthinkable.
13. **Our business is highly competitive, and we aggressively seek to expand our client relationships.** However, we must always be fair competitors and must never denigrate other firms.
14. **Integrity and honesty are at the heart of our business.** We expect our people to maintain high ethical standards in everything they do, both in their work for the firm and in their personal lives.

### 3.3 Comparison of Goldman Sachs' corporate culture with the Chinese culture

Hofstede's culture framework is conducive to analyzing Goldman Sachs' corporate culture, which is different from the Chinese culture according to the following five dimensions:



Figure 6: Cultural Comparison by Countries (Hofstede 2020)

#### (1) Power Distance

Power distance in Goldman Sachs is low because it is a typical company based in America where the power distance is low, as shown in above figure 6. Goldman Sachs is devoted to creating a family-feeling and collegial atmosphere for employees (Mandis 2013). The low power distance is also reflected in Goldman Sachs' 8<sup>th</sup> principle presented in figure 5 – extremely emphasize on the group work in every task.

However, the power distance is large in China. The Chinese accept inequalities but feel that power should be moderated by obligations (Hofstede Insight 2020). Besides, the seniority and titles are important in China. The Chinese employees will hesitate to follow an expatriate expert's order if the expatriate is younger and has a lower status than the Chinese staff (Tong 2016).

#### (2) Uncertainty Avoidance

According to the 5<sup>th</sup> and 8<sup>th</sup> principles of Goldman Sachs, the company is highly risk-averse, because its employees are expected to use traditional and standard techniques

or practices to handle clients' problems, and it is unacceptable to put personal interest ahead of the interest of group or firm. Goldman Sachs' negative attitude towards risk and uncertainty can also attribute to the huge risk inherent in the investment-banking business per se.

However, the Chinese are comfortable with ambiguity; the Chinese language is full of ambiguous meanings that can be difficult for Western people to follow. Furthermore, the Chinese are adaptable and entrepreneurial; since the reform and opening-up in 1978, there are more and more small-medium enterprises (SMEs) that make their business success thanks to the less regulation from government and the social-development uncertainty (Hofstede Insight 2020).

### (3) Collectivism-Individualism

Although America is an individualism-oriented country, Goldman Sachs is an opposite. Referring to the 8<sup>th</sup> and 9<sup>th</sup> principles in figure 5, Goldman Sachs is a collectivist organization that encourages teamwork in all business activities. In Goldman Sachs, there is no place to show personal glory, and employees are encouraged to say 'we' instead of 'I' (Endlich 2000).

The Chinese culture is also collectivistic but different from Goldman Sachs' culture. In China, employees' commitment to the organization is low, while they are cooperative in small groups and are cold even hostile to those out of their group (Bond 1986). Therefore, the collectivism of Goldman Sachs embodies that employees work together towards the company's benefit, but most Chinese prioritize the interests of their small groups, not the whole company.

### (4) Masculinity-Femininity

Commensurate with the American culture, Goldman Sachs' culture is very masculine. Most of the 14 principles in figure 5 emphasize achievement, success, profitability, and leadership in business. In Goldman Sachs, employees are encouraged to put intense effort for becoming the best (Goldman 2019). Just as a former HR vice-president said, 'Goldman Sachs demands that you be a contributor. No one can survive as just an employee' (Endlich 2000).

China is also a masculine society, i.e., success-oriented (Hofstede Insight 2020). Many Chinese sacrifice family and leisure priorities to work in pursuit of business success (Li 2019). Therefore, the culture of Goldman Sachs and the Chinese culture

is somehow similar in this dimension; the similarity is conducive to Goldman Sachs' business development in China.

#### (5) Long-term/Short-term thinking

Although America ranks low in the long-term oriented dimension, Goldman Sachs is an exception. The success of Goldman Sachs can be ascribed to the firm's dual strategy – focusing on both clients' short term demands and the future (Endlich 2000).

A former senior partner Gus Levy created a legendary term to describe Goldman Sachs' culture – 'Greedy but long-term greedy' (Levitt 2005).

China is a 'Confucian' and long-term oriented society where people believe that truth depends very much on situation, context, and time (Lee et al. 2018). But the Chinese long-term thinking is more intuitive and synthetic – put things together to form a whole picture – than western thinking that is usually based on analysis (Biao 2002). Goldman Sachs may face conflicts when making a long-term plan to develop a valuable business in china at any cost because most Chinese executives only focus on short-term profits and interests within their tenures (Yao et al. 2003).

### **3.4 Recommendations**

Goldman Sachs can try to mitigate the negative influence caused by culture shock through careful selecting expatriates and provide targeted training. For selection, the firm should focus on those who have a good understanding of China and are good at developing close personal relationships with various partners. These characteristics should also be included in the performance assessment of these expatriates. Besides, Goldman Sachs is responsible for providing expatriates to China with training including knowledge of the norms and values in China, the necessary Chinese language in business, the concept of 'face' culture, etc. (Yao et al. 2003).

## 4. Issue-3: Low retention and high turnover rate of the Chinese employees

### 4.1 Who left and where they went

Compared with their local peers, the Chinese employees at Goldman Sachs are extremely highly paid. In essence, the annual salary is over 1 million USD for EDs, 200,000 USD for VPs and associates, and around 60,000 USD for junior analysts (Yao et al. 2003). So the hygiene factors (Herzberg et al. 1959) and the physical, safety, and social needs of them have already been satisfied, and their demands are now at the fourth stage, i.e., the need of esteem, according to Maslow's hierarchy of needs as shown in figure 7.



Figure 7: Maslow's Hierarchy of Needs (Maslow 1943)

However, many Chinese at senior positions such as executive director (ED) in Goldman Sachs left the company and got promoted as partner-level executives in large state-owned banks. Their demission usually makes Goldman Sachs take at least half a year to find other suitable candidates and to rebuild its client-network in China (Yao et al. 2003). For medium level managers such as VPs who are usually Chinese MBA educated in top American business schools and recruited on Wall Street, most of them leave Goldman Sachs after working four to five years with few promotion opportunities and launch private investment companies or work as managing directors in second-tier local players (Mandis 2013). For low-tier analysts in China who are graduated from the top 4 Chinese universities, they usually leave the company

after three years to pursue an MBA degree as a professional break and promotion springboard (Financial Times 2015).

## 4.2 The reason analysis based on motivation theories

The low retention rate of Chinese employees in Goldman Sachs can be attributed to seeking for higher-level esteem and lacking motivation towards current positions. These are caused by the following four reasons:

### (1) Glass ceiling

In Goldman Sachs, only senior partners above EDs have the right to develop new business directly with clients. The China EDs/MDs, through sounds prestigious, virtually is merely a task carrier or a relationship keeper, and their work experience in the China capital market is not sufficient to help them be promoted to be board members (Mandis 2013). Therefore, after decades of work at Goldman Sachs, the Chinese executives have already accumulated enough wealth and are no longer satisfied with the relatively low-esteem status. Most of them choose to be entrepreneurs or be promoted and assigned more responsibilities in local highly-recognized institutions where they can fulfill the authority needs - to be influential, useful, and make a difference (McClelland 1958).

### (2) Seeking social status and political interests

It is natural for any person to assume senior social responsibilities when rich enough. In recent years, the Chinese government welcomes senior bankers from American big-names and recruits them as prestigious officials for the Chinese emerging capital market (Yao et al. 2003). These methods stimulate the Chinese EDs/MDs of Goldman Sachs to resign in pursue of higher social status to realize self-actualization, i.e., achieving their full potential.

### (3) Health and family issues

Firstly, the Chinese traditionally cherish family relations. The Chinese managers usually need to focus more on their families after entering into their 30s when their children are born, and their parents are retired and need more care (Zhang et al. 2018). Besides, managers over 35 become relatively economic independence and pay more attention to hygiene factors such as health and work-life balance, rather than continue

working in the Goldman Sachs' way – 14 hours a day, one-third of a year in the air (Mandis 2013).

(4) Weak professional perspective as a repatriate back to America

Jewish white males dominate the upper-echelon on Wall Street, and few Chinese can be renowned. Besides, because China is an emerging and immature capital market, the professional experience in China is not as recognized as those work in America, Japan, and Japan (Doyran 2017). This phenomenon makes it hard for Chinese expatriates to be recognized by colleagues or headhunters in America after their repatriation (Yao et al. 2003). Therefore, they leave Goldman Sachs and switch to organizations where they can fulfill their esteem and self-actualization needs.

### **4.3 Recommendations**

To motivate more Chinese employees to stay at and contribute more to the company, Goldman Sachs need to provide them and their families with more support beyond the high salary – for example, maternity and paternity leave, access to international schools for their children, high-quality nursing home care for the old, etc. (Hollinshead 2010). Besides, a diverse and inclusive appraisal system should be established to create opportunities for senior executives from emerging markets to be promoted to Goldman Sachs' headquarter in America.

## **5. Issue-4: The underrepresentation of female employees**

### **5.1 Male-dominated situation and the consequences**

One main challenge that Goldman Sachs faces is the gender gap, i.e., the proportion of female employees is lower in senior and management roles but higher in junior positions than male employees (Powell and Graves 2003). In figure 8, the employees of two main entities of Goldman Sachs – Goldman Sachs International (GSI) and Goldman Sachs (UK) SVC. Limited (GSUL) – are divided into four equally sized quartiles according to the position level from 1 (highest position) to 4 (lowest position) (Goldman Sachs 2019).

	GSI		GSUL	
	Women	Men	Women	Men
<b>Quartile 4 (lowest)</b>	57.1%	42.9%	52.1%	47.9%
<b>Quartile 3</b>	40.5%	59.5%	37.7%	62.3%
<b>Quartile 2</b>	30.0%	70.0%	34.7%	65.3%
<b>Quartile 1 (highest)</b>	18.1%	81.9%	22.4%	77.6%

Figure 8: Percentage of Women and Men in Different Position Levels at GSI and GSUL (Goldman Sachs 2019)

The figure was snapshotted on 5<sup>th</sup> April 2018 and shows that women are disproportionately underrepresented in senior positions than men. Although female employees occupy half of the medium-level positions, they have fewer development opportunities at work than do male colleagues (Northouse 2015). Moreover, the pay gap between women and men also exists in Goldman Sachs, as shown in figure 9, which demonstrates the mean and median gender pay gap, at the snapshot date of 5<sup>th</sup> April 2018, and bonus gap, in the 12 month reference period to 5<sup>th</sup> April 2018, for employees in GSI and GSUL (Goldman Sachs 2019).

	GSI		GSUL	
	Mean	Median	Mean	Median
<b>Hourly Pay</b>	50.6%	35.5%	17.9%	19.5%
<b>Bonus Pay</b>	66.7%	68.9%	40.7%	35.8%

Figure 9: The Mean and Median Gender Pay Gap and Bonus Gap (Goldman Sachs 2019)

The gender gap is detrimental to Goldman Sachs because, firstly, it may lead to the bias that women are less competent for senior positions and enhance the stereotype that women take care and men take charge (Hoyt and Chemers 2008). These prejudices are harmful to selecting senior managers, because not only the HR teams may be influenced by the stereotypes that disadvantage women in senior positions but also they may succumb to homosocial reproduction – a tendency for the whole company to repeat and strengthen the prejudice (Kanter 1977). Furthermore, the gender gap can also directly affect female employees

themselves – bring them immense psychological pressures and causing them more sensitive to their gender and accompanying stereotypes (Sekaquaptewa and Thompson 2003).

## 5.2 How Goldman Sachs promotes female status through HRM

Goldman Sachs is devoted to mitigating the gender gap, eliminate gender discrimination, and improve the status of female employees. Firstly and most importantly, Goldman Sachs is trying to increase the representation of women at senior levels where the real imbalance lies, with particular focus on attracting more women to the finance industry at the earliest recruitment and selection process and ensuring the female employees receive fair development opportunities as they progress through their career (Goldman Sachs 2019). For example, Goldman Sachs launches the annual Women's Leadership Camp – a multi-day camp targeting penultimate-year female students who are interested in financial services, introducing them to the vast opportunities at Goldman Sachs, and navigating them to finish the summer-intern recruiting process, to participate in career workshops, and to meet with members of Goldman Sachs's women network (Goldman Sachs 2020).

Secondly, to mitigate the gender pay gap, Goldman Sachs insists on paying female and male employees in similar roles with similar performance equally, i.e., the compensation and benefits are set by performance and merit, not by gender (Financial Times 2019). Figure 10 and 11 below present the proportion of employees at GSI and GSUL that received a bonus in 2017 and 2018 by gender (Goldman Sachs 2019). The outcome shows that, compared with men, women have equal opportunity to gain the bonus at Goldman Sachs.

GSI		GSUL	
Women	Men	Women	Men
94.6%	93.9%	90.1%	89.5%

Figure 10: The Percentage of Employees at GSI and GSUL that Received a Bonus in 2018 (Goldman Sachs 2019)

GSI		GSUL	
Women	Men	Women	Men
95.8%	95.1%	94.7%	95.1%

Figure 11: The Percentage of Employees at GSI and GSUL that Received a Bonus in 2017 (Goldman Sachs 2019)

Moreover, Goldman Sachs is always committed to creating a comfortable and decent working environment to ensure that female employees can achieve their full potential and advance to the most senior positions in the firm (Goldman Sachs 2019). Finally, Goldman Sachs highlights the work-life balance and well-being of female employees, for example, providing training on managing parental leave and the availability of breast milk shipping for working mothers (Goldman Sachs 2019).

### 5.3 Recommendations

Although Goldman Sachs has made considerable achievements in mitigating the gender gap and inequality, more methods can be introduced to deal with the issue.

Firstly, the firm should systematically detect the root reasons for the existing gender gap. As shown in figure 12 below, the Oaxaca Decomposition (Oaxaca 1973) can be used for detecting whether discrimination or skills gap exists.

**Definition of parameters:**

$w_M, w_W$  : Male wage and female wage separately

$s_M, s_W$  : School level of men and women separately

$\alpha_M, \alpha_W$  : The intercept – wage for men and women with zero years of schooling separately

$\beta_M, \beta_W$  : Coefficient of schooling – the change of wage for increasing a unit period of schooling

$\Delta\bar{w}$  : The raw mean wage differential for similar positions

$w_w^*$  : Wage of women if they were equally treated ‘like a man’

**Functions:**

$$\text{Male earnings function: } w_M = \alpha_M + \beta_M * s_M \quad (1)$$

$$\text{Female earnings function: } w_W = \alpha_W + \beta_W * s_W \quad (2)$$

$$(1) - (2): \Delta\bar{w} = \bar{w}_M - \bar{w}_W = (\underbrace{\alpha_M - \alpha_W}_{(4)} + \underbrace{(\beta_M - \beta_W) * \bar{s}_W}_{(5)} + \beta_M * (\bar{s}_M - \bar{s}_W)) \quad (3)$$

(4): Differential due to discrimination

(5): Differential due to differences in skills

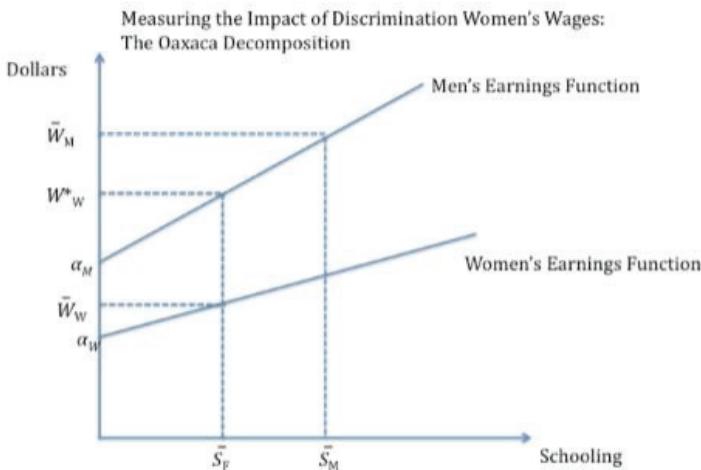
**Diagram of the Oaxaca Decomposition:**

Figure 12: Oaxaca Decomposition (Oaxaca 1973)

Based on the decomposition function, the average wage of different positions at Goldman Sachs can be calculated. If  $w_w^* \neq \bar{w}_w$ , i.e., women gain less than men for similar jobs, the discrimination exists, and this can be solved by insisting the performance-based compensation system, setting clear policies, practices, and procedures to inform all employees about gender equity, handling complaints from female employees, and punishing violation behaviors when necessary (Werner et al. 2016). The difference  $(\bar{w}_M - w_F^*)$  is attributable to the skill differences between men and women, and this can be addressed by providing additional training for female employees, especially on leadership and management.

Besides, a mentorship program can be introduced to reduce the gender gap by assigning more women to senior positions and developing supportive mentor relationships with those in junior positions (Ensher and Murphy 2005). Recent studies have found that firms developing mentorship programs led by women can attract more female graduates (Gulf Intelligence 2014), and that most female employees believe that having a senior female mentor is conducive to career success.

Furthermore, the status of female employees and their level of work-life balance can be improved by providing professional training on improving women's negotiation skills and how to restructure negotiations to female advantage. For example, women can be trained to proactively negotiate with their employers about valued positions, bonus/benefits, and job-protected maternity leaves and to negotiate with their husbands and family members about the family responsibilities and the workload of housework (Bowles and McGinn 2005).

## 6. Conclusion

Overall, Goldman Sachs is facing several HR challenges, which include but are not limited to the work-life imbalance, the underrepresentation of female employees, the culture conflicted when sending expatriates to China, and the high turnover rate of Chinese employees. All the four issues discussed above are presented as discrete areas with defined focuses, while, in practice, they overlap and interact in ways that cannot be detailed. For example, the underrepresentation of women reflects the company's corporate culture, and the low retention rate is partly caused by the work-life imbalance. To optimize the firm's HR management and

to attract more global talents, Goldman Sachs needs to focus more on employees' work-life balance, to provide sufficient training on host countries' culture, and to create relatively fair opportunities for promotion towards employees from emerging markets and women. Besides, it is indispensable to integrate the HR strategy into the firm's corporate strategy to maximize the effectiveness of main HR activities such as staffing, training, performance management, as well as compensation and benefits management. Furthermore, continually monitoring and evaluating these activities and the outcomes, for example, the percentage of women in the recruitment, will go a long way in improving the HRM system so that it is as effective as it is designed, as long as reasonable adjustments are made based on the evaluations.

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# Chapter 6: Analysis on time and cost efficiency of using autonomous vehicles for the last-mile delivery

Before this book, part or all of the content of this article has been published in following academic journal:

Xuan Feng (2021). Time and Cost Efficiency of Autonomous Vehicles in the Last-Mile Delivery: A UK Case. *International Business Research*. Volume 14, Issue 3, Pages 26-40

# **1. Introduction**

## **1.1 Background and context**

In recent years, last-mile delivery has become an increasingly important area in the global supply chain. This was made possible by the development of e-commerce. A research conducted by McKinsey & Company (2016) concluded that the biggest driver of the growth of the last-mile delivery, not surprisingly, is e-commerce, which has shifted market share from the business-to-business (B2B) to the business-to-customer (B2C) segment (Joerss et al. 2016). The global e-commerce market continues to grow at a double-digit pace (Digital Commerce 360 2015). With this growth comes a great opportunity for expansion in the market for product delivery (Lee et al. 2016: 2). Besides e-commerce, Industry 4.0 also plays a vital role in the boom of last-mile delivery.

Recent developments in the last-mile delivery industry have heightened the need for higher efficiency. Industry 4.0, a German concept of smart production and logistics, aims at comprising energy and resource efficiency, increased productivity, shorten of innovation, and time-to-market cycles. (Hoffmann and Prause 2018: 1). Thanks to the development of Industry 4.0, the low-efficiency problem of the last-mile delivery can be dealt with innovative ideas (Ranieri et al. 2018: 1). Central to the creative solutions for improving both time and cost efficiency is the concept of using autonomous vehicles/robots.

Practically, there has been an increasing worldwide interest in developing the last-mile delivery robots/vehicles to increase the efficiency of the whole supply chain. Estonia plays a leading role in this field with its start-up, Starship Technologies, which focuses on providing a promising solution to solve the last-mile delivery problem (Hoffmann and Prause 2018: 1). In September 2016, the start-up announced a strategic partnership with Mercedes-Benz Vans, a German truck producer, to develop the ‘Robovans’ – a truck-based autonomous-robots model for delivery (Estonian World 2016). This model, indeed, realizes the ‘hub and spoke’ concept – a well-known standard model in logistics – and creates a smart solution for bridging longer distances of delivery (Hoffmann and Prause 2018: 6).

China is also an important player in the area of autonomous delivery robots, as the largest e-commerce platform by revenue, JD.com, conducted its first trial in autonomous driving vehicles for last-mile delivery on June 18, 2017, at Renmin University, Beijing. The vehicle delivered about 10 packages in approximately six hours. JD subsequently deployed

approximately 60 autonomous driving vehicles for last-mile delivery at Beijing, Xian, and Hangzhou for pilot AI-based package delivery (Xia and Yang 2018: 4).

Other leading companies developing delivery robots include SideWalk, which has already conducted pilot projects with DHL in Lithuania, and Dispatch, which is formed by MIT and University of Pennsylvania experts (Lee et al. 2016: 14).

Theoretically, several researchers have suggested that using autonomous robots brings more efficiency for delivery. However, there remain uncertainties about this aspect which the project seeks to address.

## 1.2 Research Aim and Objectives

The goal of this study is to investigate whether and how autonomous vehicles/robots can address the issue of cost and time efficiency. Specifically, this research aims at identifying the time and cost structures of using autonomous vehicles for the delivery along the chosen route – a single way from the Sainsbury's supermarket to the Amazon pick-up station at Coventry, as shown in figure 1-1. Furthermore, the research aims to find whether using autonomous vehicles is more efficient in time and/or cost than using vans with drivers for this route.

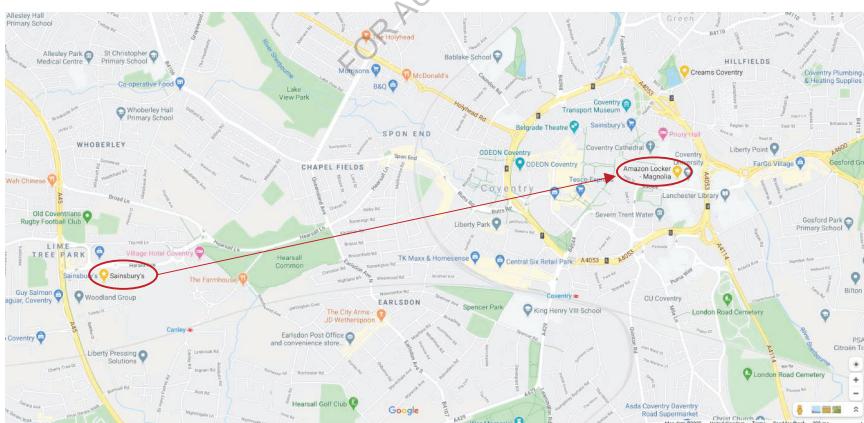


Figure 1-1: The route chosen for this research (Google Map 2020)

The project will try to achieve the following objectives:

- (1) To identify and visualize the chosen delivery route.

- (2) To build time and cost models for both using autonomous vehicles and using manned trucks.
- (3) To analyse the time and cost efficiency of using autonomous vehicles.
- (4) To provide some recommendations on the way for further researches to improve the research value for business practice potentially.

### **1.3 Outline of the Structure**

The research develops in the following outline. It first briefly introduces the background of the last-mile delivery and lists the research objectives. Following that, the literature-review section presents the concept of last-mile delivery and the current research achievements about cost and time efficiency of autonomous delivery vehicles. In light of these previous studies, the essay then moves into more detailed methodologies about the analysis of cost and time efficiency of using autonomous delivery vehicles on the chosen route. The research strategies and underlying rationales are elucidated in the section of methodology, and the key findings are discussed and summarized in the following section commensurately. Finally, the section of the conclusion reviews the whole project, raises criticisms for the research, and discusses the implication of the findings to future research and real business practice in the area of last-mile delivery.

## **2. Literature Review**

The literature review mainly presents current studies focusing on the niche fragment of autonomous/self-driving package delivery vehicles that are used for the last-mile delivery in the context of Industry 4.0 and the E-commerce boom worldwide. Section 2.1 introduces the concept of last-mile delivery. This section also provides the main challenges faced by the last-mile delivery and shows why autonomous delivery vehicles are proposed as a potential solution to these challenges. The following sections 2.2 demonstrates the time-efficiency and cost-saving advantages of introducing autonomous vehicles/robots. In addition to its advantages, using autonomous vehicles/robots has several weaknesses, which are elucidated in section 2.3. Finally, section 2.4 summarizes the literature and introduces the next-step research in this field.

### **2.1 The Last-mile Concept**

Dablanc et al. (2013: 4) defined the last-mile delivery as ‘the final haul of a shipment to its end receiver, be it a shop, a business, a facility or a residence in case of home deliveries’. Specifically, under the rising e-commerce environment, the last-mile delivery can be defined as ‘the last stretch of B2C parcel delivery to the final consignee who has to take reception of the goods at home or at a cluster/collection point.’ (Gevaers et al. 2009: 2). In a nutshell, the last-mile delivery represents the last part of the supply chain where parcels ordered online are delivered from hubs, such as supermarkets and urban warehouses, to final destinations, i.e., customers’ hands or self-pickup stations.

A Stanford research identified that one important feature of the last-mile delivery is that it generally involves three parties — customers, merchants, and delivery providers — each with their own set of expectations and challenges (Lee et al. 2016: 14). The customers have an increasingly complex set of expectations regarding the speed, flexibility, security, and cost of delivery (Lee et al. 2016: 14). A Temando report shows that most customers prefer same-day delivery and deliveries on weekends or after business hours when they are home to avoid exposure of their parcels to bad weather and potential theft (Temando 2016). Besides, customers do not want to pay much for the deliveries. A Deloitte survey concluded that free shipping is even more important to customers than fast shipping (Deloitte 2015).

As for merchants, consumer preferences have grown increasingly important in the formerly business-oriented parcel-delivery market with the rise of e-commerce. Vendors have identified last-mile services as a key differentiator and are working hard to offer the best customer

experience possible, especially by reducing delivery times and operation costs (Joerss et al. 2016). However, many retailers cannot provide same-day delivery or store pickup, which are valued by consumers.

For delivery providers, their challenges are how to profitably meet the complex expectations of consumers and merchants (Lee et al. 2016: 14). To meet these expectations, providers need to offer flexible service base on technology innovations (Lowe and Rigby 2014), and meanwhile, they need to efficiently manage the delivery costs and peak times (Stevens 2015). Another challenge for providers is how to deliver poorly packaged goods, which cause problems for providers and negatively affect the merchants because they need to bear the cost of return items (Lowe and Rigby 2014).

Therefore, the main development direction of the last mile delivery is for merchants and providers to provide an efficient service for customers, to reduce delivery time and operation cost, and to maximize profit. This vision is also one of the important themes that lead to the new idea of the city, the smart city, where an efficient and sustainable use of resources can be created through the development of new mobility systems and services under the background of Industry 4.0 (Ranieri et al. 2018: 1-3). However, the current last-mile delivery is usually considered to be the most inefficient due to its specificities such as a spatial distribution of relatively small receiving points, demands for more frequent but smaller shipments, delivery time windows, etc. (Masa Slabinac 2015: 111).

## **2.2 Advantages of Delivery Vehicles/Robots**

The aspiration of developing delivery robots is to achieve fast, cheap, and flexible delivery (L. Lee et al. 2016). As Ahti Heinla, CEO of Starship Technologies – a leading delivery-robots company created by founding engineers of Skype, said, Starship's vision 'revolves around three zeroes — zero cost, zero waiting time, and zero environmental impact. We want to do to local deliveries what Skype did to telecommunications.' (The New York Times 2015). In this section, the following paragraphs summarize several studies that have been conducted to investigate the advantages of time and the cost efficiency if using autonomous delivery vehicles/robots.

### **2.2.1 Time Efficiency**

Recent studies have shown the time efficiency of using autonomous delivery vehicles/robots according to the delay of the delivery process and the accuracy of delivery windows.

In a research conducted by Boysen et al. (2018), they analysed the delay extent of the delivery process of using autonomous delivery vehicles/robots compared with using delivery trucks with drivers, with the delay extent manifested by the number of late deliveries. The researchers introduced a practical autonomous delivery model - the ‘robots to depot’ model (R2D): the driverless delivery vehicles/robots are carried by a platform - i.e., a truck, to get into the intercity releasing site, then the platform releases them to delivery couriers to customers. After delivering the parcels to customers, the autonomous vehicles/robots will go to specific depots for further collecting. The researchers built mathematic models for the number of late deliveries of using the R2D model and compared the calculation results with those of the status quo. The research finding shows that compared with the traditional way of using drivers and deliverymen, the autonomous delivery model considerably decreases the number of late deliveries, and that to reach the same service level as R2D model, at least 3 more times of deliverymen are required if no autonomous vehicles/robots are deployed (Boysen et al. 2018: 1096).

As for the time of delivery windows, a qualitative research conducted by Hoffmann and Prause (2018) mentions that autonomous delivery provides a 15-to-20 min delivery window as standard - much more precise than the traditional manned delivery that so far is only able to provide a general date (calendar day) beforehand (Hoffmann and Prause 2018: 4).

### **2.2.2 Cost Efficiency**

Much of the current literature on the cost efficiency of using autonomous delivery vehicles/robots pay particular attention to the manufacturing cost, labour cost, and operation cost. The philosophy of most existing researches on cost efficiency is interpretivism, which emphasizes qualitative analysis rather than quantitative analysis (Ryan 2018). Their research strategy is documentary research, which refers to using personal and official documents as the original data. Documents include but are not limited to newspapers, publications, even tapes, and computer files (Kiss 2019).

One cost efficiency is that the investment and manufacturing cost of autonomous vehicles/robots is less than the labour cost of using drivers and deliverymen, but this advantage only exists in developed countries where labour costs are high enough to make the return on

investment significant (Joerss et al. 2016). In the same vein, because of the claims of Starship CEO Ahti Heinla that their robots would cost no more than 1\$ for each delivery when deployed (CNBC 2015), Hoffmann and Prause (2018) emphasize the competitive cost advantage of autonomous delivery robots – up to 15 times cheaper than traditional delivery services – used for the last-mile delivery in suburbs and areas where the traffic is relatively low (Hoffmann and Prause 2018: 4).

Furthermore, a Stanford University team concludes that the lack of a driver helps to reduce operating costs. For example, autonomous vehicles/robots consume less energy because they can run at a more stable speed than vehicles with drivers (Lee et al. 2016: 16).

## **2.3 Criticisms of Delivery Vehicles/Robots**

Although considerable advantages, some scholars have raised criticisms of using autonomous vehicles/robots due to its both time and cost inefficiency. Most of these criticisms are qualitative analysis based on secondary information, and these scholars prevalently use the induction methods, i.e., generalizing conclusions from specific events.

### **2.3.1 Time Inefficiency**

The time inefficiency results when vehicles running at low speed on long routes. Firstly, the speed of autonomous vehicles/robots depends on public sentiment and traffic regulations (Joerss et al. 2016). In concern of technology immaturity, most countries require that autonomous vehicles/robots only run in pedestrian areas (pavements) at low speed, i.e., walking speed, due to their low weight (Hoffmann and Prause 2018). In reality, Starship's self-driving vehicles are designed for driving on sidewalks with a speed of maximal 6 km/h, much slower than human-driving delivery trucks (Prause 2019). Furthermore, because most current cities do not have specific roads for autonomous vehicles/robots, their delivery routes are usually subject to various limitations, which make the paths more complex and thus increase the delivery time (Koopman and Wagner 2017).

### **2.3.2 Cost Inefficiency**

As for cost inefficiency, Joerss et al. argue that using autonomous vehicles/robots is cheaper than human in developed countries, but in developing countries, labour costs are more likely to remain low enough to impede any new technology changes in the next five to ten years

(Joerss et al. 2016). Besides the labour cost, James and Katsuaki found that the cost of introducing pioneer technologies is usually underestimated due to uncertainty, instability, and unrecognized problems (James and Katsuaki 1984). Therefore, the profitability of using autonomous delivery would depend on many factors and would need to be assessed on a case-by-case basis (Lee et al. 2016: 16).

## 2.4 Summary

The proposed review aims at answering the questions what is the last-mile delivery, what the challenges are, and whether using autonomous vehicles/robots can improve time and cost efficiency in last-mile delivery activities. To this purpose, the concept, features, and challenges of the last-mile delivery are demonstrated. Furthermore, a comprehensive review of the relevant literature on both the advantages and disadvantages of using autonomous vehicles/robots for last-mile delivery is presented.

For time efficiency, current studies mainly focus on the less waiting time for customers. However, whether autonomous vehicles/robots can save more time than human-driven vans running the same route from a place of dispatch directly to the pick-up station is overlooked. Besides, few studies consider the waste of time due to low speed and complex routes.

For cost efficiency, most scholars conclude that using autonomous vehicles/robots costs less by only comparing the labour cost and the manufacturing cost of vehicles/robots. But the relative emerging costs of training, operation, and maintenance, as well as the cost caused by uncertain social impacts, are less studied. In addition, due to the various innovative models of introducing autonomous vehicles/robots and the complicity of the last-mile delivery system per se, there are few studies that build a heuristic and systematic cost analysis structure for the holistic last-mile delivery industry or for any unit process or activity in this industry.

Overall, these studies highlight the need for deeper research in areas such as the impact of different speeds and routes on time efficiency and the implicit costs of introducing pioneer technologies. Moreover, further study on the systemic cost structure in the last-mile delivery industry will contribute to better analysis for the whole industry.

This research is devoted to addressing the research gap of the scant consideration on a specific last-mile delivery activity – transport from supermarkets after loading to pick-up stations

before unloading – through focusing on time and cost efficiency of using autonomous vehicles for a chosen delivery route at Coventry, UK.

### 3. Methodology

The research onion, as shown in figure 3-1, is a layered structure that efficiently represents the intermediate parts of the research. An idea about the appropriate research techniques can be gained easily through this pictorial representation from the research philosophies in the outside layer to the data collection and analysis at the core (Kothari 2004). In this project, the research onion is a useful tool that is conducive to designing research philosophies, methods, and strategies.

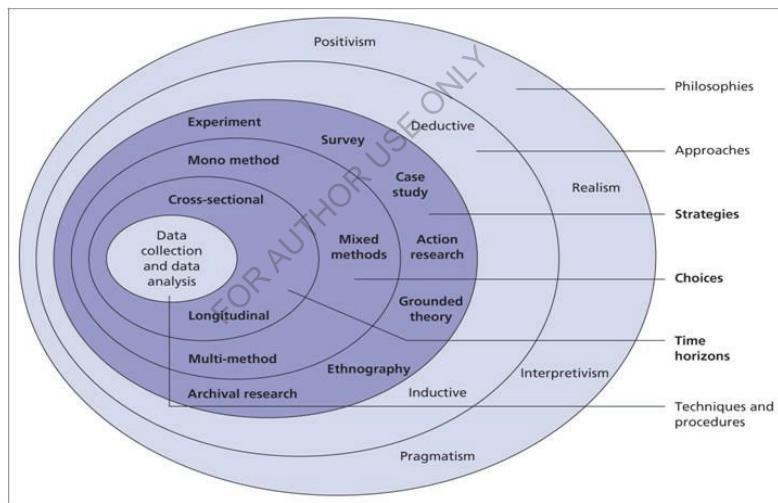


Figure 3-1: The research onion (Kothari 2004)

#### 3.1 Research Philosophies, Methods, and Strategies

The philosophy of the research can be of multiple types. The selection of the accurate philosophy depends on the requirement, resources, time, and directives of the research (Fink and Benz 2019). The main type of philosophy used in this research is positivism – using scientific methods, building hypotheses, and performing multiple tests to find the answers to these hypotheses (Fink and Benz 2019). For analysing the time efficiency, this research makes

a null hypothesis of ‘using autonomous vehicles costs less time than using tracks with drivers for the chosen route’. Then the time models for both using autonomous vehicles and using drivers are built for analysing in the next step. Finally, this research uses statistic hypothesis-testing methods to judge the null hypothesis by estimating the confidence interval of the relative parameter defined in section 2. While for analysing the cost efficiency, the hypothesis is that using autonomous vehicles will cost more at the beginning but less in the long term than using tracks with drivers. Instead of conducting hypothesis testing, this research establishes cost models to find the breakpoint, i.e., after running how many times will the cost of using autonomous vehicles be lower than the cost of using tracks with drivers. In the process of building time and cost models, this research uses the realism philosophy by referring to experience and integrating external views.

The research onion suggests mono-method, mixed-method, and multi-method as possible choices for conducting research. The mono-method includes only one research method (Crossman 2020). The research method used in this project is mono-quantitative, and this whole research is based on mathematics and statistics.

The research strategies comprise primary research and secondary research. In the primary research, laboratory experiments, surveys, interviews are derived. While in the secondary research, a gathering of the data is made in a theoretical ground, and all the available existing theories, subsidiary resources, case studies are reviewed (Crossman 2020). This project uses both primary and secondary research. Primary research includes building models and simulating the process by generating random data through Excel. While using existing theories and collecting data such as energy prices and the cost of vehicles from sound public recourses can be seen as secondary research.

Due to the outbreak of COVID19 during this research and the corresponding close of the university, it is difficult to use very professional software – such as SIMUL8 for process simulation and MATLAB for mathematic analysis – that is only accessible at university labs and can better simulate the delivery process to provide more accurate and all-side analysis. For this reason, the research simplifies the models and the analysis process. It only conducts the sensitivity analysis on one parameter – the number of deliveries – as detailed in the following sections.

## 3.2 Modelling Assumptions and Parameters

This research builds mathematic models to separately demonstrate the time and cost for using autonomous vehicles and using manned tracks in the single route from the Sainsbury's supermarket to the Amazon pick-up station (S-A), as shown in figure 3-2. This route is chosen because it represents a typical situation of last-mile delivery from a supermarket or warehouse to a pick-up station in downtown.

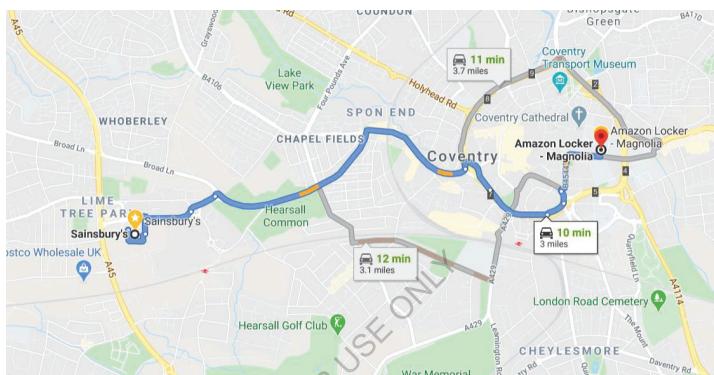


Figure 3-2: The running route from Sainsbury's to Amazon Locker (Google Map 2020)

### 3.2.1 Key Assumptions

This research establishes the following model assumptions to simplify and idealize the delivery process in the route S-A.

- (1) An autonomous vehicle can carry the same weight as a manned truck.
- (2) An autonomous vehicle has the same service life as a manned truck.
- (3) Each manned truck only needs one driver.
- (4) If put into use, one autonomous vehicle can replace one manned truck with one driver.
- (5) Autonomous vehicles run on pedestrian or bike lanes along the motorways at constant low speed. The low speed is required by many governments as delineated in the literature review – section 2.3 (Hoffmann and Prause 2018). And because autonomous vehicles are

programmed by computers, they can speed up and brake suddenly. They are also easier to run at a constant speed without human behaviours that lead to frequent speed change.

(6) The delivery time is the sum of waiting time at traffic lights and the running time on the road.

(7) The waiting time at traffic lights and the speed of manned trucks are independent variables that are subject to normal distributions.

(8) The waiting time at traffic lights for autonomous vehicles running on pedestrians or bicycle lanes is much shorter than that of manned trucks (Li 2013) and can be idealized to a particle infinitely close to zero in this research.

(9) Student-test (t-test) is appropriately used for verifying the time efficiency of using autonomous vehicles.

(10) For using manned trucks, the delivery cost is mainly determined by the wage of drivers and the energy (gasoline) consumption, and for using manned vehicles, the delivery cost depends mostly on the purchasing cost of unmanned vehicles and the energy (electricity) consumption. While other costs, for example, the maintenance cost, the depreciation cost, the cost of accidents, etc., are the same for both autonomous vehicles and manned trucks, and these costs are low enough to be ignored.

(11) The analysis focus on time and cost efficiency after autonomous vehicles are purchased. Therefore, the purchasing cost of manned trucks is not considered because they are already put into use.

(12) All autonomous vehicles only use electricity, and all manned trucks only use gasoline.

### 3.2.2 Delivery Time

The delivery time ( $T$ ) of this route is a function of four parameters: the speed of vehicles ( $v$ ), the distance of the route ( $L$ ), the number of traffic lights ( $n$ ), and the waiting time at  $i^{\text{th}}$  traffic light ( $t_i$ ), i.e.,  $T = f(v, L, n, t_i)$ . Thus, the time consumed by manned trucks for the route S-A can be formulated as equation (1), where  $\bar{t}$  is the average waiting time at each traffic light, and the subscript M is for manned trucks.

$$T_M = \sum_{i=1}^n t_{Mi} + \int_0^L \frac{dL}{v_M} \approx n \times \bar{t}_M + \frac{L}{\bar{v}_M} \quad (1)$$

Similarly, the time consumed by autonomous vehicles for route S-A can be formulated as equation (2), where the subscript A is for autonomous vehicles.

$$T_A = \sum_{i=1}^n t_{Ai} + \int_0^L \frac{dL}{v_A} = \sum_{i=1}^n t_{Ai} + \frac{L}{\bar{v}_A} \quad (2)$$

According to assumption (8), the waiting time at each traffic light for autonomous vehicles ( $t_{Ai}$ ) is much shorter than  $\bar{t}_M$ . Therefore, the accumulated waiting time  $\sum_{i=1}^n t_{Ai}$  can be represented as a positive infinitesimal value  $\varepsilon(t_{Ai})$  that is close to zero, and the equation (2) can be simplified as equation (2)\*

$$T_A = \frac{L}{\bar{v}_A} + \varepsilon(t_{Ai}) \quad (2)^*,$$

Where  $\varepsilon(t_{Ai})$  is positive and  $\lim_{t_{Ai} \rightarrow 0} \varepsilon(t_{Ai}) = 0$ .

In line with the assumption (7),  $t_{Mi}$  and  $v_M$  are independent variables that are subject to normal distributions. The other two parameters – n and L – stay the same in equation (1) and (2)/(2)\* because the distance and the number of traffic lights in the route S-A are constants. This research is devoted to verifying whether  $T_A$  is significantly less than  $T_M$ . If so, using autonomous vehicles is more time-efficient than using manned trucks.

### 3.2.3 Delivery Cost

The delivery cost of the route S-A varies from using autonomous vehicles to using manned tracks. For using one autonomous vehicle, the delivery cost ( $C_A$ ) mainly comprises the initial cost of purchasing autonomous vehicles ( $C_V$ ) and the accumulated operating cost of consuming electricity after  $m$  deliveries ( $C_E$ ). Let  $C_{Ej}$  be the cost of electricity consumption for  $j^{\text{th}}$  delivery, and  $C_{Ej}$  can be expressed as the product of the electricity consumption per distance ( $\phi$ ), the distance of the route ( $L$ ), and the electricity price per kWh for  $j^{\text{th}}$  delivery ( $P_{Ej}$ ), i.e.,  $C_{Ej} = \phi \times L \times P_{Ej}$ .

By adding  $C_V$  to  $C_E$  and simplifying the unit electricity price as a constant value  $\overline{P_E}$  for each delivery, the research calculates the total delivery cost of each autonomous vehicle through equation (3).

$$C_A = C_V + \sum_{j=1}^m C_{Ej} \approx C_V + \phi \times m \times L \times \overline{P_E} \quad (3),$$

where

$$C_E = \sum_{j=1}^m C_{Ej} = \phi \times L \times \sum_{j=1}^m P_{Ej} \approx \phi \times m \times L \times \overline{P_E}.$$

While for continue to use manned trucks, the delivery cost ( $C_M$ ) mainly includes the accumulated wage of drivers ( $W_M$ ) and the accumulated operating cost of consuming gasoline ( $C_G$ ). The wage paid a driver for  $j^{\text{th}}$  delivery ( $W_{Mj}$ ) can be gained through multiplying the average wage per hour ( $\overline{w_M}$ ) by the delivery time for  $j^{\text{th}}$  delivery ( $T_{Mj}$ ), which can be calculated through equation (1). Therefore, the accumulated wage  $W_M$  is given by

$$W_M = \sum_{j=1}^m W_{Mj} = \sum_{j=1}^m \overline{w_M} \times T_{Mj} \approx m \times \overline{w_M} \times \overline{T_M},$$

Where the research uses the average time consumed per delivery ( $\overline{T_M}$ ) to simplify the calculation.

Similar to  $C_E$ ,  $C_G$  can be approximately calculated as the product of the gasoline consumption per distance ( $\phi$ ), the distance of the route ( $L$ ), the accumulated number of delivery ( $m$ ), and the average gasoline price ( $\overline{P_G}$ ). Therefore, the accumulated cost of gasoline ( $C_G$ ) is given by

$$C_G = \sum_{j=1}^m C_{Gj} = \phi \times L \times \sum_{j=1}^m P_{Gj} \approx \phi \times m \times L \times \overline{P_G},$$

where  $C_{Gj}$  and  $P_{Gj}$  represent the energy cost and the price of gasoline for  $j^{\text{th}}$  delivery separately.

Then,  $C_M$  is the sum of  $W_M$  and  $C_G$ , as presented in equation (4).

$$C_M = W_M + C_G = \sum_{j=1}^m W_{Mj} + \sum_{j=1}^m C_{Gj} \approx m \times \overline{w_M} \times \overline{T_M} + \phi \times m \times L \times \overline{P_G} \quad (4)$$

$C_A$  is higher than  $C_M$  at the beginning of introducing autonomous vehicles because the purchasing price of autonomous vehicles is considerably higher than other operating costs. However, the initial investment on autonomous vehicles only happens at the beginning, and  $C_A$  is assumed to be lower than  $C_M$  in the long term at the advantage of lower energy consumption and no need to pay for drivers. This research aims to find whether there is a breakpoint  $m^*$  where  $C_A$  will be lower than  $C_M$  after  $m^*$  deliveries through the single route S-A and to estimate the value of  $m^*$  if the breakpoint exists.

### 3.3 Data Collection

Data collection and analysis is the last layer and the core of the research onion and can clearly explain the way and purpose of the research (Moser and Korstjens 2018). Both primary data and secondary data are used in this research. The primary experiment is appropriate to simulate the waiting time at  $i^{\text{th}}$  traffic light ( $t_{Mi}$ ) and the speed of manned trucks ( $v_M$ ). Although professional simulation software cannot be used due to COVID19, the two parameters can be represented by random numbers generated by Excel because both the de facto waiting time and the driving speed vary case by case and are, to a large extent, random in reality. Because of these reasons, the values of both the two parameters are gained through separately generating 200 random data subject to normal distributions inside appropriate intervals. Scholars prevalently use the normal distribution to simulate the random data in real life, and 200 data are necessary because big data will create more accurate predictions (Killeen 2019).

The speed of manned trucks ( $v_M$ ) has a minimum value of 0 km/h at the time of extreme road conditions and a maximum value of 112 km/h required by the UK government (GOV.UK 2020). Based on these constraints, 200 data of  $v_M$  are generated through Excel, as shown in figure 3-3. After using the Minitab software to conduct descriptive statistics analysis for these data, figure 3-4 presents the distribution of manned trucks' average speed – a normal distribution with an average speed of 57.14 km/h ( $\bar{v}_M$ ) and a standard deviation ( $\sigma_{v_M}$ ) of 25.12, i.e.,  $v_M \sim N(57.14, 25.12^2)$ .

Average running speed of manned trucks on route S-A (Km/h)												
101	42	40	86	58	29	84	15	76	56			
20	88	76	57	64	39	53	86	44	32			
100	53	68	44	7	72	61	78	53	77			
27	28	25	12	51	37	108	63	48	35			
63	41	83	13	111	80	63	77	58	83			
53	99	32	60	27	87	1	52	27	91			
51	41	49	51	43	58	59	46	29	65			
79	56	75	6	67	35	99	51	47	82			
79	82	39	8	38	72	75	27	85	47			
49	76	54	25	23	52	55	39	95	57			
44	96	25	64	36	96	45	3	78	44			
53	37	50	62	70	81	82	111	71	18			
74	53	33	61	112	79	24	9	59	55			
68	78	81	96	8	57	44	35	69	33			
36	45	51	48	58	75	49	34	59	82			
60	71	59	87	8	93	41	29	82	92			
74	89	67	56	108	36	20	101	62	40			
86	55	77	73	82	105	31	70	60	24			
75	41	76	65	72	34	30	15	25	55			
54	56	82	43	102	34	89	35	50	66			

Figure 3-3: Average running speed of manned trucks on route S-A

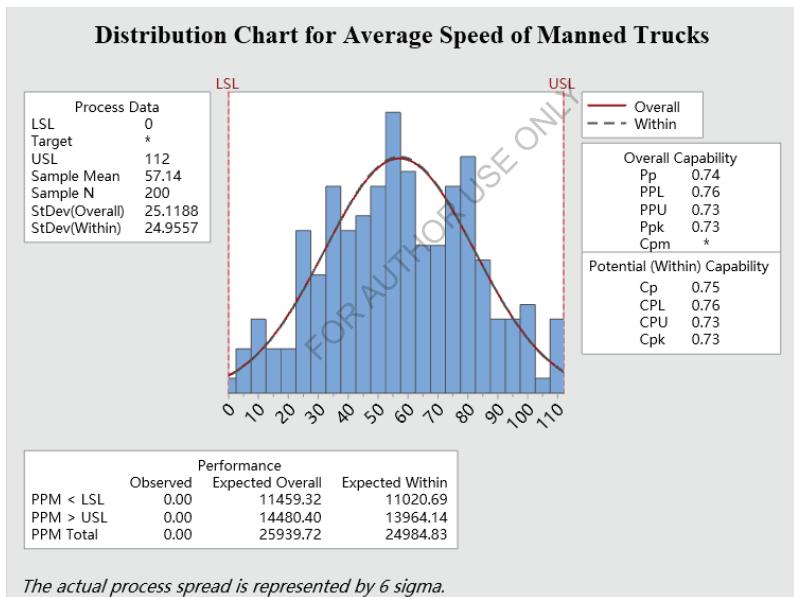


Figure 3-4: Distribution of the average speed of maned trucks

Similarly, the waiting time at  $i^{\text{th}}$  traffic light ( $t_{Mi}$ ) can also be simulated as a random value from 0 to 2 mins – the maximum minutes for waiting (GOV.UK 2020). The simulation results and the distribution are presented in figure 3-5 and figure 3-6 separately. The average waiting time ( $\bar{t}_M$ ) is 1.04 minutes and  $t_M \sim N(1.04, 0.52^2)$ .

Waiting time at each traffic light for manned trucks (Mins)												
0.2	0.4	0.9	0.2	0.9	11	11	18	15	13			
0.4	0.3	0.6	0.2	1.7	19	1.9	0.9	0.2	0.6			
1.6	1.4	0.8	0.4	0.6	12	0.7	1.5	0	1.1			
2.0	0.4	0.2	0.5	0.4	14	1.4	0.9	1.4	1.1			
1.2	1.2	0.5	1.1	0.1	13	1.8	1.0	2.0	0.4			
1.4	1.1	0.2	0.5	1.2	1.5	0.6	1.0	0.2	1.9			
2.0	1.0	1.0	1.4	0.7	0.6	0.3	0.8	1.3	1.1			
0.7	1.1	1.8	1.8	1.6	0.5	1.9	1.0	0.6	1.3			
1.9	0.9	1.1	0.2	1.1	1.0	0.7	0.4	0.1	1.4			
1.5	0	0.6	0.7	1.3	1.3	0.4	1.1	1.6	1.2			
0	0.3	1.1	1.8	0.8	1.5	1.0	1.9	2.0	0.7			
1.6	0.5	1.7	0.7	1.7	0	1.1	0.7	0.5	0.6			
0.5	1.3	1.1	1.5	1.1	1.1	1.0	1.1	1.0	0.9			
1.1	0.1	0.9	0.5	1.3	1.3	0.7	0.8	1.6	1.4			
1.1	0.6	0.5	0.4	1.0	0.9	1.6	1.6	1.3	0.8			
1.2	1.6	1.1	1.6	1.8	2.0	0.7	1.5	0	1.0			
0.1	1.5	1.3	1.0	1.1	1.1	0.4	0.8	1.8	1.4			
1.1	0.4	0.5	1.0	0.7	1.4	1.0	1.3	1.3	1.2			
2.0	1.2	1.7	1.9	1.1	1.6	1.6	0.8	1.4	0.2			
1.8	1.1	0.5	1.2	0.9	1.4	1.6	1.6	1.6	1.5			

Figure 3-5: The waiting time at each traffic lights for manned trucks

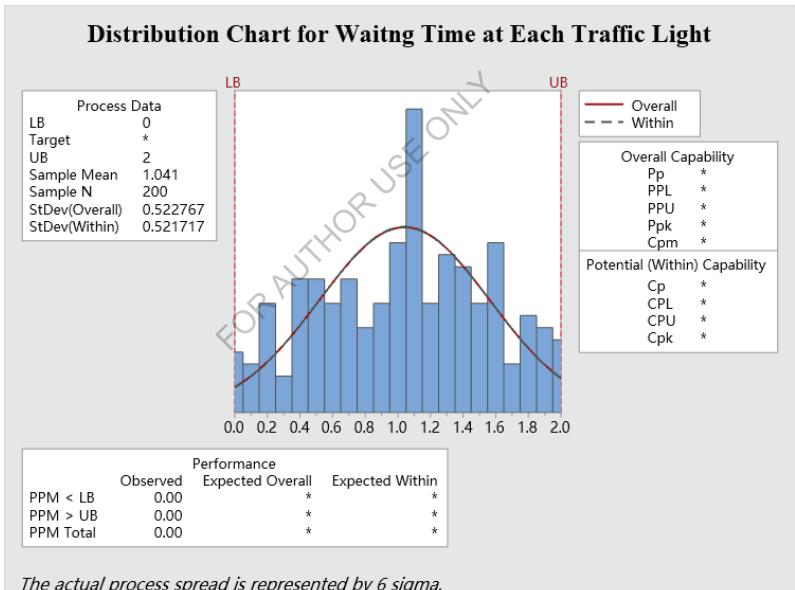


Figure 3-6: The distribution of the waiting time at each traffic lights

The values of other parameters can be obtained through public secondary sources, including websites, journals, Google map, etc. According to Google map, the driving distance of route S-A ( $L$ ) is 3 miles (4.8 km), and there are 11 traffic lights located at 11 crossroads, as shown in figure 3-7.

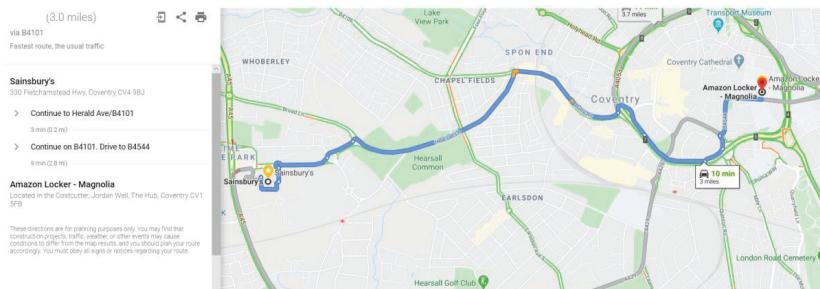


Figure 3-7: The driving distance of the route S-A

Due to the law requirements and the technology immaturity, autonomous vehicles are designed to travel on pedestrian and bike lanes at a constant low speed ( $v_A$ ) of about 4 miles per hour (6.4 km/h) (Lee et al. 2016). The average hourly wage of a delivery Driver ( $\bar{w}_M$ ) in the United Kingdom is £12.78 (Indeed 2020). And the estimated price for an autonomous vehicle ( $G_V$ ) is nearly £24,000 (Bloomberg 2020). In the UK, the average electricity price for electro mobiles ( $\bar{P}_E$ ) is £0.25 per kWh (Power Compare 2020) and the average gasoline price ( $\bar{P}_G$ ) during the last quarter is £1.23 per litre, which is calculated based on the UK weekly gasoline price (Global Petrol Prices 2020), as shown in figure 3-8.

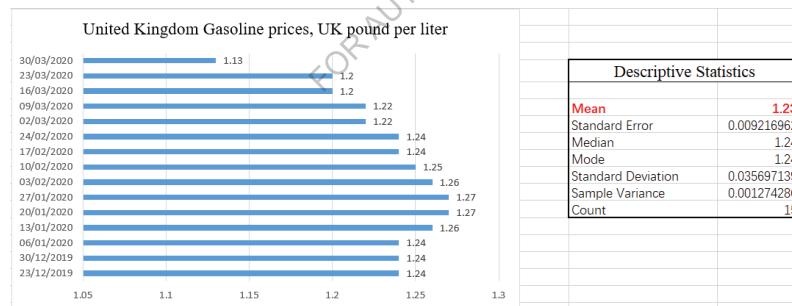


Figure 3-8: The UK weekly gasoline prices in the first quarter of 2020

Similar to electric cars, electricity consumption ( $\phi$ ) of autonomous vehicles is 0.19 kWh per kilometre (Aqua-Calc 2020). While for manned trucks, the gasoline consumption ( $\phi$ ) is 0.05 litre per kilometre (Energuide.be 2020).

Base on the data collection methods above, table 3-1 summarizes the values of parameters used in this research.

Parameter	Symbol	Value
The distance of route S-A	$L$	4.8 km
The number of traffic lights on route S-A	$n$	11
The average waiting time at each traffic light for manned trucks	$\bar{t}_M$	1.04 mins
The average speed of manned trucks	$\bar{v}_M$	57.14 km/h
The constant speed of autonomous vehicles	$v_A$	6.4 km/h
The average hourly wage of a delivery Driver	$\bar{W}_M$	£12.78 per hour
The purchasing price for an autonomous vehicle	$C_V$	£24,000
The average electricity price for autonomous vehicles	$\bar{P}_E$	£0.25 per kWh
The average gasoline price	$\bar{P}_G$	£1.23 per litre
The electricity consumption of autonomous vehicles	$\phi$	0.19 kWh/km
The gasoline consumption of manned trucks	$\varphi$	0.05 litre/km

Table 3-1: Nomenclature and values of parameters

### 3.4 Research Ethics

Research ethics is highly essential in research. Although primary researches are supposed to follow more ethics, secondary researches are subject to rigorous ethics as well. The research process of the project obeys all the ethical rules and principles that secondary researches must follow. This research is based on the secondary data collected from different sound resources, including books, journals, websites, and online articles. These sources are all public and accessible to anyone. The data in this research only hold information about the data, are correctly cited with references, and do not expose any personal details. This research paper does not contain any confidential data, and the "Data Protection Act of 1998" has been maintained in the data collection process. This research conducts the data analysis mainly through the Data Analysis tool in Excel. Theories and models are developed with the help of empirical study. Advanced models are established according to statistic theories described in this paper. The paper structure is in a dissertation style, and the Coventry-Harvard citation style has maintained in the whole paper. Overall, this paper has followed all the rules of business research and gives a clear view to readers.

## 4. Analysis and Findings

### 4.1 Time Efficiency Analysis

#### 4.1.1 Data Analysis

As mentioned in the methodology chapter, a null hypothesis ( $H_0$ ) is defined as autonomous vehicles spend less time than manned tracks for the chosen route S-A, i.e., whether the inequation  $T_A < T_M$  holds. To verify  $H_0$ , the hypothesis testing should be used following the decision rule – if the test statistic is greater than the critical value,  $H_0$  should be refused.

Through putting parameter values in table 1 into equation (2)\*, the time of autonomous vehicles ( $T_A$ ) can be calculated.

$$T_A \approx \frac{L}{v_A} + \varepsilon(t_{Ai}) = \frac{4.8km}{6.4km/h} \times \frac{60mins}{h} + \varepsilon(t_{Ai}) = 45mins + \varepsilon(t_{Ai})$$

Because  $\varepsilon(t_{Ai})$  is positive and  $\lim_{t_{Ai} \rightarrow 0} \varepsilon(t_{Ai}) = 0$ ,  $T_A > 45mins$ .

While for  $T_M$ , because  $t_{Mi}$  and  $v_M$  are subject to distributions [ $v_M \sim N(57.14, 25.12^2)$ ,  $t_{Mi} \sim N(1.04, 0.52^2)$ ], the distribution of  $T_M$  can be obtained through Minitab software, as shown in figure 4-1.

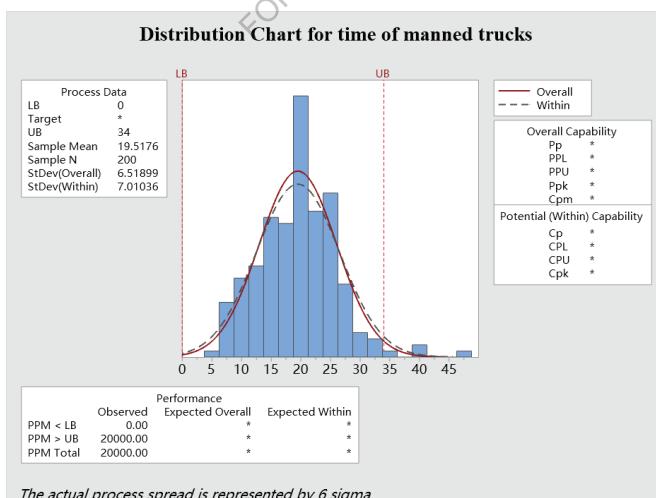


Figure 4-1: Distribution of the running time of manned trucks

For distribution  $T_M \sim N(19.5, 6.5^2)$ , the mean value ( $\bar{T}_M^*$ ) is 19.5, and the standard deviation ( $\sigma_{T_M}$ ) is 6.5. These values can help the research to define the test statistic as  $\tau = \frac{\bar{T}_A - \bar{T}_M^*}{\sigma_{T_M}}$ .  $\frac{45+\varepsilon(t_{Ai})-19.5}{6.5} > 3.92$ , which is greater than 3.30 – the critical value to refuse the null hypothesis under the confidence level of 99.9% and the degree of freedom of 200 (interval from 100 to 1000) as shown in table 4-1.

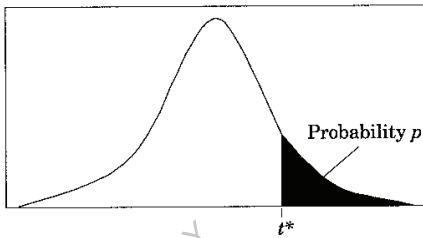


Table entry for  $p$   
and  $C$  is the point  
 $t^*$  with probability  
 $p$  lying above it  
and probability  $C$   
lying between  
 $-t^*$  and  $t^*$ .

**Table B** *t* distribution critical values

df	Tail probability $p$												
	.25	.20	.15	.10	.05	.025	.02	.01	.005	.0025	.001	.0005	
1	1.000	1.376	1.963	3.076	6.314	12.71	15.89	31.82	63.66	127.3	318.3	636.6	
2	.816	1.061	1.386	1.886	2.920	4.303	4.849	6.965	9.925	14.09	22.33	31.60	
3	.765	.978	1.250	1.638	2.353	3.182	3.482	4.541	5.841	7.453	10.21	12.92	
4	.741	.941	1.190	1.538	2.132	2.776	2.999	3.747	4.604	5.598	7.173	8.610	
5	.727	.920	1.156	1.476	2.015	2.571	2.757	3.365	4.032	4.773	5.893	6.869	
6	.718	.906	1.134	1.440	1.943	2.447	2.612	3.143	3.707	4.317	5.208	5.959	
7	.711	.896	1.119	1.415	1.895	2.365	2.517	2.998	3.499	4.029	4.783	5.408	
8	.706	.889	1.108	1.397	1.860	2.306	2.449	2.896	3.355	3.883	4.501	5.041	
9	.703	.883	1.100	1.383	1.833	2.262	2.398	2.821	3.250	3.690	4.297	4.781	
10	.700	.879	1.093	1.372	1.812	2.228	2.359	2.764	3.169	3.581	4.144	4.587	
11	.697	.876	1.088	1.363	1.796	2.201	2.328	2.718	3.106	3.497	4.025	4.437	
12	.695	.873	1.083	1.356	1.782	2.179	2.303	2.681	3.055	3.428	3.930	4.318	
13	.694	.870	1.079	1.350	1.771	2.160	2.282	2.650	3.012	3.372	3.852	4.221	
14	.692	.868	1.076	1.345	1.761	2.145	2.294	2.624	2.977	3.326	3.787	4.140	
15	.691	.866	1.074	1.341	1.753	2.131	2.249	2.602	2.947	3.286	3.733	4.073	
16	.690	.865	1.071	1.337	1.746	2.120	2.235	2.583	2.921	3.252	3.686	4.015	
17	.689	.863	1.069	1.333	1.740	2.110	2.224	2.567	2.898	3.222	3.646	3.965	
18	.688	.862	1.067	1.330	1.734	2.101	2.214	2.552	2.878	3.197	3.611	3.922	
19	.688	.861	1.066	1.328	1.729	2.093	2.205	2.538	2.861	3.174	3.579	3.883	
20	.687	.860	1.064	1.325	1.725	2.086	2.197	2.528	2.845	3.153	3.552	3.850	
21	.686	.859	1.063	1.323	1.721	2.080	2.189	2.518	2.831	3.135	3.527	3.819	
22	.686	.858	1.061	1.321	1.717	2.074	2.183	2.508	2.819	3.119	3.505	3.792	
23	.685	.858	1.060	1.319	1.714	2.069	2.177	2.500	2.807	3.104	3.485	3.768	
24	.685	.857	1.059	1.318	1.711	2.064	2.172	2.492	2.797	3.091	3.467	3.745	
25	.684	.856	1.058	1.316	1.708	2.060	2.167	2.485	2.787	3.078	3.450	3.725	
26	.684	.856	1.058	1.315	1.706	2.056	2.162	2.479	2.779	3.067	3.435	3.707	
27	.684	.855	1.057	1.314	1.703	2.052	2.158	2.473	2.771	3.057	3.421	3.690	
28	.683	.855	1.056	1.313	1.701	2.048	2.154	2.467	2.763	3.047	3.408	3.674	
29	.683	.854	1.055	1.311	1.699	2.045	2.150	2.462	2.756	3.038	3.396	3.659	
30	.683	.854	1.055	1.310	1.697	2.042	2.147	2.457	2.750	3.030	3.388	3.646	
40	.681	.851	1.050	1.303	1.684	2.021	2.123	2.422	2.704	2.971	3.307	3.551	
50	.679	.849	1.047	1.299	1.676	2.009	2.109	2.405	2.678	2.937	3.261	3.496	
60	.679	.848	1.045	1.296	1.671	2.000	2.099	2.390	2.660	2.915	3.232	3.460	
80	.678	.846	1.043	1.292	1.664	1.990	2.088	2.374	2.639	2.887	3.195	3.416	
100	.677	.845	1.042	1.290	1.660	1.984	2.081	2.364	2.626	2.871	3.174	3.390	
1000	.675	.842	1.037	1.282	1.646	1.962	2.056	2.330	2.581	2.813	3.098	3.300	
$\infty$	.674	.841	1.036	1.282	1.645	1.960	2.054	2.326	2.576	2.807	3.091	3.291	
	50%	60%	70%	80%	90%	95%	96%	98%	99%	99.5%	99.8%	99.9%	

Confidence level C

Table 4-1: The t-distribution chart

According to the result, the null hypothesis is refused, and the conclusion is that using autonomous vehicles costs more time than using manned trucks under the confidence level of 99.9%. Therefore, using autonomous vehicles cannot achieve the time efficiency in most cases if the vehicles are limited to run on pedestrian or bike lanes at a low speed of 6km/h.

Based on the equation (2)\* –  $T_A \approx \frac{L}{v_A} + \varepsilon = \frac{4.8}{v_A} \times 60 \frac{\text{mins}}{\text{h}} + \varepsilon(t_{Ai})$ , autonomous vehicles should run faster to achieve time efficiency. Using autonomous vehicles can spend the same time as manned trucks when  $T_A \approx \frac{4.8}{v_A} + \varepsilon(t_{Ai}) = \overline{T_M^*} = 19.5 \text{ mins}$ , i.e.,  $v_A \approx 15 \text{ km/h}$ . Using autonomous vehicles is time-efficient only when the test statistic  $\tau = \frac{T_A - \overline{T_M^*}}{\sigma_{T_M}}$  less than  $-1.96 -$  the critical value to accept the null hypothesis that autonomous vehicles cost less time than manned trucks under the confidence level of 95%. The sufficient speed  $v_A$  can be calculated through inequation  $\tau = \frac{T_A - \overline{T_M^*}}{\sigma_{T_M}} = \frac{\frac{4.8}{v_A} \times 60 + \varepsilon(t_{Ai}) - 19.5}{6.5} < -1.96$ , and the result is  $v_A > 42.6 \text{ km/h}$ . This means that if autonomous vehicles want to achieve the significant advantage of time efficiency against manned trucks, the speed of autonomous vehicles should be greater than 42.6 km/h. And their speed cannot be lower than 15km/h, below which the autonomous vehicles will cost more time than manned trucks. While for the speed interval from 15km/h to 42.6 km/h, autonomous vehicles' time advantage is not very significant.

However, it is not feasible for autonomous vehicles to run on pedestrians or bike lanes at such a high speed over 15km/h. If the autonomous vehicles run on motorways, they will also face the time waste due to traffic lights and need to run at speed no less than the average speed of manned trucks ( $\overline{v_M}$ ), i.e., 57.14 km/h according to the result emerged in table 4-1. This is hard to achieve in the short term because autonomous vehicles are subject to a series of limitations and constraints in six aspects – political, economic, social, technological, environmental, and legal – according to the PESTEL analysis (Johnson et al. 2018).

### (1) Political

Due to the concern for public safety, many governments have enacted a set of regulations to limit the running speed and relative tests of autonomous vehicles on motorways. For example, the California state government in America require the speed of autonomous vehicles can not run over 40 km/h after a series accident – a Google self-driving car crashed into a bus in 2016 (Forbes 2020).

## (2) Economic

Because of the considerable investment in research and development (R&D) at the beginning stage, the manufacturing cost of autonomous vehicles that can run on motorways with manned cars will stay huge in the following years (Forbes 2020).

## (3) Social

The social acceptance of autonomous vehicles running on motorways is not optimistic. A Gartner survey reveals 55 percent of respondents are not willing to drive along with autonomous vehicles on motorways (Gartner 2017).

## (4) Technology

The technology of autonomous vehicles is still at the stage of exploration. Currently, most autonomous vehicles can only achieve level 2 or 3 automation according to SAE international's levels of automation for defining driving automation, as shown in figure 4-2. While level 5 automation- autonomous vehicles that totally do not need drivers – cannot be realized before 2025 (Lee et al. 2018).

SUMMARY OF LEVELS OF DRIVING AUTOMATION ACCORDING TO SAE J3016™					
Level	Name	Definition	Ordinary Driving	Monitoring	Emergency Control
0	No automation	The full-time performance by the human driver of all aspects of the dynamic driving task, even when enhanced by warning or intervention systems	Driver	Driver	Driver
1	Driver assistance	The driving mode-specific execution by a driver assistance system of either steering or acceleration/deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task.	Driver	Driver	Driver
2	Partial automation	The driving mode-specific execution by one or more driver assistance systems of both steering and acceleration/ deceleration using information about the driving environment and with the expectation that the human driver performs all remaining aspects of the dynamic driving task.	System	Driver	Driver
3	Conditional automation	The driving mode-specific performance by an Automated Driving System of all aspects of the dynamic driving task with the expectation that the human driver will respond appropriately to a request to intervene	System	System	Driver
4	High automation	The driving mode-specific performance by an Automated Driving System of all aspects of the dynamic driving task, even if a human driver does not respond appropriately to a request to intervene	System	System	Driver/ System
5	Full automation	The full-time performance by an Automated Driving System of all aspects of the dynamic driving task under all roadway and environmental conditions that can be managed by a human driver	System	System	System

Figure 4-2: Summary of Levels of driving automation (SAE 2020)

## (5) Environmental

Introducing autonomous vehicles is a process that needs to be interacted with outside environmental factors such as city infrastructures. It needs considerable investment to re-establish a complex traffic system, which integrates autonomous vehicles with existing transit, redesign curbs, and redevelop road rules (Mckinsey&Company 2019).

## (6) Legal

Using autonomous vehicles are facing lots of legal challenges. For example, it is hard to define and clarify the legal liabilities when an autonomous vehicle crash with another autonomous vehicle or a manned car (Hoffmann and Prause 2018).

#### **4.1.2 Findings**

The analysis concludes that autonomous vehicles spend more time than manned trucks for the delivery route of S-A. Autonomous vehicles running on pedestrians or bike lanes can never be more time-efficient than manned trucks because the speed of this kind of autonomous vehicles is highly limited in concern of safety. The only method of achieving time efficiency for autonomous vehicles is to improve their running speed to over 57.14 km/h. The speed is so high that the autonomous vehicles can only run on current motorways mixed with all kinds of manned cars or on special lanes established for autonomous vehicles. However, autonomous vehicles running on current motorways are not feasible in the short term because they are facing huge technical challenges of being smart enough to accomplish all the driving behaviours of a human on roads. In addition to technical constraints, legal limitations and social risks, such as public acceptance, also hinder the running of autonomous vehicles on motorways together with manned cars. Building special lanes for autonomous vehicles cannot achieve in the short term as well because such infrastructure projects always need long-term planning and construction. Therefore, using autonomous vehicles cannot achieve time efficiency in the short term unless all the technical, legal, and social challenges are adequately addressed.

## **4.2 Cost Efficiency Analysis**

### **4.2.1 Data Analysis**

The cost of using autonomous vehicles ( $C_A$ ) can be presented as functions (5) below through putting values of parameters in table 3-1 into equations (3).

$$C_A \approx C_V + \phi \times m \times L \times \bar{P_E} = 24,000 + 0.228m \quad (5)$$

The curve of function (6) can be generated through Excel, as shown in figure 4-3.

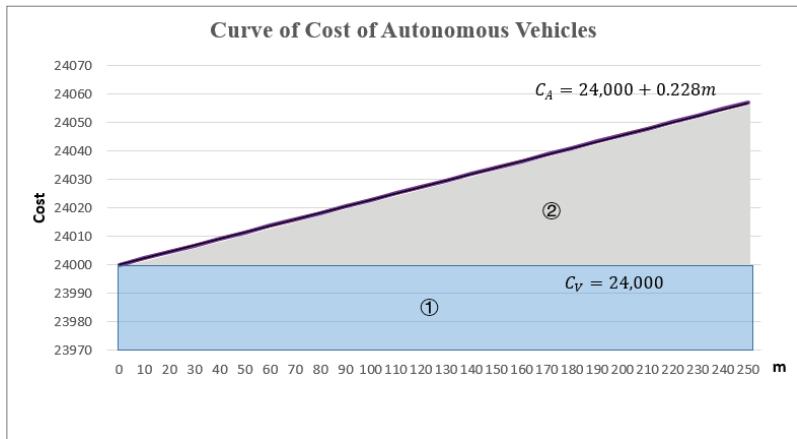


Figure 4-3: The curve of the cost of autonomous vehicles

As can be seen from figure 4-3, the total cost of using autonomous vehicles ( $C_A$ ) comprises two parts. Area ① represents the fixed cost – the investment on purchasing autonomous vehicles ( $C_V$ ). Area ② represents the accumulated operating cost, i.e., the accumulated cost of electricity consumption ( $C_E$ ), which is a variable cost that becomes large as the accumulated number of delivery ( $m$ ) increases. Therefore, the fixed cost  $C_V$  contributes an initial value, and subsequent long-run incremental part of the total cost ( $C_A$ ) depends on the accumulated electricity consumption.

Similarly, the total cost of using manned trucks ( $C_M$ ) can be presented as function (6) through using the mean value of manned trucks' delivery time ( $\bar{T}_M^* = 19.5 \text{ mins} \approx 0.33h$ ) as the input of the average time of per delivery ( $\bar{T}_M$ ) and putting other parameters' values in table 3-1 into equation (4).

$$C_M \approx m \times \overline{w_M} \times \overline{T_M^*} + \varphi \times m \times L \times \overline{P_G} = 4.22m + 0.295m = 4.51m \quad (6)$$

The curve of function (6) can be generated through Excel, as shown in figure 4-4. The cost of a driver's wage ( $C_W$ ) and the accumulated cost of gasoline consumption ( $C_G$ ) are represented by area ③ and area ④ separately. Both  $C_W$  and  $C_G$  are variable costs that grow linearly as the accumulated number of delivery ( $m$ ) increases. Compared with  $C_G$ , the cost of a driver's wage ( $C_W$ ) is higher and contributes more to the growth of total cost ( $C_M$ ) in the long term.

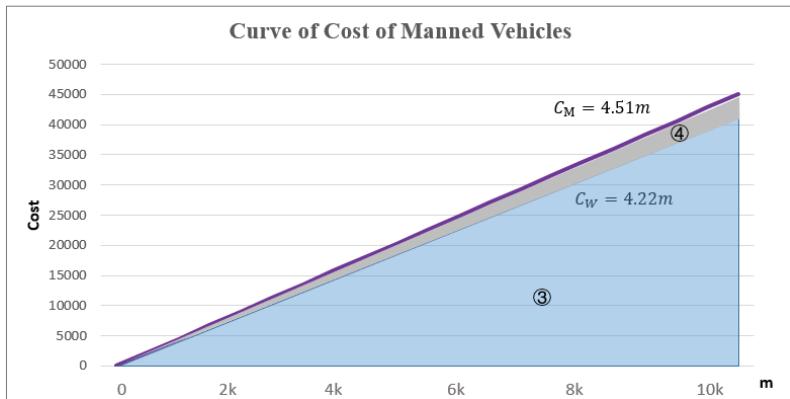


Figure 4-4: The curve of the cost of manned trucks

Putting the two curves into one coordinate system, figure 4-5 shows that the two curves have an intersection with an abscissa  $m^* = 5604.86$ .

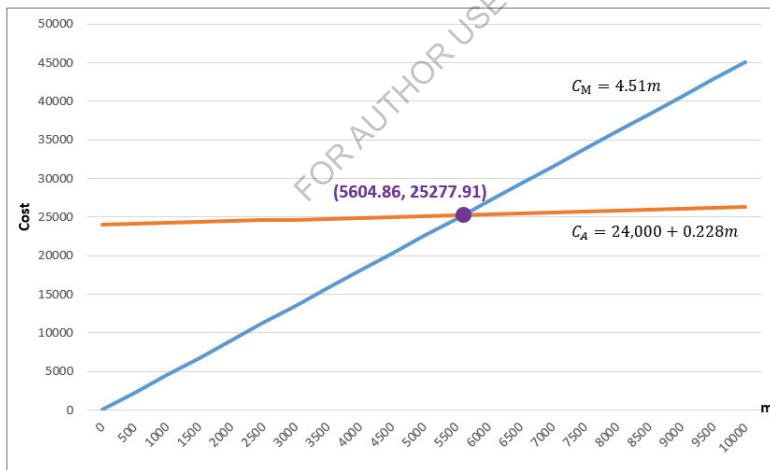


Figure 4-5: The combined curve for two costs

Because  $m$  represents the accumulated frequency of delivery,  $m^*$  needs to be rounded to an integer, i.e.,  $m^* = 5605$ . As can be seen from figure 4-5, the cost of using autonomous vehicles ( $C_A$ ) is significantly higher than that of using manned trucks ( $C_M$ ) for delivery on route S-A. But  $C_A$  will be lower than  $C_M$  after  $5605$  ( $m^*$ ) times of delivery, and the difference between  $C_A$  and  $C_M$  will continually enlarge. This means that using autonomous vehicles on

route S-A will show cost-efficiency after 5605 times of delivery – approximately equivalent to 3 years if each vehicle deliveries 8 times a day, 250 working days a year.

Drawing the cost curves of electricity consumption ( $C_E$ ) and gasoline consumption ( $C_G$ ) in one coordinate system, figure 4-6 shows that the cost of consuming electricity ( $C_E$ ) is only slightly lower than the cost of consuming gasoline ( $C_G$ ).

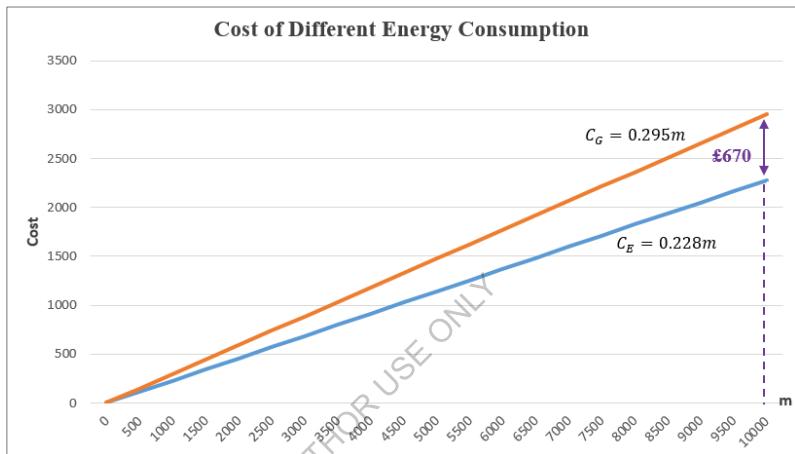


Figure 4-6: The cost of different energy consumption

It can be seen that one autonomous vehicle that uses electricity will only save £670 than one manned truck that uses gasoline after 10,000 times of delivery – an extremely slight difference of nearly 7 pennies per delivery. Therefore, the cost advantage of autonomous vehicles, to a large extent, benefits from the vanishment of wages paid for drivers.

#### 4.2.2 Findings

Based on the cost analysis, the research concludes that despite the significant initial investment in purchasing vehicles, using autonomous vehicles is more cost-efficient than using manned trucks for delivery on route S-A in the long term – nearly after three years since introducing autonomous vehicles. This cost advantage greatly depends on the removal of drivers and no need to pay for them commensurately. But the cost discrepancy due to fuel difference – autonomous vehicles using electricity while manned trucks using gasoline – is slight enough

to be overlooked. The purchasing cost occupies a large part of the total cost of using autonomous vehicles for delivery. Therefore, the cost advantage of autonomous vehicles will appear more early in the future as the unit vehicle cost will become lower as a result of technological advance and commercialized production. However, purchasing vehicles will inevitably generate a considerable initial capital outflow, which may, in the short term, magnify the corporate leverage and cause a greater financial burden for institutions that are willing to replace current manned trucks with autonomous delivery vehicles.

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## **5. Conclusion**

This research analyses the economic feasibility of introducing autonomous vehicles for last-mile delivery by focusing on time and cost efficiencies. Although the last-mile delivery is an emerging industry with intrinsic complexity and uncertainty, this project thrusts the main research into the limelight of a single process – exclusively, the one-way route from one dispatch centre, i.e., the Sainsbury's supermarket, to one Amazon pick-up station at Coventry city – without considering the return route and any processes involving customers. In light of these, the cost and time of using autonomous vehicles have been reasonably estimated and compared with the status quo, i.e., using manned trucks.

The research is designed in a way to accomplish all the project objectives identified at the beginning. Firstly, the delivery route is chosen and visualized through the Google map, which presents its distance and the number of crossroads. Then the time and cost models for using autonomous vehicles and using manned trucks are established separately, with both primary and secondary data as input for the values of parameters in these models. Based on these models, the time and cost spent by autonomous vehicles are calculated and compared with those of manned trucks to come to the findings on efficiency. For time efficiency, the key finding of this research is that using autonomous vehicles will spend more time than using manned trucks if the autonomous vehicles are limited to run on pedestrians or bicycle lanes at a commensurate low speed. However, it is infeasible for autonomous vehicles to run on motorways mixed with manned cars in the short term due to constraints such as technology immaturity, low social acceptability, and legal requirements. As for cost efficiency, the research concludes that there exists a breakpoint, after which using autonomous vehicles will become more cost-efficient than manned delivery trucks. But in the short term, the cost of autonomous vehicles is higher on account of the significant initial investment to purchase vehicles. Furthermore, the limitations of this research, the potential recommendations on how to improve the time and cost efficiency, and suggestions on further researchers are presented in the following paragraphs.

The analysis in this research is based on a set of idealized assumptions and commensurate models. While the research has some merits, it omits some important concerns that need to be addressed to substantiate the argument. Firstly, it is gratuitous to assume that one autonomous vehicle can carry the same weight as one manned truck. However, the real fact is that the carrying capacity of autonomous vehicles is usually significantly lower than that of manned

trucks to satisfy the load limit for pedestrians or bicycle lanes. If so, the cost of using autonomous vehicles may become huger because a merchant needs to purchase more vehicles to achieve the same carrying capacity as a manned truck. Besides, the time and cost models in this research are oversimplified and overlook some important factors. The time models fail to consider the additional time, such as the delay caused by accidents, detours, or gridlock. The cost models do not include any implicit costs that emerged in line with the introduction of autonomous vehicles, such as the expense for training employees and for maintenance. These uncovered factors increase the uncertainty and ambiguity of the analysis results, and it may turn out that using autonomous vehicles is more time-efficient while less cost-efficient than using manned trucks. Furthermore, the models and findings in this research are not representative and cannot be applied to other business cases because the chosen route is highly unique and has a strong local identity. Whether using autonomous vehicles is more efficient depends on various factors such as the distance of a route, the number of traffic lights, the local speed limitation, etc., and these factors overlap and interact with each other in ways that cannot be detailed in this research. Such complexity makes it difficult for the conclusion of this project to be a universal principle that can be applied to the whole last-mile industry. Finally, the outbreak of COVID19 limits the use of professional simulation and programming software that can handle the complex factors through conducting sensitivity analysis on more parameters and considering more than one situation at the same time.

The project has thrown up many questions in need of further research. From this study, the cost and time efficiency of using autonomous vehicles for a particular single way is analysed. However, it is recommended that further research examine the cost and time efficiency for the whole last-mile delivery process that includes the loading, unloading, and return activities. Besides, the models built in this research is oversimplified, and, therefore, building unified time and cost models that can represent the most last-mile delivery processes could be usefully explored in further studies. Another possible area of future research would be to investigate the real distribution of parameters such as the waiting time at traffic lights and to build corresponding regression models for prediction. Although using random data that succumb to the normal distribution is one method of simulating the seemly out-of-order values of a parameter, more previous information would help us to establish a higher degree of accuracy on this matter. Furthermore, it would be interesting to assess the relationship and correlation between the time efficiency and the cost efficiency of introducing autonomous vehicles for last-mile delivery.

The findings of this study also have some important implications for future business practice. Unless the advanced technologies and local governments allow autonomous vehicles to run on regular motorways, the time efficiency of using autonomous vehicles for the last-mile delivery will not be attained. Due to the high purchasing cost at the beginning, supermarkets or warehouses can consider renting autonomous vehicles in the way of financial leasing. Besides, a merchant or a delivery company can introduce other alternative delivery methods to realize the time efficiency and the cost advantage. For example, unmanned delivery drones have lower unit costs, consume less energy, and fly faster. These advantages are conducive to achieving both cost and time efficiency (Lee et al. 2016).

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# Chapter 7: Text Mining on New York Times’ news titles since 2020 – with comparison to the US congressional speech records in the same period

Before this book, part or all of the content of this article has been published in academic journal.

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## 1. Executive Summary

This task mainly focuses on topic I.2-News Articles and conducts certain analyses based on topic I.1-Congressional speech and information content. For News articles, this task selects the news titles in the New York Times journal from January 2020 to April 2021 for analysis. The news titles are gathered for each month. In this task, the most frequent words (central topics) covered in the whole period and each month are presented visually, the sentiment of news is analyzed, and the time change of the coverage on keywords is summarized and showed appropriately. For congressional speeches, this task selects the first congressional speech report each month from January 2020 to April 2021 for analysis. Therefore, both text analyses are based on monthly data from January 2020 to April 2021. This research also compares the two databases but found that their main focuses are not similar.

In brief, this task is devoted to answering the following questions:

- (1) What are key focuses for New York Times news title and US congressional speech in the last 16 months, and what are the time-series change of these key focuses?
- (2) What is the time-series change of New York Times news sentiment?
- (3) How the central topics (Covid-19, US presidential election., etc.) change over time, and how are they distributed?
- (4) How does the result of this task look like? What other analyses are interesting for further analysis, and why are they not included in this task?

This task is done in the RStudio environment. An Intel Core i5-8250U CPU (1.60 GHz) laptop with 8 GB RAM is applied for carrying out all the calculations and analyses. Only the R (4.0.3 version) programming language is used. The R codes and the task-based database are available on the Github link <https://github.com/XUAN-FENG9/Advanced-Financial-Analytics/>. [Appendix 1](#) also presents the R codes used for this task, and, in the codes, there are many vital notes for better understanding.

This report develops in the following outline. Following [Section 2](#) first briefly introduces how the data is collected and why the data is collected in this way. Following that, [Section 3](#) describes the steps for data cleaning. Based on the cleaned data, this report then moves into the main analysis – [Section 4](#) illustrates the logic and methods used for text mining in this task, as well as presents and discusses the analysis results. The final [Section 5](#) evaluates the whole task, summarizes major imperfections and contributions, and presents insights into

further analysis refining. All references listed in the [References List](#) are subject to the Harvard style. The [Appendix 1](#) presents the screenshot of all R codes used for this task. The necessary R packages and functions used in this task are described in the main report and notes for R codes.

## 2. Data Selection and Collection

This task mainly collects all the news titles of the New York Times journal from 1852 to 2021. All the data has been downloaded and saved as separate txt documents, each document for each month. However, only news titles from Jan 2020 to Apr 2021 are used for analysis because the whole data is so large that, in further data cleaning and analysis steps, the laptop cannot deal with all data in a short time. One contribution of this task is that the codes for this part ([line 28 to 65](#)) can be used to extract the news titles of the New York Times journal in any specific time period by setting years (line 40) and months (line 43) in for-loops.

In this web-mining process, all paths (url) of news titles follow the hierachic structure shown in the following **figure 2-1**.

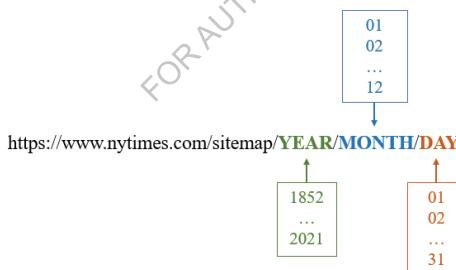


Figure 2-1: The webpath/url structure of daily news' webpage (New York Times)

In the appendix R codes, [line 28 to 65](#) shows the R codes that are used to collects all the news titles from 1852 to 2021 and save/write them in a defined local directory – each month's news titles are collected and written in one txt file. These codes work in the following ways. Firstly, a ‘gettitle’ function is defined (in code [lines 34 to 36](#)) to read and extract the news titles on each day’s webpage. Then, this whole data extract & collection work is mainly done by the “rvest” package through a triple loop – the most outside is a for-loop to read/open each year’s webpage, then the second layer is a for-loop to read/open each month’s webpage on

this year, and finally the core is a ‘lapply’ loop to read/open each day’s webpage on this month and extract & summarize the daily titles through applying the ‘gettext’ function (defined in codes [line 34 to 36](#)) on each day’s webpage. Besides, in loops, a ‘try’ function is used for codes inside each loop, an approach that can jump some warnings and errors and continue the loop. For example, because some months do not have the news’ webpage, the original loop (loop on months from 1 to 12 for each year) will appear error and stop running when meeting these months. But this problem can be solved, and the loops can continue by packaging the codes inside a loop under a ‘try’ function. Furthermore, in this work, the tkProgressBar function in the ‘tcltk’ package is used to create a process bar, which can present the loop process and show how much percentage is finished when running the whole loop.

Similarly, this task also extracts and collects all the US congressional speech records data from 1951 to 2021 (82<sup>nd</sup> to 117<sup>th</sup> Congress) on [US government website](#). Each day’s record is separately saved as a txt file, and all days’ records during one Congress session are saved in a separate folder/directory. Code line 88-119 records all codes that are needed to conduct the above work. According to demand, one can extract the congressional speech records in one or more Congress sessions by changing the session setting in line 74 (for sessions 104 to 117) or line 103 (for sessions 82 to 103). It is worth to be noticed that the website/url structures are different between period 1 (Congress session 82 to 103) and period 2 (Congress session 104 to 117), as shown in the following **figure 2-2**. In this task, only the speech records on the first available day in each month from Jan 2020 to Apr 2021 are used for analysis because the laptop can only deal with limited data in a short time.

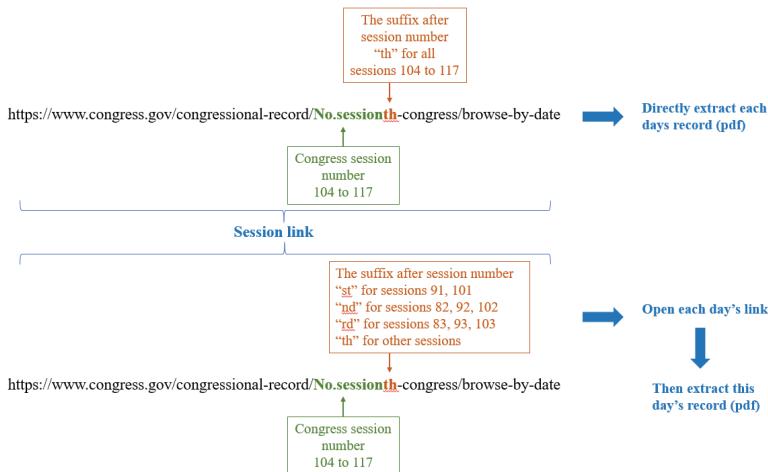


Figure 2-2: The webpath/url structure of daily US congressional speech records

### 3. Data Cleaning

Code lines 123 to 164 are used for data cleaning work in this task. The data cleaning process is conducted for both the ‘NYtimes’ (New York Times news titles 2020-2021) and ‘congress’ (US congressional speech records 2020-2021) corpora by the ‘tm’ package. The data cleaning work is done in two steps. The first step (code lines 126-150) is a normal cleaning – transfer all words to lower case and remove all number, month, punctuation, English stop words, independent English letters, white spaces, and a vector of defined useless words (vector ‘remove’ defined in code lines 126-129) that frequently appear in the corpus but are useless for further analysis. For example, words like ‘front page’, ‘title’, and ‘record’ frequently appear in the news titles but do not have any meaning for text analysis.

The second cleaning step is to remove all non-English words, like messy strings and words in other languages. The English words are defined as all English words included in the ‘GradyAugmented’ dictionary, which can be loaded by installing the ‘qdapDictionaries’ package. For this task, three new appeared words – ‘corona’, ‘coronavirus’, ‘covid’ – are added to the list/dictionary of English words. This cleaning work can be roughly done by listing all words in each corpus first, then finding strings that are not included in the English words list – non-overlapped strings by comparing the words list in each corpus and the

English words list through the ‘setdiff’ function, and finally delete them. However, the ‘setdiff’ function can only deal with less than 4,000 words at one time. But there are nearly 1 million words in each corpus – most words only appear one time. Therefore, in this task, instead of all words, only words that appear more than one time in each corpus are compared with the defined English dictionary, because less-frequency words that only appear one time have few impacts on further analysis in this task. There are nearly 6000 words that appeared more than one time in each corpus – one third of them appeared more than 5 times. So, I firstly filtered all words that appear more than 5 times, compared them with the dictionary, and deleted non-overlapped strings. Then I set the frequency to 2 and redone the above job – filter words with frequency 2, compare them with the defined dictionary, and delete non-overlapped items.

## 4. Main Analysis

### 4.1 Overview of data

Firstly, the word clouds for both corpora are generated by codes in lines 170 to 177. Following **figure 4-1** presents the word cloud based on all words covered in the New York Times news titles from Jan 2020 to Apr 2021. **Figure 4-2** presents the word cloud based on all words in the US congressional speech records on the first day of each month in the same period. The result shows that the top-frequency words covered in these two corpora are different. For New York Times, the most frequent words covered in the news title in the last 14 months are, in sequence, ‘Coronavirus (covid/pandemic)’, ‘Trump’, ‘election’, and ‘vaccine’. These words just reflect the significant events that happened in the last 14 months – the outbreak of Covid-19, the US presidential election, and the introduction of vaccines for Covid-19. But the most frequent words covered in the US congressional speeches on the first day of the last 14 months include ‘House’, ‘committee’, ‘senate’, ‘congress’, and ‘The United States’. These words are no more than daily governmental/political terms and reflect few focuses on global events. But these words do reflect the political property of congressional speeches. By comparison, the New York Times news focuses more on the hotspot issues than congressional speeches.

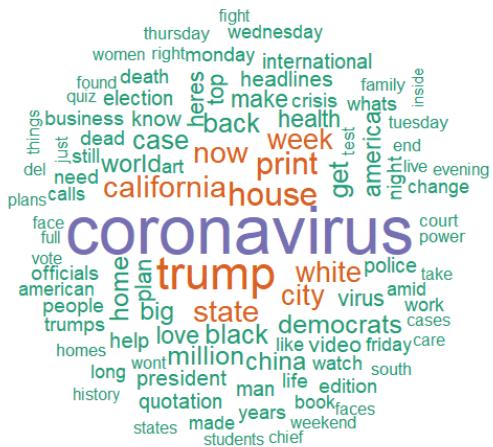


Figure 4-1: Word cloud for news titles of New York Times in the last 14 months

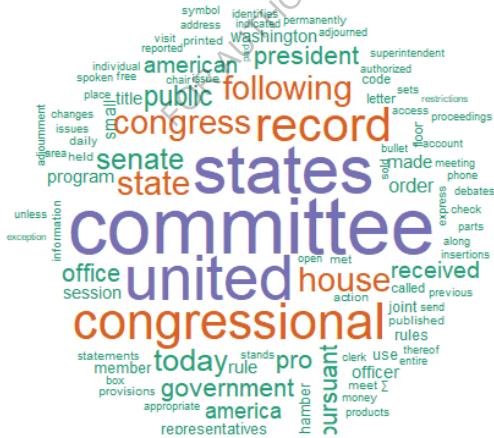


Figure 4-2: Word cloud for US congressional speeches on the 1<sup>st</sup> day in the last 14 months

## 4.2 The changes of focus over time

This work is to study the change of focus of both New York Times news titles and US congressional speeches by extracting the top 3 frequent words appeared in these two corpora in each of the previous 16 months. The result is presented in following **table 1**.

Top 3 frequent words, delete meaningless words

Time	New York Times News Title	Congressional Speech Records
2020/01	Trump, impeachment, Iran	house, anguished, Arabia
2020/02	coronavirus, Trump	president, halftime, serling
2020/03	coronavirus, Trump, virus	committee, accuses, arguments
2020/04	coronavirus, Trump, pandemic	senate, administrators, anguished
2020/05	coronavirus, Trump, pandemic	house, additional, Arabia
2020/06	coronavirus, Trump, primary	committee, arrested, arguments
2020/07	coronavirus, Trump, pandemic	house, accuses, Arabia
2020/08	Trump, coronavirus, election	abandon, arguments, arrested
2020/09	Trump, coronavirus, election	committee, Arabia, problem
2020/10	Trump, election, coronavirus	senate, apple, additional
2020/11	Trump, election, coronavirus	currency, fink, engineers
2020/12	vaccine, covid, coronavirus	senate, additional, abandon
2021/01	covid, case, risk	states, arrested, argues
2021/02	recipes, covid, Trump	committee, abandon, domains
2021/03	covid, vaccine, pandemic	senate, accuses, arguments
2021/04	covid, vaccine, police	committee, administrations, Arabia

From this table, we can see that the news titles of the New York Times closely and timely reflect hotspot issues. At the beginning of January of 2020, the US kills Iran general Qassem Suleimani (The Guardian, 2020), and this event became the hottest issue at that time. The Covid-19 pandemic was outbroken widely worldwide since February 2020, and since then, the most important and frequent word covered in the news title of the New York Times is ‘coronavirus’. The focus changed to ‘Trump’ 4 months before the US presidential election and lasted until the election result released in November 2020. After then, the global focus turned to popularize vaccination, and, therefore, the word ‘vaccine’ was more frequently covered in news titles. However, the top 3 frequent words covered in US congressional speeches varied significantly over months and did not reflect the hotspot issues. The only thing that can be reflected in these speeches is the US government’s long-term focus on Arabia because the word ‘Arabia’ was usually among the top 3 frequent words covered in US congressional speeches.

### 4.3 Sensitivity analysis

Deephouse (1996) and Bansal and Clelland (2004) introduced a modified Janis-Fadner imbalance coefficient to measure the tendency (positive or negative) of media coverages. Based on all news titles of the New York Times from Jan 2020 to Apr 2021, the Janis-Fadner (JF) coefficients for each month are presented in following **Figure 4-3**.

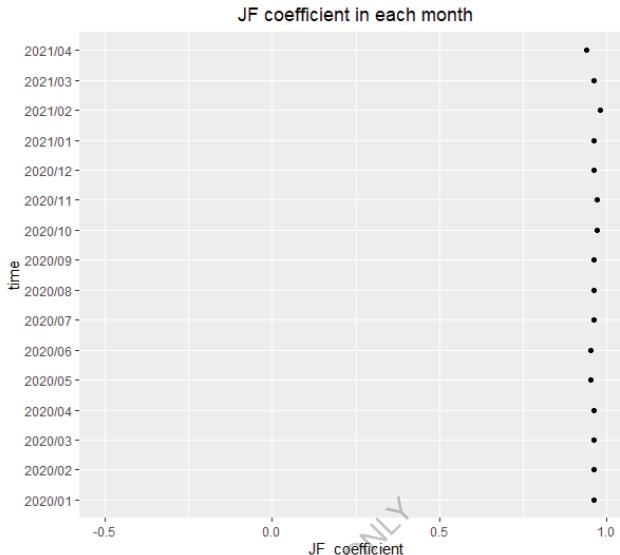


Figure 4-3: Monthly Janis-Fadner coefficient of New York Times news titles

It can be seen that, in the past 16 months, the monthly Janis-Fadner coefficients vary from 0.94 to 0.98, and the total JF coefficient is very close to 1. This result means that in the last 16 months, the New York Times news covered much fewer negative words than positive words. So, the overall tendency of the last 16 months' news report is positive. Code lines 214 to 238 are used to conduct the work of this part. And following **Figure 4-4** presents how the Janis-Fadner coefficient is calculated in this task.

$$y = \begin{cases} \frac{f^2 - fu}{r^2}, & \text{if } f > u \\ 0 & \text{if } f = u, \\ \frac{fu - u^2}{r^2}, & \text{if } u > f \end{cases}$$

where  $f$  = number of favorable (positive) coding units,  $u$  = number of unfavorable (negative) coding units, and  $r$  = the total number of favorable and unfavorable coding units.

Figure 4-4: Modified Janis-Fadner coefficient (Deephouse,1996; Bansal & Clelland, 2004)

#### 4.4 Keywords analysis

In this section (code lines 241-252), some keywords are defined, and their time changes of frequency are analyzed based on the New York Times news titles corpus. The ‘keywords’ include ‘coronavirus’, ‘covid’, ‘pandemic’, ‘trump’, ‘election’, and ‘vaccine’. The three words – ‘coronavirus’, ‘covid’, and ‘pandemic’ – all reflect the Covid-19 topic, so this task also uses the sum of these three words to represent the ‘Covid-19’ topic. Following **figure 4-5** presents the appearance of each keyword over time, and **figure 4-6** plots the change of the frequency of these keywords according to their appearances in each month from Jan 2020 to Apr 2021.

The result shows that, among these keywords, the Covid-19 related words appeared more frequent in most months from Jan 2020 to Apr 2021, especially in March-April 2020, when the pandemic was first outbreak, and at the beginning of 2021, when the second wave was highly considered by the public. Two words – ‘Trump’ and ‘election’ – were most popular from September to November 2020, when the competition for the US president position came to the final stage and attracted many people’s consideration at that time. The word ‘vaccine’ was more mentioned since the end of 2020, when many kinds of effective coronavirus vaccines were developed successfully and put into widespread use. This result is in line with the analysis result in section 4.2 – the changing focuses of New York Times news titles reflect the change of global hotspot issues over time.

time	coronavirus	election	pandemic	trump	vaccine	covid	sum_covid_19
2020/01	109	18	2	290	4	0	111
2020/02	346	28	9	248	1	1	356
2020/03	1305	24	105	184	7	18	1428
2020/04	1085	21	193	208	20	70	1348
2020/05	600	30	191	193	35	60	851
2020/06	315	191	120	250	15	44	479
2020/07	326	119	120	278	31	87	533
2020/08	229	165	88	368	28	88	405
2020/09	199	146	132	445	64	100	431
2020/10	245	272	102	609	26	162	509
2020/11	180	304	126	376	66	128	434
2020/12	205	64	140	197	224	208	553
2021/01	150	159	111	406	151	3324	3585
2021/02	90	16	106	165	160	169	365
2021/03	108	27	130	55	187	249	487
2021/04	48	13	66	31	108	125	239

Figure 4-5: The appearance of each keyword over time in the last 16 months

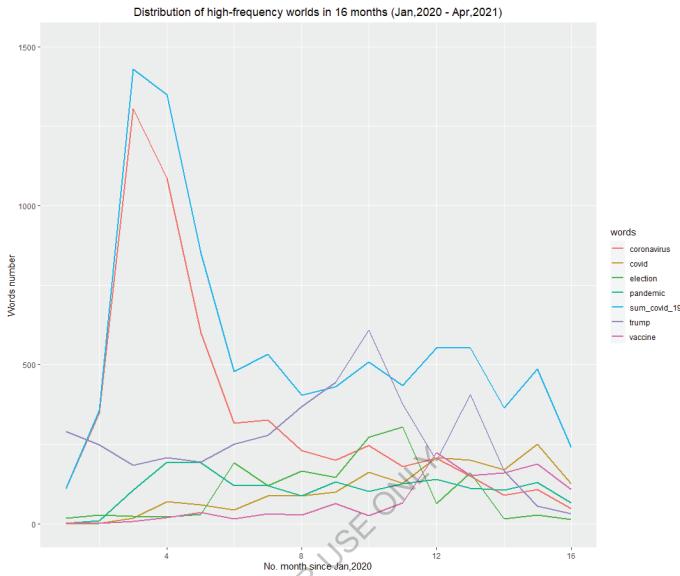


Figure 4-6: The change of the frequency of keywords in the last 14 months

## 5. Evaluation and Recommendation

This task conducted a series of text mining jobs mainly based on the New York Times news titles corpus from Jan 2020 to Apr 2021. This task also did some analyses based on the US congressional speeches during the same period. The result shows that compared with the focuses of US congressional speeches, the focuses of New York Times news titles better reflected the changing hotspot issues over time. Besides, although this task only uses a small sample of the whole database of both the two sources (New York Times and US congressional speeches) because of the limitation on running speed and time, one important contribution of this task is that the codes for this task can be used to download the New York Times news title and US congressional speech records among any time period since 1852. Based on the whole data, more interesting exploring works are worth to be conducted in the future. For example, it is interesting to exploring the change of the title style (length of news titles) of New York Times News over a longer history (more than 50 years). It is also

attractive to investigate the changing focuses on countries in US congressional speeches – the result can reflect the changing of the most concerned country of US government over time. Both the above works should be based on analyzing massive data covering at least 50 years in order to make the analysis persuasive and meaningful. For conducting these works, enough time and a high-speed computer are needed.

FOR AUTHOR USE ONLY

## **References List**

- Bansal, P. and Clelland, I., 2004. Talking trash: Legitimacy, impression management, and unsystematic risk in the context of the natural environment. *Academy of Management journal*, 47(1), pp.93-103.
- Deephouse, D.L., 1996. Does isomorphism legitimate?. *Academy of management journal*, 39(4), pp.1024-1039.
- The Guardian. 2020. *US kills Iran general Qassem Suleimani in strike ordered by Trump*. [online] Available at: <<https://www.theguardian.com/world/2020/jan/03/baghdad-airport-iraq-attack-deaths-iran-us-tensions>> [Accessed 24 April 2021].

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## Appendix-1: R codes

The R codes is also available on the Github link: <https://github.com/XUAN-FENG9/Advanced-Financial-Analytics/>

### Load packages

```
1 ##### Individual Empirical Assignment for AFA course
2 #Author: XUAN FENG
3 #Student ID: 559937
4 #####
5 #
6 # clean workspace/environment
7 rm(list = ls())
8 #
9 #
10 # load necessary packages
11 library('rvest')
12 library('tidyverse')
13 library('tm')
14 library('text')
15 library('stringr')
16 library('wordcloud')
17 library('gridExtra') # for reading pdf documents and transfer them to texts
18 library('tcltk') # deal with output problem - in for loop, if a pdf is too large and consume too much time for reading, then skip
19 library('quanteda') # use the english dictionary 'graddaugmented' for data cleaning - remove meaningless words.
20 library('quanteda.enities') # use the english dictionary 'graddaugmented' for data cleaning - remove meaningless words.
21 library('lubridate')
22 
```

### Load text (New York Times news titles)

```
1 # STEP 1: Load texts
2 #
3 #
4 ##### STEP 1: Load texts
5 #
6 #
7 # Following codes are used for load all new articles of Newyork Times Journal (1852 to 2022)
8 web = "https://www.nytimes.com/sitemap/"
9 # use a double for-loop plus a lapply function to read the webpages of each day in each month in each year
10 dirc.create("D:/Nytimes_monthly") # generate the main output directory - each txt file represents each year
11 dirc.create("D:/Nytimes_monthly") # generate the main output directory - each txt file represents each month
12 wholetitle.list() # create an empty list directory for further write-in news titles
13 #
14 # define a function url()
15 gettitle<-function(url){
16   url<-read_html(url)$html_nodes(xpath = '//*[@id="site-content"]/div[1]/h1')$html_text()
17   }
18 #
19 pb <- tigr прогрессар(title="process",label="finished %", min=0, max=100, initial = 0, width = 300) # create a process bar
20 # use a double for-loop plus a lapply function to read the webpages of each day in each month in each year
21 for (i in 1852:2022) { # first loop based on year - open each year's web
22   for (j in 1:12) { # second loop based on month - open each month's web in each year
23     for (k in 1:30) { # third loop to judge whether continue the loop or not
24       url0<-paste0("D:/Nytimes_monthly/",i)
25       url0.paste0(url,sep="") # if false j=0,paste0(i,j), j=1,paste0(i,1) ... , j=30,paste0(i,30) generate the web url for each month
26       ndays<-as.numeric(Ndays)
27       url1<-url0[1:(nDays*30),paste0(0,ndays),nDays] # generate the web url for each day's news
28       url1<-split(url1, length(url1)) # transfer to a list, which can be used for 'lapply'
29       wholetitle.list() # apply lapply, gettitle # third loop - apply the 'gettitle' function on each day, output a list containing all titles in each month
30       wholetitle.list() # paste each month's title and output a list containing all titles in each year
31       txt<-unlist(wholetitle.list)
32       write.txt(paste0("D:/Nytimes_monthly/",i,"/",j,".txt"))
33     },silent=TRUE) # and try, don't show server warning information
34   }
35   try(error) # use error to jump errors/warnings and continue the loop
36   wholetitle.list() # output a list directory including all news titles
37   wholetitle<-wholetitle.list(text) # output a list directory including all news titles
38   write.txt(paste0("D:/Nytimes_yearly/",i,".txt")) # write the new titles in "D:/Nytimes" as txt document, each document for each year
39   # following two lines are used for the process bar
40   info<- sprintf("finished %s", round((i-2001)*100/(2022-2001)))
41   setTkrProgressbar(pb,value = -(i-2001)*100/(2022-2001), title = sprintf("process (%s)",info),label = info)
42   }
43 close.pb # close the process bar
44 
```

## Load text (US congressional speeches)

```

07 # following codes are used for 104th-117th congresses, which have the websites in the same format
08 # we can use "congress.gov"
09 pdfLinkList<-list()
10 dir.create("0/congress") #generate the main output directory
11
12 # First use a For loop to read all congress's website (mainly use the 'rvest' package)
13 for (i in 104:117) {
14   url_pasted<-paste0("https://www.congress.gov/congressional-record/",i,"th-congress/browse-by-date")
15   pdfLink<-tibble(link=paste0(url_pasted,i)) #generate the full web-link for each record/pdf
16   pdfLink$read_html()$xml_nodes(xpath = "/td[6]/a")$xml_attr("href") #for each record/pdf's web link
17   pdfLink$create_paste0(web,pdfLink) #generate the full web-link for each record/pdf
18   pdfLink$create_paste0(web,tibble(link=pdfLink)) #generate the list that save all the web-link for all record, each item in the list represents one congress
19   dir.create(paste0("0/congress/",i)) #create a folder for the main folder of each congress
20   for (j in 1:nrow(pdfLink)) { #then use a for loop to read all pdf in each congress's website, convert that to txt files, and save them in each congress's folder
21     pdfLink[j]$text->pdf_text(paste0("0/congress/",i,"/",j,".txt"))
22     write(text.paste0("0/congress/",i,"/",j,".txt"))
23   }
24 }
25
26
27 ##### Following codes are used for loading 87nd-103rd congresses speeches, which have the websites in the same format
28 # define the suffix for each congress, because the suffix is included in each congress's website url location
29 suffix<-function (i) {
30   if (i %in% c(84,94,101)) {
31     "st"
32   } else if (i %in% c(82,92,102)) {
33     "nd"
34   } else if (i %in% c(83,93,103)) {
35     "rd"
36   } else {
37     "th"
38   }
39 }
40
41
42 # First use a double for loop to read all congresses' website (mainly use the 'rvest' package)
43 # we need to First open the congress website including all records' link, then open the website For each record, then open the pdf link
44 # we can use "congress.gov/congressional-record/"
45 url_pasted<-paste0("https://www.congress.gov/congressional-record/",i,suffix(i),"congress/browse-by-date")
46 dir.create(paste0("0/congress/",i)) # create a folder in the main folder 0/congress for each congress
47 tibble(link=pdfLink)$read_html()$xml_nodes(xpath = "/td[3]/a")$xml_attr("href") #generate the full web-link for each record/pdf
48 linko<-tibble(link=paste0(url_pasted,web,link))
49 pdfLink<-linko
50
51 ##### Second for loop to read all pdf in each congress's website, convert them to txt files, and save them in each congress's folder
52 for (n in 1:nrow(linko)) {
53   tryCatch({
54     pdfLink$link[n]$link0$link$read_html()$xml_nodes(xpath = "//[@id='content']//div[2]/p[2]/a")$xml_attr("href")
55     pdfLink$link[n]$read_html()$xml_nodes(xpath = "/td[3]/a")$xml_attr("href")
56     pdfLink$link[n]$pasteo(web,pdfLink$link[n])
57     pdfLink$link[n]$text->pdf_text(paste0("0/congress/",i,"/",n,".txt"))
58     write(text.paste0("0/congress/",i,"/",n,".txt"))
59   }, silent = TRUE)
60 }
61 pdfLinkList<-c(pdfLinkList, list(pdfLink))
62
63
64
65
66
67
68
69
70
71
72
73
74
75
76
77
78
79
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162
163
164
165

```

```

123 ##### STEP 2: data Cleaning
124 # define a vector which contains the words that appear in the speeches, but not in the news
125 remove_C<-c("articles", "titles", "from_page", "corrections", "correction", "for the record", "letters", "to the editor",
126 "paid notice", "deaths", "news summary", "weddings", "new york", "news", "will", "month", "year", "day", "jkt", "frm",
127 "smr", "mtm", "next", "last", "one", "two", "three", "first", "second", "new", "time", "times", "briefing", "dies",
128 "one", "two", "three", "four", "five", "six", "seven", "eight", "nine", "ten", "eleven", "twelve", "thirteen", "fourteen",
129 "months", "toween", "onehun", "month", "abb") #generates a vector included 107 months(including abbreviations) for data clean
130 isoLetters<-c("letters") #generates a vector of 26 letters for data clean - the meaningless isolated letters may appear due to other data clean steps
131
132 #define a function 'textclean' - use it for all txt documents
133 textclean<-function(x){
134   document<-Corpus(DirSource(dir))
135   document<-tm_map(document,lower) #convert all text to lower-case
136   document<-tm_map(document,removeNumbers) #remove all numbers
137   document<-tm_map(document,removePunct) #remove all punctuation
138   document<-tm_map(document,removeWords,remove) #remove all uninteresting words defined before in 'remove' vector
139   document<-tm_map(document,removeVowels) #remove all vowels
140   document<-tm_map(document,removePattern,gsub(pattern," ",x)) #remove all patterns
141   document<-tm_map(document,removePunctuation) #remove punctuations
142   document<-tm_map(document,removeWords,stopwords("en")) #remove all English stopwords
143   document<-tm_map(document,removeWords,months) #remove all months
144   document<-tm_map(document,removeWords,abbreviations) #remove all abbreviations
145   document<-tm_map(document,stripWhitespace) #remove white space
146 }
147
148 # use the 'textclean' Function for all new title records From 2020 to 2021, by month
149 NYTimes<-textclean(dir="0/nytimes_monthly") #generate a corpus list including all after-cleaned texts
150 congress<-textclean(dir="0/congress/selected") #use the 'textclean' function for all congress speeches
151
152 # Further clean - clean non-english words
153 tdmnyt<-TermDocumentMatrix(NYTimes)
154 allTokens1<-findfreqterms(tdmnyt,2) #recognize words that appears over 2 times - these words are worth consideration
155 allTokens2<-findfreqterms(tdmnyt,1) #recognize words that appears over 1 times - these words are worth consideration
156 congress<-tm_map(congress,removeWords,allTokens1) #add covid related new terms
157 NYTimes<-tm_map(NYTimes,removeWords,allTokens2) #add covid related new terms
158 NYTimes<-tm_map(NYTimes,stripWhitespace)
159
160 tdmcs<-TermDocumentMatrix(congress)
161 allTokens2<-findfreqterms(tdmcs,2)
162 allTokens3<-findfreqterms(tdmcs,1) #add items1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,21,22,23,24,25,26,27,28,29,30,31,32,33,34,35,36,37,38,39,40,41,42,43,44,45,46,47,48,49,50,51,52,53,54,55,56,57,58,59,60,61,62,63,64,65,66,67,68,69,70,71,72,73,74,75,76,77,78,79,80,81,82,83,84,85,86,87,88,89,90,91,92,93,94,95,96,97,98,99,100,101,102,103,104,105,106,107,108,109,110,111,112,113,114,115,116,117,118,119,120,121,122,123,124,125,126,127,128,129,130,131,132,133,134,135,136,137,138,139,140,141,142,143,144,145,146,147,148,149,150,151,152,153,154,155,156,157,158,159,160,161,162,163,164,165

```

## Text analysis (all steps)

```

166 # STEP3: Text Analysis
167 #####
168 # PART 1: News analysis
169 # Overall pattern
170 tMyt1<-tmix(tMyt1*x$Nytimes)
171 tMyt1<-as.matrix(tMyt1)
172 communityly.cloudMyt1,max.words = 100,colors=brewer.pal(3,"dark2"),random.order=FALSE) #word cloud for newyork times news title
173
174 tMcgs<-tmix(tMcgs)
175 communityly.cloudMcgs,max.words = 100,colors=brewer.pal(3,"dark2"),random.order=FALSE) #word cloud for congress speeches
176
177 # 3.2 - The change of focus over time - top three frequent words for both corpuses
178 TMyt1<-tmix(tMyt1*rownames_pkconfig_get_config("tibble::rownames", NA)) #transfer matrix to DataFrame and keep row names
179 Mcgs<-tmix(tMcgs*rownames_pkconfig_get_config("tibble::rownames", NA)) #transfer matrix to DataFrame and keep row names
180 TMyt1<-TMyt1 %>% TMyt1 %>% "copy"
181 TMyt1<-TMyt1 %>% "copy"
182 TMyt1<-TMyt1 %>% "copy"
183 TMyt1<-TMyt1 %>% "copy"
184
185 #define a function to explore each corpus's top three Frequent word in each month (2020-2021)
186 topMyt1<-function(x)
187 {
188   first<-rownames(TMyt1)[which(x==max(x))]
189   x[x==max(x)]<-0
190   second<-rownames(TMyt1)[which(x==max(x))]
191   x[x==max(x)]<-0
192   third<-rownames(TMyt1)[which(x==max(x))]
193   x[x==max(x)]<-0
194   top<-c(first,second,third)
195 }
196
197 topMyt1<-apply(TMyt1,1,top3by)
198 #Topic 1 has more meaningless strings, so pick top 5.
199 topics<-function(x)
200 {
201   first<-rownames(TMyt1)[which(x==max(x))]
202   x[x==max(x)]<-0
203   second<-rownames(TMyt1)[which(x==max(x))]
204   x[x==max(x)]<-0
205   third<-rownames(TMyt1)[which(x==max(x))]
206   x[x==max(x)]<-0
207   forth<-rownames(TMyt1)[which(x==max(x))]
208   x[x==max(x)]<-0
209   fifth<-rownames(TMyt1)[which(x==max(x))]
210   x[x==max(x)]<-0
211   top<-c(first,second,third,forth,fifth)
212 }
213
214 topics<-apply(TMyt1,1,top3by)
215
216 # 3.3 - Sensitivity Analysis - The change of JF Factor
217 JF<-function(x)
218 {
219   text_df<-tibble(text_as.character(x))
220   tokentext<-text_df %>% unnest_tokens(word,text)
221   negwords<-tibble_get_sentiments("loughran")%>%filter(sentiment=="negative")
222   tokentext<-tokentext %>% inner_join(negwords)%>%count(word,sentiment,sort = TRUE)
223   nneg<-sum(tokentext$`n`[1])
224   poswords<-tibble_get_sentiments("loughran")%>%filter(sentiment=="positive")
225   tokentext<-tokentext %>% inner_join(poswords)%>%count(word,sentiment,sort = TRUE)
226   npst<-sum(tokentext$`n`[1])
227   total<-nneg+npst
228   npst<-npst/(nneg+npst)/total
229   nneg<-nneg/(nneg+npst)/total
230   round(JF,2)
231 }
232
233 JF_Total<-JF(Nytimes)
234 JF_monthly<-apply(Nytimes,2,JF)
235 JF_monthly<-tibble(JF_monthly)
236 JF_monthly<-JF_monthly %>% monthly(rownames_pkconfig_get_config("tibble::rownames", NA))
237 JF_monthly<-time(JF_monthly, c("2020/01", "2020/02", "2020/03", "2020/04", "2020/05", "2020/06", "2020/07", "2020/08", "2020/09", "2020/10", "2020/11", "2020/12", "2021/01", "2021/02", "2021/03", "2021/04"))
238 JF_monthly<-time(JF_monthly, c("2020/01", "2020/02", "2020/03", "2020/04", "2020/05", "2020/06", "2020/07", "2020/08", "2020/09", "2020/10", "2020/11", "2020/12", "2021/01", "2021/02", "2021/03", "2021/04"))
239
240 # 3.4 - Key words analysis
241 analysis<-c("coronavirus", "covid", "pandemic", "trump", "election", "vaccine")
242 analysis<-TMyt1 %>% filter(x %in% analysis)
243 ananyt1<-tibble(ananyt1,rownames_pkconfig_get_config("tibble::rownames", NA))
244 ananyt1<-time(ananyt1, c("2020/01", "2020/02", "2020/03", "2020/04", "2020/05", "2020/06", "2020/07", "2020/08", "2020/09", "2020/10", "2020/11", "2020/12", "2021/01", "2021/02", "2021/03", "2021/04"))
245 ananyt1<-ananyt1[-1,]
246 ananyt1<-ananyt1[1:(16)]
247 ananyt1<-ananyt1 %>% mutate(`c`=coronavirus, `ananyt1_covid`=covid, `ananyt1_pandemic`=pandemic, `trump`="trump", `election`="election", `vaccine`="sum_covid_19")
248 ananyt1<-ggplot(aes(x=ananyt1$month,y=ananyt1$c),color_words)+theme_plot_title_element_text(hjust=-0.5)+geom_line(size=1.5)+ylim(0,1500)+ggtitle("Distribution of high-frequency words in 16 months (Jan,2020 - Apr,2021)")+
249 xlab("Mo. month since Jan,2020") + ylab("words number")
250
251
252
253
254
255
256 # end 22nd, Apr11, 2021
257

```







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