INVESTIGATING THE RELATIONSHIP BETWEEN DIGITALIZATION AND VALUATION OF GLOBAL LOGISTICS COMPANIES

A Dissertation
Submitted to
the Temple University Graduate Board

In Partial Fulfillment
of the Requirements for the Degree
DOCTORAL OF SCIENCE IN GLOBAL FINANCE

---

by
CHOW, Ka Lok Kevin
May 2023

Examining Committee Members:

Gurdip Bakshi, Department of Finance
Xiaohui Gao Bakshi, Department of Finance
Zhigen Zhao, Department of Statistics, Operations, and Data Science
Elizabeth Gordon, Department of Accounting

ABSTRACT

We are trying to explore and analyze the possible relationship between digitalization and the valuation of global logistics companies. We focus on the top 70 global logistics companies listed on reputable stock exchanges around the world by market value and go through their annual reports and audited financial accounts with a view to create an insight on their level of digitalization. We observe that there is an obvious increase in attention to digitalization by the logistics service providers throughout the world over the last decade. While we are not in the position to prove a causal relationship between digitalization and valuation, we find that an increase in digitalization awareness is strongly related to growth in both financial performance and market valuation in the logistics industry, especially during the recent disrupting period caused by the COVID-19 pandemic. It seems that investors across different major capital markets, from New York to London, Frankfurt to Tokyo, Hong Kong to Shanghai, are willing to reward digitalization efforts made by a logistics company in the form of both higher absolute value and rate of increase of market capitalization.

Key words: Logistics, Digitalization, Information Technology, Market Value, Global Logistics Networks, Supply Chain Disruption

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

Logistics powers the global economies. It is an overall process of acquiring, coordinating, moving, and storing resources (including people, materials, inventory, and equipment) from one location to its desired destination. Digital technology's advancement has massively transformed the logistics industry from many aspects. It, however, also makes the global and domestic trade networks more complex than before which brings new and unique challenges to the industry. Modern logistics service providers face increased disruption due to new form of business model (like e-commerce), changing consumer behavior, and new regulatory environment. There is no doubt that the industry has benefited tremendously from continued technological advancement and making great progress on digitalization. However, it has yet to take advantage of the full potential of digital technologies. In addition, the precise scope of digitalization is difficult to grasp. While we can observe the influence and trend of digitalization in adoption of different digital technologies, such as, internet, mobile communication, cloud computing, artificial intelligence, big data, blockchain, internet of things, 5G, etc., there is no agreed method on how to measure level of digitalization. It is also lack of evidence to show a direct relationship between company's level of digitalization and its business performance as well as capital market performance. A study of this topic may provide support for the senior management of logistics service providers in designing its approach toward digitalization and in making budgeting and spending decisions.

Our research provided evidence for a positive association between digitalization awareness and valuation in global logistics sector. While we are not in the position to

prove a causal relationship between digitalization and valuation, we find that an increase in digitalization awareness is strongly related to growth in both financial performance and market valuation in the logistics industry, especially during the recent disrupting period caused by the COVID-19 pandemic. Such findings are consistence for the logistics companied listed in different major stock markets around the world. In another words, a logistics service provider with better financial performance generally shows a higher awareness in digitalization, and equity investors who invest in logistics sector are more willing to include such companies in their portfolio.

CHAPTER 2

LITERATURE REVIEW

The so-called Industry 4.0, the fourth industrial revolution, has become a common theme around the world. Application of new technologies, in particular information technologies, has transformed the entire production process and business engagement. That also enhances the globalization in many aspects. In order to remain competitive in this more globalized world, logistics companies, especially those with certain scale, need to continuously invest in their business operation systems to adapt to the changing market needs and challenges.

Impact of Digitalization on International Logistics and Supply Chain

In this information age, digitalization in logistics is a major trend. Especially during the COVID-19 pandemic, the ubiquitous access to information and the demand for digital services by consumers have further reshaped the logistics industry, and digitalization is a key factor in the transformation of logistics and supply chain management[1,2]. For international logistics companies, digitalization helps to maintain global competitiveness[3]. The use of digital applications makes it possible to improve the operational management system based on the value chain model, to quickly identify potential risks and possible losses in the simulated value chain[4].

However, not all sub-sectors of logistics industry having a smooth transition in their digital journey, Giorgio Bavassanoa, Claudio Ferrarib, Alessio Tei[5] noticed that technological and technical advancements in maritime industry had been always considered a challenging issue due to a certain conservatism of the industry. Port and shipping companies have often proved themselves quite resilient to innovative

solutions and this is mainly connected to the nature of their own business[6,7,8]. Although there is resistance to the digital transformation, it's benefits are supported by many researchers. In their studies, Assunta Di Vaio & Luisa Varriale observed, by using a digital platform, the reduction of coordination and control costs for managing information and data regarding the port operations (improvement of timing schedules and reduction of paper documents), and higher transparency can be achieved in sharing knowledge and data in the seaport industry, along with lower uncertainty regarding the management of port operations, and major trust between port stakeholders (easier and unlimited accessibility and tracking)[9]. Anecdotal evidence suggests that some firms are more successful than others because of their superior digital business capability, which creates value by effectively managing digital business transformation[10,11,12]. Digital business transformation is a continuous process that aims to improve a firm's value proposition by triggering significant changes to its resources through combinations of digital technologies[13]. It forces firms to develop foundational capabilities to remain competitive[14].

Fundamental to the digital transformation of the freight and logistics sector is the need for suitable information and communication technologies to enable data collection, storage, processing, and sharing to create strong digital links within and outside the organization [15]. In the context of the global trend to focus on green, Joseph Sarkis [16] through literature analysis, links digital technology to environmental sustainability, arguing that the impact of digital technology on the supply chain is two-sided, on the one hand, its promotion of physical, environmental, economic, and social sustainability of transportation, and on the other hand the risk of data misuse[17], which could potentially be a source of environmental degradation across the supply chain. In a study based on a Turkish logistics company, Kayikci, Y.[18] argues that in order to

achieve the requirements of sustainable development, logistics should be placed in a broader framework. International logistics companies, as a service industry, provide products that include information in addition to transportation services[19]. The real existence of a variety of low-value information aggregated together becomes a source of big data, and the use of big data technology can uncover its hidden value, which has a significant impact on improving the services provided by logistics companies[20,21,22]. A company's resourcefulness affects financial performance, and Yu, W., Chavez, R., Jacobs, M. A., & Feng, M.[23]'s use of big data as a resource deepens our understanding of how to manage supply chains in a data-rich environment. Digital supply chains integrate technologies such as big data and blockchain to create more value upstream and downstream in the supply chain with a customer-oriented approach[24]. Social and economic factors are important drivers in building digital supply chains and must be taken into account by governments and businesses[25,26].

Major Digital Technologies and their Applications

The key technologies needed in the process of logistics digitalization construction include: AI, Cloud Computing, Big Data, loT, Block Chain, 5G, Digital Twins, etc[27]. The digital transformation of logistics industry is giving birth to huge and increasingly growing sets of voluminous data with high velocity and varied data sources, also known as Big Data[28]. Big Data analysis refers to the extraction of useful information from the database according to the demand, and application in specific fields. Cloud computing technology supports data storage, management, and analysis[29]. In supply chain management, big data and cloud computing are often used together to analyze large amounts of information to better capture the needs of incoming customers and achieve reliable decisions[30]. Logistics companies have limited resources, and the

use of big data technology for resource allocation ensures that all resources are effectively applied to business activities. Digital twins use bionic programs to form idealized models of supply chains, using ideal supply chains as the goal for building more advanced logistics systems[31]. In the supply chain connecting consumers and suppliers, Block Chain is used as an information management tool to alleviate information asymmetry and enhance supply chain management through internal and external cooperation[32]. For warehouses, an important node in logistics, digital warehouse management systems provide unique digital markers for stored goods and minimize counting errors in goods[3]. Harris, I., Wang, Y., & Wang, H.[33] outline the current applications of ICT in logistics from a multimodal perspective, including freight resource management systems and applications, terminal and port information and communication systems and applications, freight and fleet tracking and management systems, and integrated information platforms. The application of these technologies enables the real-time flow of information between different modes of transportation. Specifically in maritime transportation, blockchain technology simplifies paperwork like making documents, declaration, and traceability of dangerous goods, and facilitates the information transfer process of various participants in international logistics[34]. Using these technologies, the supply chain forms a cycle of collecting data, analyzing it as well as carrying out actions[35]. Executives' attitudes towards the use of trends and technologies in supply chain are affected by the type of company, year of establishment, number of employees and technological infrastructure, and the main factors revealed in regression analysis are mobility, human factor, and pricing[36].

Relationship between Digitalization and Market Value

Digitization facilitates the promotion of firm's value, and there are significant differences in the impact of digitalization on firm value for firms at different lifecycle stages[37]. Previous studies on the relationship between digitization information provided directly or indirectly by the company and the value of the company are insufficient. This gap is filled by Salvi, A., Vitolla, F., Rubino, M., Giakoumelou, A., & Raimo, N.'s research[38], which shows that the level of digitization of information published by companies contributes to a positive impact on the value of the company. Ricci, F., Scafarto, V., Ferri, S., & Tron, A.[39] quantifies the level of digital information disclosed by each company by analyzing the annual reports of 75 Italian listed companies and similarly concludes that there is a link between the digital information published by the company and the market value of the company's shares. On this basis, Truant, E., Broccardo, L., & Dana, L. P.[40] further investigated the positive correlation between the market value of the stocks of these Italian listed companies and digital investments. In the Chinese market, Wu Fei et al.[41] conducted a similar study and found that the digital transformation of companies significantly enhances stock liquidity, thus providing clues to understanding the liquidity of micro-entities in the capital market. Because of these links, securities regulators should require listed companies to disclose more information in their annual reports about digitization[42]. However, such link is still not entirely clear. Wilbur Chen and Suraj Srinivasan[43] find weak evidence of near-term, positive improvements in fundamental performance, as we find some evidence of interim productivity increases, but declines in sales growth conditional on digital activities. Thus, further research on this topic is needed.

The logistics industry, as an important part of the national economy and an important service sector serving social development, shows a non-linear U-shaped

relationship between digitalization and service level on firm performance[44]. Although all companies cannot avoid the general trend of digital transformation, technological upgrades add significant costs, while the ensuing effect on firm value is slow[45]. Strategic emphasis on digital transformation leads to a higher market capitalization for larger firms and to a lower market capitalization for smaller firms. Whereas larger firms should further disclose their strategic emphasis on digital transformation, smaller firms should consider sending additional signals to investors, demonstrating their ability to undergo digital transformation successfully[46].

Conceptual Foundation

One of the core objectives of this research is trying to establish a method to measure the level of digitalization awareness. Based on the assumption that digitally innovative logistics service providers would report their progress on digitalization more extensively and use digital technology related key words more frequently, our review will focus on identify using such key words in different topics in the selected companies' standard annual reports. A pioneer in adopting digital technology should also be aware of the importance of digitalization earlier than its peer companies, and therefore, making more comprehensive disclosure about digitalization in its annual reports.

Digital technology can be applied to many aspects of logistics service providers' operation. In general, the purposes for a logistics company to embark its digital journey are usually trying to improve their operation efficiency, shorten service response time, create new service offerings, and facilitate decision making, based on an assumption that all such improvement will transform into to higher revenue and better cost structure. Therefore, we are expecting to see a company with higher tech spending and stronger emphasis in digitalization would have a higher growth rate and stronger profitability.

While it is hard to confirm a direct causation link between digitalization and market value, as the market value of a particular company would be affected by many internal and external factors, one may draw a positive association between digitalization efforts and valuation on the basis that the top valuation companies in the logistics sector around the world are making continuously substantial investment in adopting digital technology. In other words, the investors across different major capital markets are willing to include digitally innovative logistics service providers in their portfolios.

CHAPTER 3

RESEARCH METHODOLOGY

In our research, we are trying to investigate the relationship between digitalization and market value of publicly-listed logistics companies by reviewing the past ten years (from 2011 to 2020) annual reports and audited financial accounts of a set of 70-companies (hereafter referred to as the "Selected Companies") in total. Such set of companies are selected according to their closing market capitalization as of 1 April 2022. We picked the 70 highest market capitalization companies in logistics sector around the world. For the purpose of our research, logistics property developers and trading companies with logistics service offering are excluded. Broadly speaking, these two types of companies are usually considered in logistics sector. However, we consider it may provide a more meaningful insight to investigate how digitalization may affect an operation-driven company than an asset-based company or a trading company taking logistics service as a supplement to their main trading business.

The Selected Companies are listed on 24 different Stock Exchanges around the world, including Australian Securities Exchange, Bovespa Brazil, BSE India, Copenhagen Stock Exchange, Deutsche Borse, Euronext, Frankfurt Stock Exchange, Hong Kong Stock Exchange, KRX Stock, London Stock Exchange, Madrid Stock Exchange, Nasdaq, Nasdaq Nordic, New York Stock Exchange, New Zealand's Exchange, NSE India, Shanghai Stock Exchange, Shenzhen Stock Exchange, Swiss Stock Exchange, Taiwan Stock Exchange, Tokyo Stock Exchange, Toronto Stock Exchange and Vienna Stock Exchange (in alphabetical order). Some of the companies have been listed on more than one Exchanges, and there are differences on its market capitalization in different markets. We consider such differences are negligible and take

its initial listing market of such companies for the purpose of our research. The following table is the list of the Selected Companies:

Table 1: List of Selected Companies

No.	Selected Company	Headquarters Region	Stock Exchange	Sub-sector	Operating Revenue (2020)
1	UNITED PARCEL	USA	NYSE/Bovespa Brazil	INTEGRATED LOGISTICS	>USD 15,000m
2	HAPAG-LLOYD	Germany	Deutsche Borse/ Frankfurt	SHIPPING	>USD 15,000m
3	AP MOELLER-MAERSK A/S-A	Denmark	Nasdaq Nordic	SHIPPING	>USD 15,000m
4	DEUTSCHE POST	Germany	Deutsche Borse	INTEGRATED LOGISTICS	>USD 15,000m
5	FEDEX	USA	NYSE	INTEGRATED LOGISTICS	>USD 15,000m
6	DSV PANALPINA AS	Denmark	Copenhagen	FREIGHT FORWARDER	>USD 15,000m
7	SF EXPRESS	China	Shenzhen	EXPRESS	>USD 15,000m
8	KUEHNE & NAGEL	Switzerland	Switzerland	FREIGHT FORWARDER	>USD 15,000m
9	ZTO EXPRESS	China	NYSE/Frankfurt	EXPRESS	USD 5,000 million to USD1,000 million
10	TFI INTERNATIONAL	Canada	TSX	ROAD FREIGHT	USD 5,000 million to USD1,000 million
11	JB HUNT	USA	Nasdaq	ROAD FREIGHT	USD 15,000 million to USD 5,000 million
12	OOCL	China (Hong Kong)	HKeX	SHIPPING	USD 15,000 million to USD 5,000 million

Table 1 Continued

13	EXPEDITORS	USA	Nasdaq	FREIGHT FORWARDER	USD 15,000 million to USD 5,000 million
14	BOLLORE LOGISTICS	France	EURONEXT/ Frankfurt	FREIGHT FORWARDER	>USD 15,000m
15	JD LOGISTICS	China	HKeX	INTEGRATED LOGISTICS	USD 15,000 million to USD 5,000 million
16	NYK LINE	Japan	Tokyo	SHIPPING	USD 15,000 million to USD 5,000 million
17	C.H. ROBINSON	USA	Nasdaq/Frankfurt	FREIGHT FORWARDER	>USD 15,000m
18	SG HOLDINGS	Japan	Tokyo	EXPRESS	USD 15,000 million to USD 5,000 million
19	AMERCO /NV/	USA	Nasdaq	INTEGRATED LOGISTICS	USD 5,000 million to USD1,000 million
20	YANG MING MARTINE	China (Taiwan)	Taiwan Stock Exchange	SHIPPING	USD 15,000 million to USD 5,000 million
21	BRAMBLES	Australia	ASX	SPECIALTY LOGISTICS	USD 5,000 million to USD1,000 million
22	SITC	China (Hong Kong)	HKeX	SHIPPING	USD 5,000 million to USD1,000 million
23	YTO EXPRESS	China	Shenzhen	EXPRESS	USD 15,000 million to USD 5,000 million
24	FINANCIERE DE L'ODET	France	EURONEXT/ Frankfurt	SPECIALTY LOGISTICS	>USD 15,000m
25	HYUNDAI MERCHANT MARINE	South Korea	South Korea	SHIPPING	USD 15,000 million to USD 5,000 million

Table 1 Continued

26	XPO LOGISTICS	USA	NYSE	FREIGHT FORWARDER	>USD 15,000m
27	YUNDA HOLDINGS	China	Shanghai	EXPRESS	USD 15,000 million to USD 5,000 million
28	GXO LOGISTICS	USA	NYSE	INTEGRATED LOGISTICS	USD 15,000 million to USD 5,000 million
29	YAMATO	Japan	Tokyo	EXPRESS	>USD 15,000m
30	CIMC	China	Shanghai	INTEGRATED LOGISTICS	USD 15,000 million to USD 5,000 million
31	SAIA	USA	Nasdaq/Frankfurt	ROAD FREIGHT	USD 5,000 million to USD1,000 million
32	HYUNDAI GLOVIS	South Korea	South Korea	SHIPPING	>USD 15,000m
33	MAINFREIGHT	New Zealand	NZX	FREIGHT FORWARDER	USD 5,000 million to USD1,000 million
34	LANDSTAR SYSTEM	USA	Nasdaq	ROAD FREIGHT	USD 5,000 million to USD1,000 million
35	HITACHI TRANSPORT SYSTEM	Japan	Tokyo	ROAD FREIGHT	USD 15,000 million to USD 5,000 million
36	QUBE HOLDINGS	Australia	ASX/Frankfurt	INTEGRATED LOGISTICS	USD 5,000 million to USD1,000 million
37	KERRY LOGISTICS	China (Hong Kong)	HKeX	FREIGHT FORWARDER	USD 15,000 million to USD 5,000 million

Table 1 Continued

38	ZHONGGU LOGISTICS	China	Shenzhen	SHIPPING	USD 5,000 million to USD1,000 million
39	ROYAL MAIL	UK	LSE	MAIL, PARCEL	>USD 15,000m
40	SINO TRANS	China	HKeX/Shanghai	FREIGHT FORWARDER	USD 15,000 million to USD 5,000 million
41	HANJINKAL	South Korea	South Korea	AIR CARGO	<USD1,000 million
42	XPO LOGISTICS EUROPE	France	EURONEXT/ Frankfurt	EXPRESS	USD 15,000 million to USD 5,000 million
43	SBM OFFSHORE	Netherlands	EURONEXT/ Frankfurt	SPECIALTY LOGISTICS	USD 5,000 million to USD1,000 million
44	WALLENIUS WILHELMSEN LOGISTICS	Norway	Frankfurt	SHIPPING	USD 5,000 million to USD1,000 million
45	MILKYWAY CHEMICAL SUPPLY CHAIN SERVICE	China	Shanghai	SPECIALTY LOGISTICS	<USD1,000 million
46	XIAMEN XIANGYU	China	Shanghai	SPECIALTY LOGISTICS	>USD 15,000m
47	DEPPON LOGISTICS	China	Shanghai	ROAD FREIGHT	USD 5,000 million to USD1,000 million
48	FORWARD AIR	USA	Nasdaq	AIR CARGO	USD 5,000 million to USD1,000 million
49	WERNER ENTERPRISES	USA	Nasdaq	ROAD FREIGHT	USD 5,000 million to USD1,000 million

Table 1 Continued

50	ANTONG HOLDINGS	China	Shanghai	SHIPPING	<USD1,000 million
51	CTS FREIGHT	China	Shanghai	FREIGHT FORWARDER	USD 5,000 million to USD1,000 million
52	HUB GROUP	USA	Nasdaq	ROAD FREIGHT	USD 5,000 million to USD1,000 million
53	OSTERREICHISCHE POST ORD SHS	Austria	Vienna	MAIL, PARCEL	USD 5,000 million to USD1,000 million
54	AIR TRANSPORT SERVICES GROUP	USA	Nasdaq/Frankfurt	AIR CARGO	USD 5,000 million to USD1,000 million
55	CJ LOGISTICS	South Korea	South Korea	ROAD FREIGHT	USD 15,000 million to USD 5,000 million
56	DADA NEXUS	China	Shanghai	EXPRESS	<USD1,000 million
57	KAMIGUMI	Japan	Tokyo	INTEGRATED LOGISTICS	USD 5,000 million to USD1,000 million
58	MITSUBISHI LOGISTICS	Japan	Tokyo	INTEGRATED LOGISTICS	USD 5,000 million to USD1,000 million
59	ID LOGISTICS GROUP	Spain	EURONEXT	INTEGRATED LOGISTICS	USD 5,000 million to USD1,000 million
60	SANKYU INC	Japan	Tokyo	PORT SERVICES	USD 15,000 million to USD 5,000 million

Table 1 Continued

61	POSTNL	France	Frankfurt	MAIL, PARCEL	USD 5,000 million to USD1,000 million
62	KINTETSU WORLD EXPRESS	Japan	Tokyo	FREIGHT FORWARDER	USD 5,000 million to USD1,000 million
63	ARCBEST	USA	Nasdaq	ROAD FREIGHT	USD 5,000 million to USD1,000 million
64	STO EXPRESS	China	Shenzhen	EXPRESS	USD 5,000 million to USD1,000 million
65	CRYOPORT	USA	Nasdaq	SPECIALTY LOGISTICS	<USD1,000 million
66	FREIGHTWAYS	New Zealand	NZX	EXPRESS	<USD1,000 million
67	NTG NORDIC TRANSPORT	Belgium	EURONEXT	INTEGRATED LOGISTICS	<USD1,000 million
68	BPOST SA	India	BSE/NSE	MAIL, PARCEL	USD 15,000 million to USD 5,000 million
69	CARGOJET	India	Toronto	AIR CARGO	<USD1,000 million
70	CONTAINER CORP OF INDIA	India	BSE/NSE	PORT SERVICES	<USD1,000 million

In order to measure the level of the Selected Companies' digitalization level, we will focus on the frequency of the references are made to a set of digital-tech related key words in the Selected Companies' annual reports. We further divide the digital-tech related keywords (hereafter referred as "Tech Keywords") into a group of general digitalization awareness keywords and a group of specific digital technology keywords.

Besides frequency, we are also looking into timing when the first-time digitalization was mentioned in their annual reports. This in fact is the time when the global logistics company formally communicated its digitalization strategy or intention to its shareholders and to the capital market investors. In our research, we will try to identify a group of companies with the highest digitalization awareness.

At a second step, we will apply our measure on digitalization to investigate its relationship with the Selected Companies' financial performance as well as market capitalization. In reviewing the published annual reports and audited accounts of the Selected Companies, effort is made to identify changes in the companies' core financial performance data, and we are also tracking market capitalization changes from 2011 to 2020. We are then trying to identify the trend of changes in both financial performance data and market capitalization figures, and matching such trend with the level of digitalization, especially of those with the highest digitalization awareness, we identified.

Data Collection

As mentioned above, our data collection effort is made with a target to measure (i) the logistics service providers' level of digitalization and (ii) their financial and capital market performance:

Level of Digitalization

The key data sets to measure the Selected Companies' level of digitalization are: (a) frequency of the reference to a set of Tech Keywords in each of the reviewed annual reports, including digitalization, digital, digital technology, information technology (IT), internet, mobile communication, cloud computing, artificial intelligence (AI), big

data, blockchain, internet of things (IoT), and 5G; and (b) the timeline of digitalization related keywords were referred to during the review period.

Financial and Capital Market Performance

The key data sets to measure the Selected Companies' financial performance are each year revenue, gross profit, operating profit, net profit, net asset value, cash flow from operating activities, and net increase in cash and cash equivalents of each company from the audited reports for ten years from 2011 to 2020. Besides the absolute amount of such data, the year-to-year percentage of changes of each item and some key ratios, such as gross margin, operating profit margin and net profit margin, are included in the data collection exercise. For the purpose of our research, we are going to focus on the operating revenue changes which would demonstrate the scale and growth of the logistics service providers' business. Regarding the Selected Companies' capital market performance, we track each of the company's closing market capitalization of each company on 31 December of each year for ten years from 2011 to 2020 (if available).

Analytical Methods

In our research, we focus our review on the top 70 highest market capitalization global logistics companies around the world which are put into different groups from three different dimensions: (i) geographical location of its headquarters; (ii) sub-sector in logistics industry; and (iii) level of operating revenue.

Geographical Location of Corporate Headquarters

In the dimension of geographical location analysis, we are trying to investigate the attitude of the logistics service providers toward digitalization in different regions. By nature, logistics business is usually across different countries and borders. It is hard

to define a logistics service provider's "nationality" based on its business footprints, and therefore, the Selected Companies are grouped by location of their corporate headquarters' regions. We consider it is a sensible way of grouping, as it may reflect how digital savvy a senior management team maybe in different regions.

The corporate headquarters locations of the selected 70 logistics service providers are as follows: 19 in China (including mainland, Hong Kong, and Taiwan), 16 in United States, 15 in Europe (including Austria, Belgium, Denmark, France, Germany, Netherlands, Norway, Spain, Switzerland and United Kingdom), 12 in North Asia (including Japan and South Korea), and 8 located in other part of the world (including Australia, Canada, India and New Zealand).

Sub-Sectors of Logistics Industry

In the dimension of sub-sectors analysis, we are trying to investigate the attitude of the logistics service providers toward digitalization in different sub-sectors of logistics industry. Logistics is a complicated process of moving people, materials, inventory, and equipment from one location to another. It requires many different modes of operation to complete the task. In our research, we group the Selected Companies according to the major sub-sectors generally recognized by the industry. Given we are reviewing a set of global leading companies, most of them have been providing services in multiple sub-sectors, and therefore, we are categorizing them according to the sub-sector which is their main revenue contributor and that is also the sub-sector they are usually being recognized.

The sub-sectors of logistics industry of the Selected Companies are as follows: 4 in air cargo, 10 in express, 11 in freight forwarder, 12 in integrated logistics, 4 in mail

and parcel, 2 in port services, 10 in road freight, 11 in shipping and 6 in specialty logistics.

Level of Operating Revenue

In the dimension of market Operating Revenue analysis, we are trying to investigate the attitude of the logistics service providers toward digitalization in different level of operating revenue. Level of operating revenue reflects a company's scale and resources that it can deploy. Among the Selected Companies, the company with highest operating revenue in 2020 was United Parcel (UPS) with USD 84,628 million and the lowest was Cryoport with USD 79 million. The average revenue of the Selected Companies in 2020 was USD 12,900 million and the median was USD 5,275 million.

We put the Selected Companies into four categories according to their operating revenue in 2020: (i) 17 of which are over USD 15,000 million; (ii) 19 of which are between USD 15,000 and USD 5,000 million; (iii) 25 of which are between USD 5,000 and USD 1,000 million; and (iv) 9 of which are below USD 1,000 million.

CHAPTER 4

MEASURING DIGITALIZATION AWARENESS

While there is no agreed method to measure level of digitalization awareness of a company, we are trying to estimate the digitalization awareness level of the Selected Companies by text-based measure: analyzing annual reports of the Selected Companies to observe the frequency of digital-tech related key words being discussed in the annual reports along with the fraction of time each key word is referred to in each of the reports.

Text-based Measure

Overall Analysis

We reviewed the annual reports of the Selected Companies from 2011 to 2020. As some of the Selected Companies were listed less than 10 years, for those companies, we reviewed the first annual reports available to their 2020 reports. There are also two Selected Companies (JD Logistics and DaDa Nexus) which were recently listed and no annual report is available. For these two companies, instead of reviewing their annual report, we reviewed their listing prospectuses. On this basis, for the purpose of our research, 591 annual reports (and prospectuses) have been reviewed.

This is the set of Tech Keywords used for our review: (1) digitalization, (2) digital / digital technology, (3) information technology (IT), (4) internet, (5) cloud computing, (6) artificial intelligence (AI), (7) big data, (8) blockchain, (9) internet of things (IoT), and (10) 5G. This set of 10 digital-tech related key words is selected based on the industry trend and awareness. While there is other digital technology which may be included in this research, the current set is considered to be a set that the industry players are generally aware of. Furthermore, as you will see in below, some of the

keywords which we at first considered to be popular digital technologies, actually received much less attention than we would expect, for example, block chain, cloud computing and 5G. Thus, we consider that instead of further expanding the list of key words, focusing on this 10 digital-tech related key words may give out a more meaningful result.

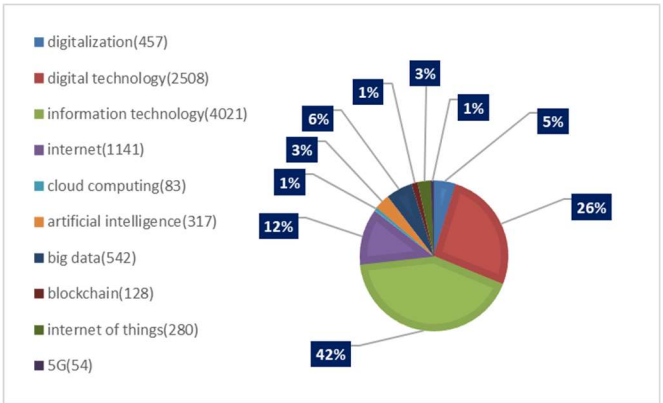
We may further divide this set of 10 digital-tech related key words into two groups:

(a) General Tech Keyword is a general reference which is a conceptual description of digital technology but not a particular nor specific technology - digitalization, digital / digital technology, information technology (IT), and internet; and

(b) Specific Tech Keyword is keyword referring to a particular or specific digital technology or an application of such technology - cloud computing, artificial intelligence (AI), big data, blockchain, internet of things (IoT), and 5G.

According to our research, 9,784 references to the digital-tech related key words were made in our 591 annual reports review. The Figure below shows the frequency of references to each Tech Keywords in our review and its percentage to all references:

Figure 1: Frequency of references to each Tech Keywords and percentage to all references

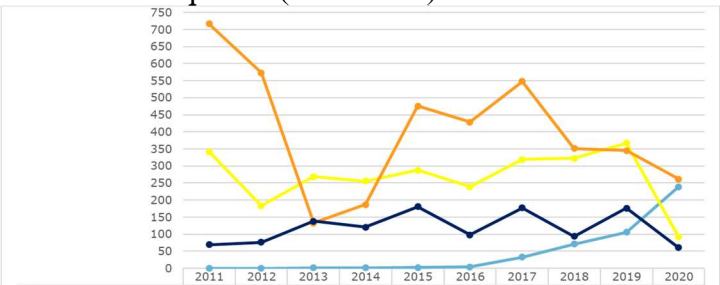


According to the review results, there is a strong emphasis on information technology (4,021 counts) from the global logistics service providers and almost all of the Selected Companies made reference to “Information Technology” in their annual reports. It also shows a very strong awareness of digitalization (digitalization and digital technology with a total count of 2,965). This result demonstrates that application of information technology and digital technology has become an integral part of global logistics service providers’ operation.

As to application of specific technology, according to our review, “Big Data” is the most referred technology by the Selected Companies with 542 counts during the review period. Logistics operations generate a huge volume of data which includes business data, cargo data, process data, data about equipment and vehicle, etc. Big data analytic is bringing number of benefits to the logistics industry. It may help logistics operators to have a better demand forecasting, resources planning and route planning. Given the volume of data collected during their operation process is huge, application of artificial intelligence can help logistics service providers to manage the increased complexity and interconnectivity of such data. This observation is supported by our review, as “Artificial Intelligence” is the second most referred technology with a count of 317. On the other hand, 5G is the least referred technology. This may suggest that 5G technology may need more time to gain popularity in logistics industry.

The Figure below shows a timeline of the frequency of references to General Tech Keywords during the review period (2011-2020):

Figure 2：Frequency of references to General Tech Keywords during the version period (2011-2020)

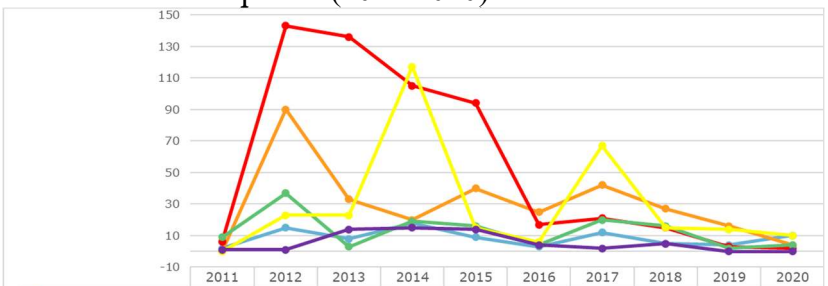


	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
digitalization	0	0	1	1	2	4	33	71	106	239
digital technology	342	183	269	256	288	239	319	323	367	92
information technology	717	573	133	187	476	429	548	351	345	262
internet	69	76	138	121	181	98	177	94	176	61

Being the most referred tech-keyword, “Information Technology” had attracted a lot of attention from the global logistics service providers at the beginning of the review period (2011). While the number of references came down from its early peak, it still had a high frequency of references during the entire review period. It further supports that information technology has become an integral part of global logistics service providers’ operation. The keyword “Digitalization” shows an interesting patten. It had almost no reference during the first five years of the review period and from 4 counts in 2016 went up to 239 counts in 2020 with a strong growing trend. The number of references to “Digitalization” in 2020 is the second most referred tech-keyword and if counts the for “Digital Technology” were included, the concept of digitalization would be the most referred technology keyword in 2020. This indicates that the concept of “Digitalization” has gain its popularity in recent years amongst the logistics industry and the global logistics service providers are embarking their digital journey.

The Figure below shows a timeline of the frequency of references to Specific Tech Keywords during the review period (2011-2020):

Figure 3：Frequency of references to Specific Tech Keywords during the version period (2011-2020)



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
cloud computing	2	15	8	18	9	3	12	5	4	10
artificial intelligence	0	90	33	20	40	25	42	27	16	4
big data	6	143	136	105	94	17	21	15	3	2
blockchain	9	37	3	19	16	4	20	16	2	4
internet of things	0	23	23	117	15	6	67	15	14	10
5G	1	1	14	15	14	4	2	5	0	0

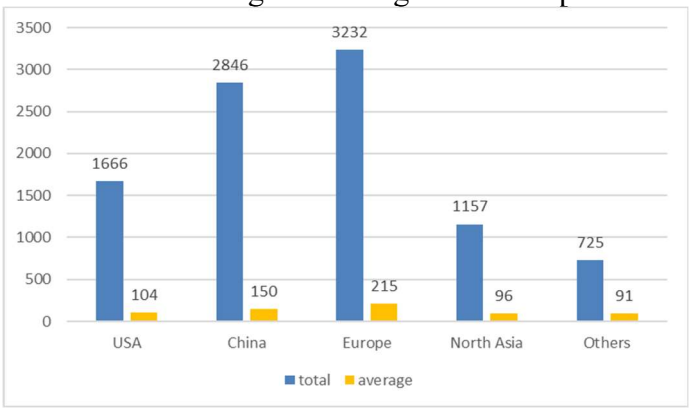
The peak of references to Specific Tech Keywords (reference to specific technology) appeared in 2012 with “Big Data” and “Artificial Intelligence” being the most referred specific technologies. While the number of references to “Big Data” and “Artificial Intelligence” came down from their peak in 2012, both of them still had a relatively high frequency of references during the rest of the review period. This trend supports that from being aware of the potential of “Big Data” and “Artificial Intelligence”, global logistics service providers had been making continuous effort in applying these technologies. On the other hand, we notice that reference to “Internet of Things” reached its peak in 2014 and then a smaller peak in 2017, and thereafter remained a relatively high frequency during the rest of the review period. This may suggest that the global logistics service providers were making effort to put “Internet of Things” in use in their operation with a view to collect more real time operation data.

Analysis by Geographical Location of Corporate Headquarters

Our annual reports review gives a good indication of the attitude of the logistics service providers toward digitalization in different regions. The corporate headquarters

locations of the Selected Companies are divided into 5 groups: (1) China, (2) United States, (3) Europe, (4) North Asia, and (5) Others.

Figure 4：Total frequency and average frequency of references to digital-tech related keywords in the five regions during the review period



According to our research, there is a strong emphasis on information technology from logistics service providers in all regions. As the number of Selected Companies in each region are difference, besides the total frequency, we also look into the average frequency based on the number of Selected Companies of each region. The results show that Selected Companies in Europe have the highest counts of digital-tech keywords references both total and average, following by China, USA, North Asia, and the Others. While a general impression is that USA companies were taking a more affirmative toward applying digital technology, our results show that Selected Companies in Europe and China are making more references to digital-tech keywords than their peers in USA. In fact, Selected Companies in all regions are actively making references to all kind of digital technologies in their annual reports, which indicates that regardless of their region, all Selected Companies are placing significant emphasis in digital technology.

The following Figures show the frequency of references to each digital-tech related key words in annual reports of the Selected Companies in different regions:

Figure 5: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in USA

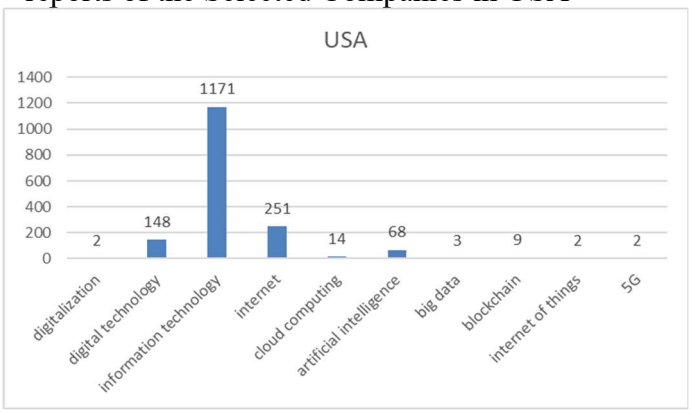


Figure 6: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in China

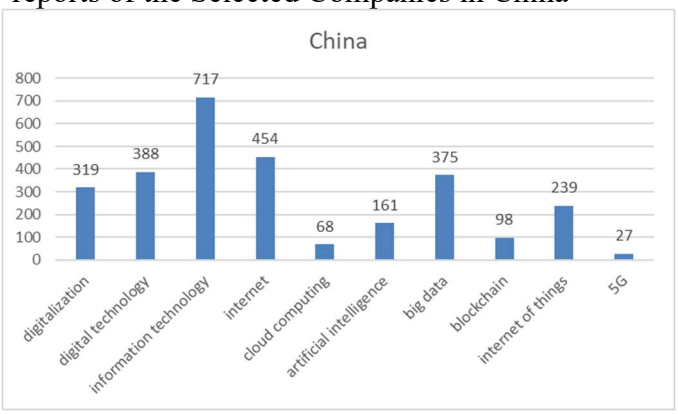


Figure 7: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in Europe

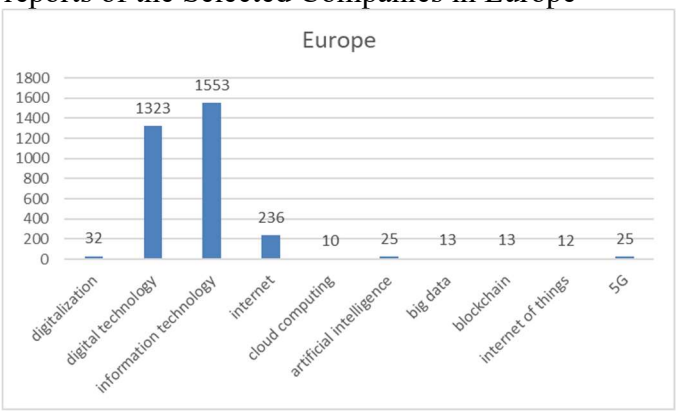


Figure 8: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in North Asia

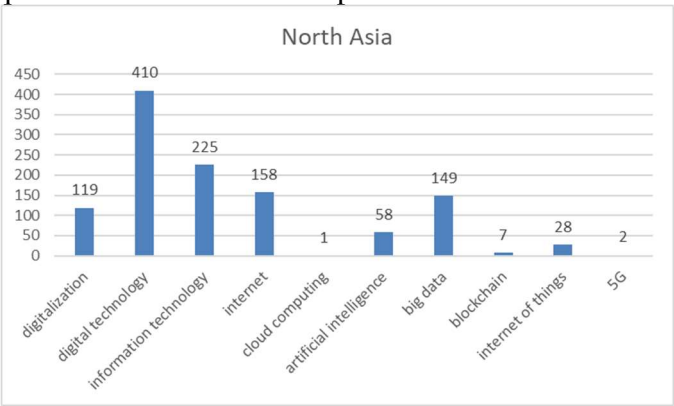
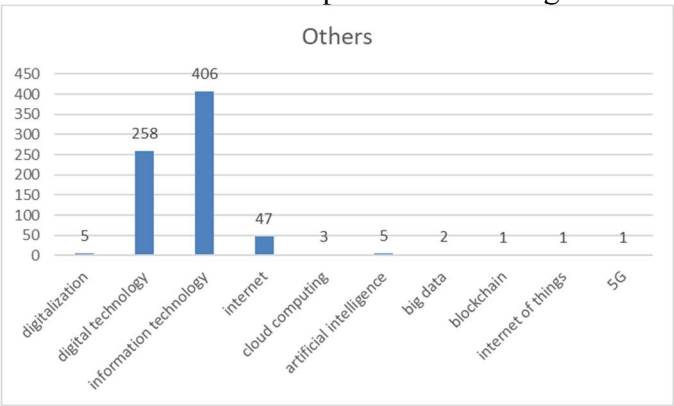


Figure 9: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in other regions



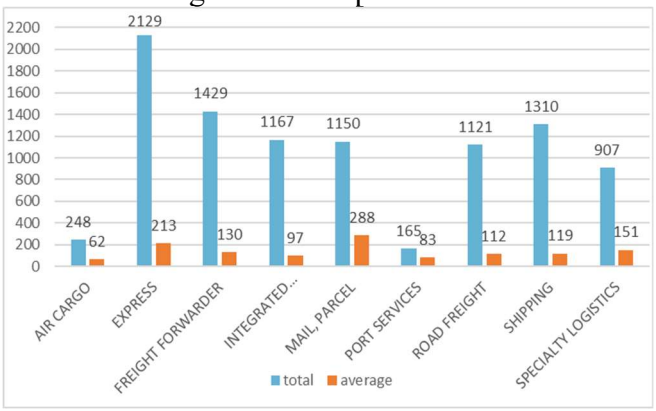
Our review shows an interesting result that while all the Selected Companies showing great interest in digital technology in their annual reports, the Selected Companies in different regions appeared to have different emphasis. While the Selected Companies in USA, Europe and Other Regions were making general references about their application of digital technology (references to General Tech Keywords), Selected Companies in China (in particular) and North Asia were making a more specific account of their digitalization journey (reference to Specific Tech Keywords). Although we cannot draw any conclusion about the level of digitalization of logistics service

providers in different regions based on the manner of their disclosure, Chinese Selected Companies, comparing with their peers, were making a more thorough disclosure to the market about their digitalization approach that may suggest a stronger awareness of the need to apply digital technology. In term of specific digital technology, Big Data, Internet of Things and Artificial Intelligence are the three most referred digital technologies in China and North Asia Selected Companies' annual reports.

Analysis by Sub-sector of Logistics Industry

Our annual reports review gives a good indication of the attitude of the logistics service providers toward digitalization in different sub-sectors of logistics industry. We divide the Selected Companies into 9 sub-sectors: (1) air cargo, (2) express, (3) freight forwarder, (4) integrated logistics, (5) mail and parcel, (6) port services, (7) road freight, (8) shipping, and (9) specialty logistics.

Figure 10：Total frequency and average frequency of references to digital-tech related keywords in the annual reports of the nine sub-sectors of logistics industry during the review period



According to the review results, there is a strong emphasis on information technology from logistics service providers in all sub-sectors. As the number of Selected Companies in each sub-sectors are different, besides the total frequency, we

also look into the average frequency based on the number of Selected Companies in each sub-sector. The results show that Selected Companies in Express had the highest counts of digital-tech keywords references in total counts and Mail and Parcel had the highest average counts. Both Express and Mail and Parcel are providing time sensitive point-to-point logistics services which success is depending on constructing a seamless pick-up, transit, transportation, and delivery network. Application of digital technology is essential part of building such network. Air Cargo shows the lowest counts in both total and average counts. Core service of Air Cargo sector is providing air transportation of cargo. Its success is depending on having a high utilization rate of each aircraft storage compartment and controlling its operational cost (in particular, fuel cost). Digital technology can enhance an Air Cargo operator's planning and managing ability, and we can see from our research that Air Cargo operators were also paying good attention to it. However, such improvement in operation may not be as significant as effectively managing its fuel cost by using different financial tools. That may be the reason for a lower count of references about digital technologies comparing with other sub-sectors. But overall, based on our revision results, Selected Companies in all sub-sectors are actively making references to digital technologies in their annual reports, which indicates that regardless of their sector all Selected Companies are placing significant emphasis in digital technology, and especially for sub-sectors which provide time sensitive services.

The following Figures show the frequency of references to each digital-tech related key words in annual reports of the Selected Companies in different sub-sectors:

Figure 11: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in Air Cargo sector

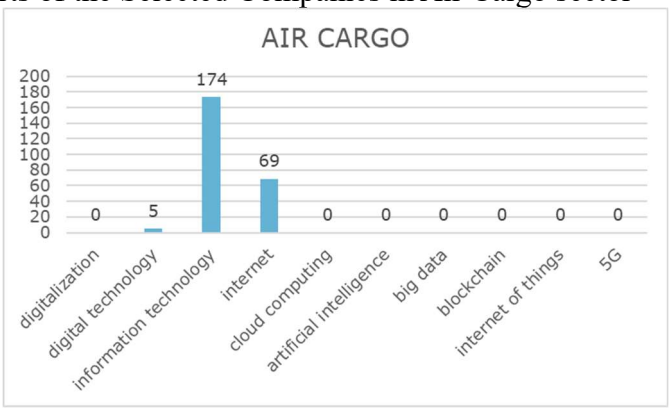


Figure 12: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in Express sector

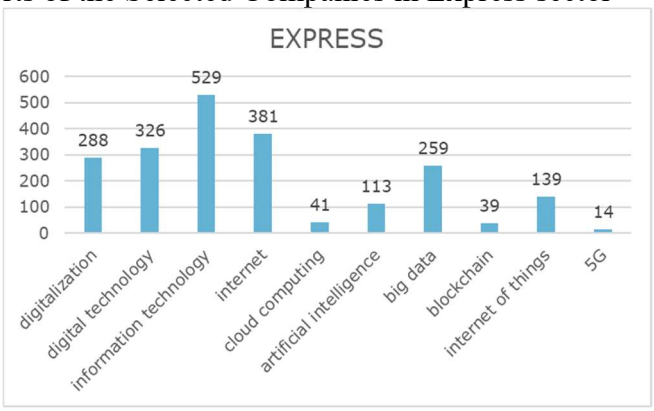


Figure 13: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in Freight Forwarder sector

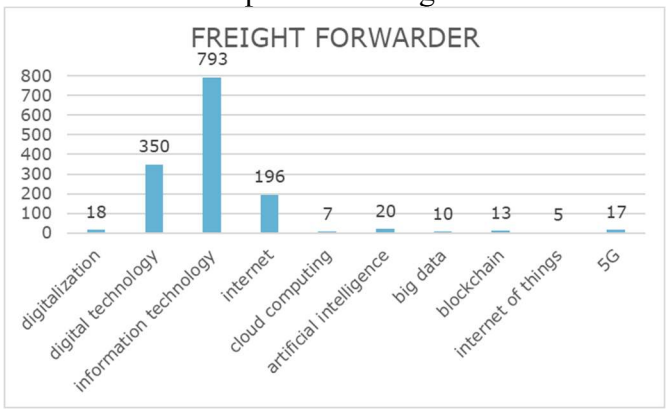


Figure 14: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in Integrated Logistics sector

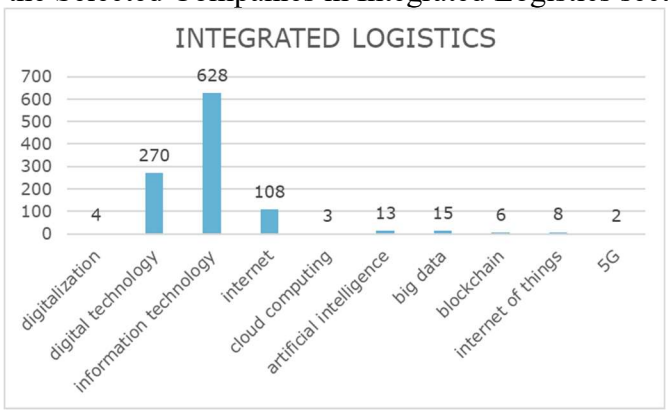


Figure 15: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in Mail and Parcel sector

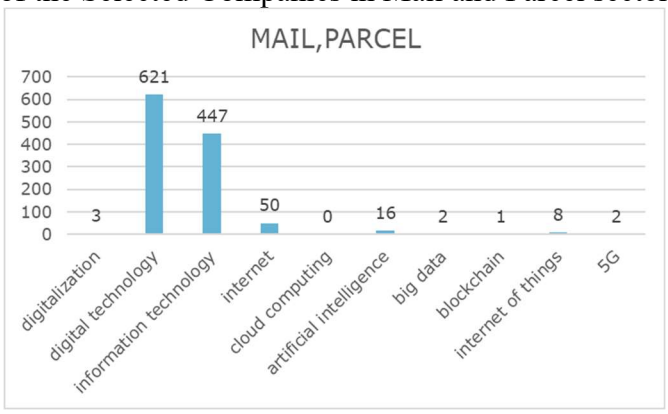


Figure 16: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in Port Service sector

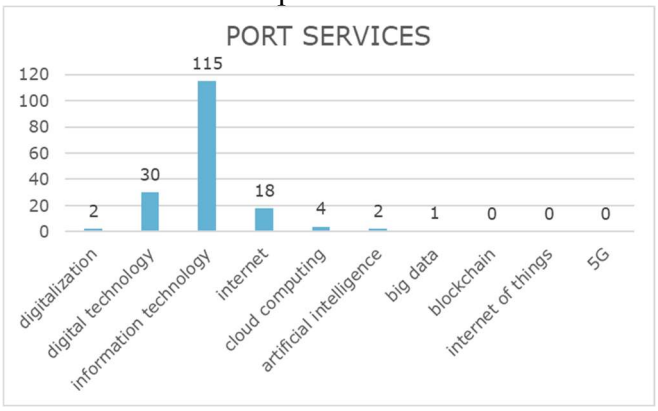


Figure 17: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in Road Freight sector

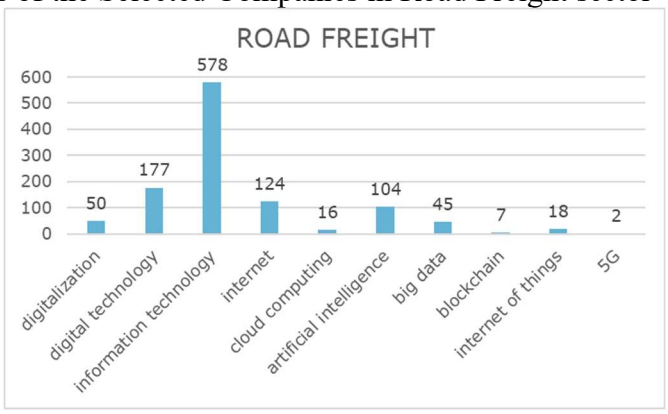


Figure 18: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in Shipping sector

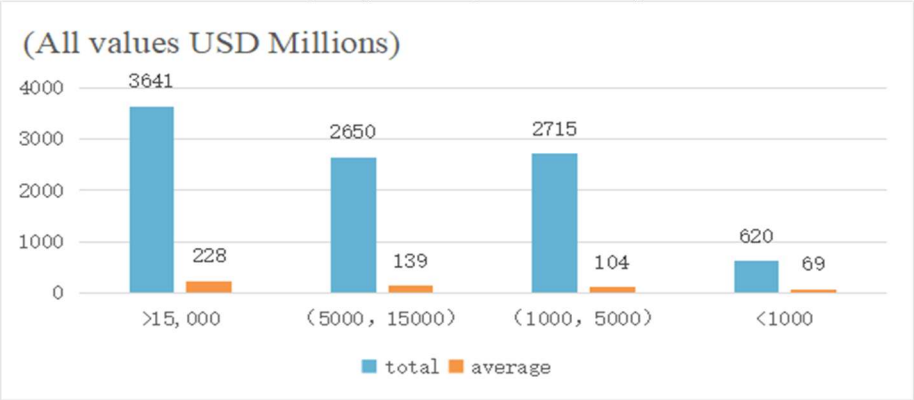
Figure 19: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies in Specialty Logistics sector

According to our research, all Selected Companies were making a lot of references about digital technology in their annual reports, but majority of digital technology references made by the Selected Companies in most of the sub-sectors are General Tech Keywords. The only clear exception is Express sector, which had elaborated their application of specific digital technology in greater details comparing with the others, hence making more references to Specific Tech Keywords in their annual reports. Artificial Intelligence, Big Data and Internet of Things are the three most referred technologies in Express companies' annual reports which may suggest Express companies pay very high attention to building their ability in connecting, tracking, and planning by applying digital technology.

Analysis by Level of Operating Revenue

One of the angles we wanted to reveal is how the scale of the logistics service providers may affect their attitude toward digitalization. We put the Selected Companies into four categories according to their operating revenue in 2020: (i) over USD 15,000 million; (ii) between USD 15,000 and USD 5,000 million; (iii) between USD 5,000 and USD 1,000 million; and (iv) below USD 1,000 million.

Figure 20： Total frequency and average frequency of references to digital-tech related keywords in the annual reports of the Selected Companies in four operating revenue groups during the review period



Our research shows a trend that the higher operating revenue the more references to digital technology were made by the Selected Companies in their annual reports during the review period. As the number of Selected Companies in each operating group are difference, besides the total frequency, we also look into the average frequency based on the number of Selected Companies in each operating revenue group. The highest operating revenue group (over USD 15,000 million) of companies made the highest counts of references to digital technology both in term of total counts and average counts. Total counts of references made by the second highest operating revenue group (between USD 15,000 and USD 5,000 million) is slightly less than the third highest operating revenue because there are 19 companies in the second group and 25 in the third, and when we looked at the average count, the second group had the more counts than the third. This result may indicate that the logistics service providers with higher operating revenue are more proactive in demonstrating their ability and application in digital technology, hence paying stronger emphasis in digitalization.

The following Figures show the frequency of references to each digital-tech related key words in annual reports of the Selected Companies in different operating revenue groups:

Figure 21: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies with Operating Revenue over USD15,000 million

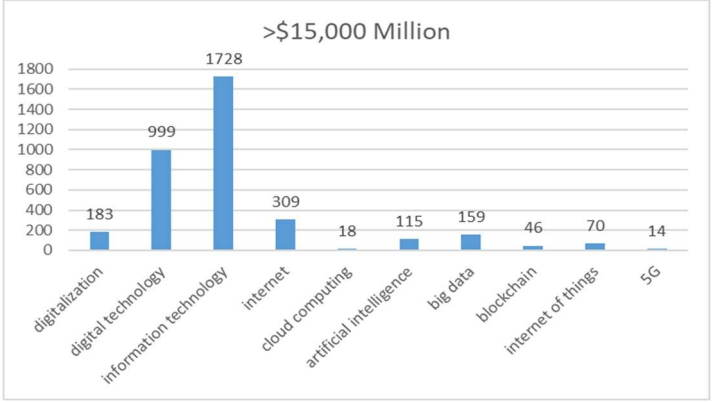


Figure 22: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies with Operating Revenue between USD15,000 million and USD5,000 million

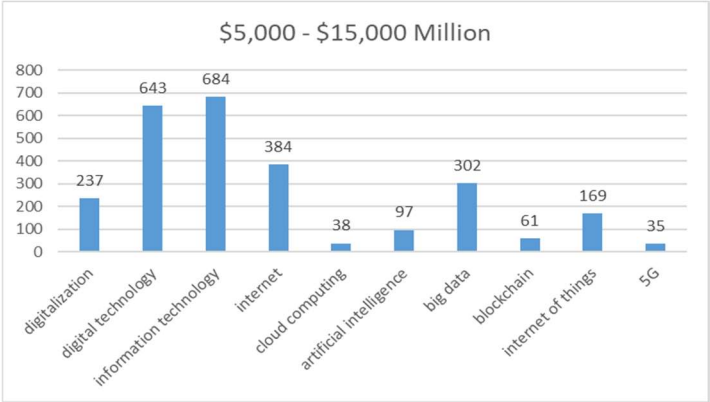


Figure 23: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies with Operating Revenue between USD5,000 million and USD1,000 million

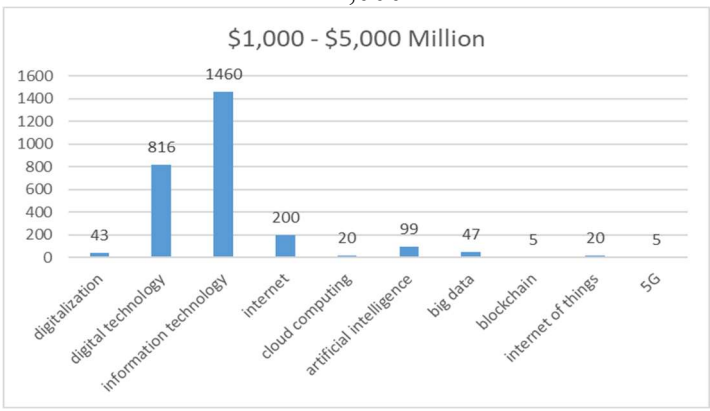
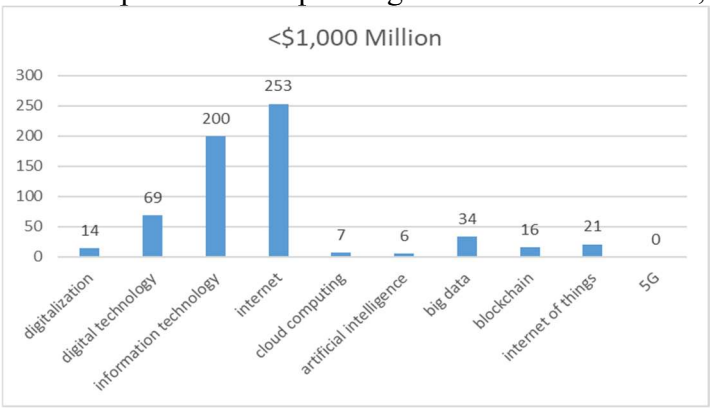


Figure 24: Frequency of references to each digital-tech related key words in annual reports of the Selected Companies with Operating Revenue below USD1,000 million



The Selected Companies in all four operating revenue groups were making a lot of references to General Tech Keywords in their annual reports, but only the Selected Companies in the highest and second highest operating revenue groups making meaningful numbers of references to Specific Tech Keywords. Big Data, Internet of Things and Artificial Intelligence are the three most referred Specific Tech Keywords made by them. Comparing with the highest operating revenue group companies, the second highest group companies were making more reference to Specific Tech Keywords and more eager to share with the market about their application in specific digital technology. This may suggest that applying digital technology is one of their strategies to further increase their operating revenue.

Identifying the Champion Group of Companies in Digitalization Awareness

After reviewing the results of our text-based review from the aforementioned three dimensions (geographical location, sub-sector, and scale), we are now trying to identify the group of companies which have the highest level of digitalization awareness out of the Selected Companies. Such group of companies will be called as the "Champion Group of Companies in Digitalization Awareness" (or the "Champion Group" in short). There is no absolute measure to weight each of the Selected Companies' level of digitalization awareness, but for the purpose of our research, a group of seven companies will be selected from the Selected Companies, representing 10% of the Selected Companies, based on the scoring scheme described below to form the Champion Group. With this objective in mind, we developed a two-level scoring scheme based on the results from the text-based measure aforementioned.

For the first level scoring scheme, we will allocate a score to each group of companies in the three dimensions under the text-based measure (geographical location

of its headquarters; sub-sector in logistics industry; and level of operating revenue). The scoring scheme are as follows: (a) number of references to Specific Tech Keywords (3 points for the top 1 group in each dimension, 2 for top 2 and 1 for top 3), (b) number of references General Tech Keywords (1.5 points for the top 1 group in each dimension, 1 for top 2 and 0.5 for top 3), and (c) average number of references to Keywords (1.5 points for the top 1 group in each dimension, 1 for top 2 and 0.5 for top 3). Higher weight was put on references to Specific Tech Keywords than the other two, because a more specific digital technology disclosures made would demonstrate a stronger sense of awareness to the digitalization technology of the company. Based on the first level scoring scheme, the top three groups of companies with the highest level of digitalization awareness in the three dimensions are as follows:

Table 2: First Level Scoring Scheme: Ranking of digitalization awareness of different groups of companies in the three measuring dimensions: Geographical Location of Corporate Headquarters, Sub-sector of Logistics Industry, and Level of Operating Revenue (2020)

	First Level Scoring Scheme Ranking		Ranking for Specific Tech Keywords References	Ranking for General Tech Keywords References	Ranking for average Keywords References
Geographical Location of Corporate Headquarters	Top 1	China	China	Europe	Europe
	Top 2	Europe	North Asia	China	China
	Top 3	USA	USA/Europe	USA	USA
Sub-sector of Logistics Industry	Top 1	Express	Express	Express	Mail and Parcel
	Top 2	Mail and Parcel	Shipping	Freight Forwarding	Express
	Top 3	Shipping	Road Freight	Mail and Parcel	Specialty Logistics

Table 2 Continued

	First Level Scoring Scheme Ranking		Ranking for Specific Tech Keywords References	Ranking for General Tech Keywords References	Ranking for average Keywords References
Level of Operating Revenue (2020)	Top 1	>15,000m	15,000m to 5,000m	>15,000m	>15,000m
	Top 2	15,000m to 5,000m	>15,000m	5,000m to 1,000m	15,000m to 5,000m
	Top 3	5,000m to 1,000m	5,000m to 1,000m	15,000m to 5,000m	5,000m to 1,000m

To further identify the Champion Group of Companies in Digitalization Awareness, we come up with a second level scoring scheme to look into individual company's level of digitalization awareness within the top three groups in the three dimensions identified in the first level scheme. For the second level scoring scheme, we looked at the average counts of digital keywords references made in the companies' annual reports (and prospectuses for JD Logistics and DaDa Nexus for the reason aforementioned) during our review period (hereafter referred as "Digital Keywords Average Counts"). The companies, which have the top 3 Digital Keywords Average Counts in each of the over ranking top groups identified in the first level scoring scheme, will be awarded 3 to 1 point according to the following table:

Table 3: Second Level Scoring Scheme: schedule for points awarded

	First Level Scoring Scheme Ranking		Points awarded for the Companies with Top 3 Digital Keywords Average Counts in each group
Geographical Location of Corporate Headquarters	Top 1	China	3 pt
	Top 2	Europe	2 pt
	Top 3	USA	1 pt
Sub-sector of Logistics Industry	Top 1	Express	3 pt
	Top 2	Mail and Parcel	2 pt
	Top 3	Shipping	1 pt
Level of Operating Revenue (2020)	Top 1	>15,000 m	3 pt
	Top 2	15,000m to 5,000m	2 pt
	Top 3	5,000m to 1,000m	1 pt

Base on the second level scoring scheme, the following table shows the ranking, points awarded and the Digital Keywords Average Counts:

Table 4: Ranking of the Selected Companies based on Second Level Scoring Scheme

Ranking	Company	Total Points	Geographical Location of Corporate Headquarters	Sub-sector of Logistics Industry	Level of Operating Revenue (2020)	Digital Keywords Average Counts
1	SF Express	9	3	3	3	107.80
2	DaDA Nexus	6	3	3	0	157.00

Table 4 Continued

Ranking	Company	Total Points	Geographical Location of Corporate Headquarters	Sub-sector of Logistics Industry	Level of Operating Revenue (2020)	Digital Keywords Average Counts
3	JD Logistics	5	3	0	2	107.80
4	POSTNL	5	2	2	1	58.70
4	Deutsche Post	5	2	0	3	54.00
4	DSV PANALPINA AS	5	2	0	3	37.57
4	YTO Express	5	0	3	2	84.75
5	Royal Mail	2	0	2	0	30.25
5	Osterreichische Post Ord Shs	2	0	2	0	22.00
5	Yunda Holdings	2	0	0	2	53.20
6	XPO Logistics	1	1	0	0	33.90
6	Landstar	1	1	0	0	20.30
6	Arcebest	1	1	0	0	18.00
6	NYK Line	1	0	1	0	42.00
6	Hapag-Lloyd	1	0	1	0	25.10
6	Antong Hongings	1	0	1	0	20.00
6	Deppon	1	0	0	1	40.75
6	ZTO Express	1	0	0	1	30.00

According to the above table, the top seven companies with the highest points awarded are the companies in the Champion Group. Amongst the companies in the Champion Group, there is only one company ranked in the Top 1 group for all of the three dimensions under the first level scoring scheme and with the highest points awarded under the second level scoring scheme, which is an Express company

headquartered in China with operating revenue over USD 15,000 million and also being the company ranked top 3 for Digital Keywords Average Counts in all groups: SF Express is the only company in the Selected Companies that met all these criteria. The following table shows the Champion Group of Companies in Digitalization Awareness:

Table 5: The Champion Group of Companies in Digitalization Awareness

Ranking	Selected Company	Headquarters Region	Stock Exchange	Sub-sector	Operating Revenue (2020)
1	SF EXPRESS	China	Shenzhen	EXPRESS	>USD 15,000m
2	DADA NEXUS	China	Nasdaq	EXPRESS	<USD1,000 million
3	JD LOGISTICS	China	HKeX	INTEGRATED LOGISTICS	USD 15,000 million to USD 5,000 million
4	POSTNL	France	Frankfurt	MAIL, PARCEL	USD 5,000 million to USD1,000 million
4	DEUTSCHE POST	Germany	Deutsche Borse	INTEGRATED LOGISTICS	>USD 15,000m
4	DSV PANALPINA AS	Denmark	Copenhagen	FREIGHT FORWARDER	>USD 15,000m
4	YTO EXPRESS	China	Shenzhen	EXPRESS	USD 15,000 million to USD 5,000 million

Correlation of Digitalization and Valuation

We are going to analyze the correlation of digitalization and valuation of global logistics in two dimensions: (i) market capitalization, and (ii) operating revenue.

Correlation of Digitalization and Market Capitalization

We collected the data about the year-end market capitalization of each of the Select Companies from 2011 to 2020 (for those available) and come up with their year-to-year changes in percentage. For companies listed through backdoor listing, their market capitalization data before the backdoor listing taken place are excluded from our analysis. On the other hand, if a company was listed during our review period, the percentage change of its market capitalization at the first closing date comparing with that at the end of its first year of listing will be included in our analysis.

In our research, we identified the median and average of the year-to-year changes in percentage of the Selected Companies' year-end market capitalization from 2011 to 2020. We then compared such data with (i) the year-to-year changes in percentage of year-end market capitalization for the same period of SF Express (being the Champion in the Champion Group of Companies in Digitalization Awareness), and (ii) the average of such changes in percentage of the Champion Group. Such comparison is shown in the following Figure:

Figure 25: Percentage Changes of the Champion Group's Market Capitalization Performance comparing with those of the Selected Companies

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
70 Companies's Median	13.93%	21.30%	9.60%	-7.22%	10.09%	26.86%	-17.02%	13.27%	30.85%
70 Companies's Average	21.46%	36.16%	20.54%	0.74%	19.17%	39.24%	-15.08%	17.31%	48.95%
Championship Group Average	36.33%	45.54%	-16.20%	8.50%	2.63%	19.42%	-38.60%	41.10%	59.34%
SF EXPRESS Performance						-6.53%	-37.98%	11.61%	161.80%

The results of the above Figure give us a very interesting insight. While we cannot draw any conclusion about a direct causation link between digitalization

awareness and changes in market capitalization, our research data show that majority of the time, the Champion Group's average market capitalization changes were higher than the average and median of the changes in market capitalization of the Selected Companies. SF Express was only listed in 2017 and thus, no data of market capitalization changes is available before that. SF Express market capitalization had been under pressure after its listing and after the first couple of years, its market capitalization was catching back up in 2019 and then had a very strong growth in 2020 that was much better than most of the Selected Companies.

The most significant incidence in 2019 and 2020 was COVID-19 pandemic for sure. It caused major disruption to the supply chain and mass destruction to the global economy. The outstanding performance of SF Express market capitalization during such difficult period may be supported by many reasons, and its strong digitalization awareness may play a major role to it. A similar trend of changes was also shown for market capitalization performance of the Champion Group comparing with the Selected Companies during 2019 and 2020. That may indicate that the capital market investors may consider logistics service providers with stronger digitalization awareness would be in a stronger position to cope with supply chain disruption, and therefore, more willing to include those companies in their portfolio.

Correlation of Digitalization and Operating Revenue

We collected the data about the operating profit of each of the Select Companies from 2011 to 2020 (for those available) and come up with their year-to-year changes in percentage. Based on the data collected, we identify the median and average of the year-to-year changes in percentage of the Selected Companies' operating revenue from 2011 to 2020. We then compared such data with (i) the year-to-year changes in

percentage of operating revenue for the same period of SF Express (being the Champion in Digitalization Awareness), and (ii) the average of such changes in percentage of the Champion Group of Companies in Digitalization Awareness. Such comparison is shown in the following Figure:

Figure 26 Percentage Changes of the Champion Group's Operating Revenue comparing with those of the Selected Companies

	2011-2012	2012-2013	2013-2014	2014-2015	2015-2016	2016-2017	2017-2018	2018-2019	2019-2020
70 Companies's Median	7.34%	4.34%	4.97%	0.29%	2.13%	19.07%	9.28%	5.16%	7.03%
70 Companies's Average	11.92%	10.07%	11.90%	6.77%	8.69%	24.92%	12.85%	9.89%	11.41%
Championship Group Average	4.68%	4.65%	-8.88%	-13.49%	14.06%	22.23%	16.23%	21.19%	36.68%
SF EXPRESS Performance						31.62%	27.92%	23.37%	37.25%

Our research data show that majority of the time, the Champion Group's average operating revenue changes were higher than the median, but lower than the average, of the changes in operating revenue of the Selected Companies. However, from 2016 onward, the trend of operating revenue changes is clearly in the Champion Group's favor. The percentage of changes in operating revenue of the Champion Group was showing a very strong growth from 2016. SF Express was only listed in 2017 and thus, no data of operating revenue before 2015 is available. Based on the data, SF Express operating revenue had been enjoying a double-digit growth.

Both the Champion Group average operating revenue changes and SF Express operating revenue changes had an outstanding performance in 2019 and 2020. Similar to our analysis in the market capitalization changes section above, the data seems to suggest that the Champion Group of Companies in Digitalization Awareness was in a in a stronger position to cope with supply chain disruption caused by COVID-19

pandemic comparing with other global logistics service providers which revenue were growth in a much lower rate. The gap of operating revenue growth between the Champion Group (being the stronger group) and the Selected Companies were getting larger during the COVID-19 pandemic period. Once again, there were many reasons contributed to the Champion Group's strong operating revenue performance during the pandemic, but application of digitalization technology was appeared to be one of the key factors.

CHAPTER 5

FURTHER DISCUSSION AND LIMITATION

There are a number of limition on this reaserch which we may further improve in the future. As we are trying to cover the global logistics service providers, we unavoidably have to cover companies listed on different stock exchanges around the world. Each of these global logistcis service providers is subjected to very different sets of rules and regulations adopted by their respective stock exchanges. The disclosure requirements are difference from one company to another as well as their applicable accounting policy, and therefore, comparing their disclosure documents may not be entirely fair. In light of this, a further research direction may be narrowing the socpe of company coverage. For example, we may focus on logistics companies listed in China. Also, we may take into account of the total word count versus the count of technology key words to eveluate the percent of technology key words in their disclosure documents.

Another limitation of this research is casued by our ambitious to cover the entire logistics industry which contains a number of sub-sectors. Each of these sub-sectors is opearting under different business models and with very different characteristics. Trying to compare their level of digitalization may not be entirely fair as their business operations are different and their needs are different, too. Therefore, as a further research direction, we may consider focusing on one sub-sector, such as express courier, to see how digitalization technology may affact their business and capital market performance.

Furthermore, as we pointed out at the beginning, while we are trying to show the relationship between digitalization awareness and logistics companies' financial

and capital market performances, we are unable to establish the causal relationship between them. However, a possible way to improve our research is that we may try to eliminate the effect of overall stock market rises and falls when we compare the annual capital market performance of the Selected Companies.

Indication of Potential for Meaningful Contribution

Confirming the Value of Making Investment in Digitalization by LogisticsSservice Providers

One of the problems troubling the management of a logistics service provider when they considering making investment in digitalization technology is how to measure the return brought by such investment. One may see the improvement of efficiency by reducing the number of staff, or increasing the number of orders handling by the same number of staff, in its operation after an IT system or a specific digital technology is put in place. Yet, most of the time, it is in fact hard to measure the overall contribution or saving brought by the technology investment, such as new opporunities created or potenital losses avoided. Our research shows that the global top 70 market capitalization logistics service providers are all paying serious attention to digitalization, and we notice that they have been making continuous investment in digitalization since the beginning of our review period (2011). As we mentioned at the beginning, we are not able to prove the causation of digitalization investment and high market capitalization, but our research shows that there is a clear correlation between the two. Thus, when the management of a logistics service provider is considering their digitalization budget, they should be aware of the fact that their leading peers have been paying serious attention to it when making their budget and spending decisions.

Identifying Specific Information Technologies Attracted the Most Attention from Logistics Service Providers

Besides realizing the importance of making use of digitalization technology in their operation, the leading global logistics service providers have been focusing on certain specific technology. Based on our research, artificial intelligence, big data and internet of things are the three most popular specific digitalization technology adopted by global logistics service providers. These three specific digitalization technologies have a common feature that they are all related to "data". A lot of data will be generated during logistics service process, from origin address to destination address, from pick up time to transporting time and delivery time, etc. Level of their ability to collect and handle data generated will have significant impact to a logistics service provider's operation efficiency and profitability. Artificial intelligence, big data and internet of things are powerful tools for logistics service providers to collect a large volume of data generated during their operation process, analyze the relationship between different type of data, and process the data into digestible formats, that can in turn helps the logistics service providers improve their operation efficiency, shorten service response time, create new service offerings, and facilitate decision making.

Providing a New Dimension to Investors for Evaluating Investment Value of a Logistics Service Provider

When analyzing the fundamentals of a logistics service provider, one usually focus on the future trend of its core business drivers (such as growth in Twenty-feet Equivalent Unit handled for shipping companies and freight forwarding companies; growth in number of parcel handled for express couriers and mail and parcel companies etc.), its financial performance (such as revenue, gross profit, operating profit, return of

assets etc.), and its asset base (such as number of vehicle, area of warehouses, number of equipment in used etc.). Given the strong link between digitalization and valuation demonstrated by the top 70 market capitalization logistics service providers, level of digitalization should be included in the evaluation model when one investigates investment value of a logistics company. On the other hand, a logistics service provider should be more proactive in making disclosure about its effort made in its digitalization journey to the market. Also, regulators may consider including digitalization information, such as technology spendings, number of IT staff, digitalization strategy and objectives etc., as part of their disclosure requirements.

REFERENCES CITED

[1] Charm , T., Coggins, B., Robinson, K. and Wilkie, J. (2020). The great consumer shift: Ten charts that show how US shopping behavior is changing, McKinsey. https://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/a-global-view-of-how-consumer-behavior-is-changing-amid-covid-19.

[2] Agafonova, A. N. (2020). Digital Transformation Of Logistics And Scm. 18th International Scientific Conference "Problems of Enterprise Development: Theory and Practice".

[3] Bardakçi, H. (2020). Benefits Of Digitalization In International Logistics Sector. International Journal of Social Science and Economic Research, 5(06), 1476-1489.

[4] Gabdullin N.M., Izmailov A.E., Kirshin I.A. (2020). The Use of Digital Application MPI Supply Chain for Efficient Management of the Firm's Operating Activities. Advances in Economics, Business and Management Research, volume 156. 547.

[5] Giorgio Bavassanoa, Claudio Ferrarib, Alessio Tei. (2019). Blockchain: How shipping industry is dealing with the ultimate technological leap. Research in Transportation Business & Management. https://doi.org/10.1016/j.rtbm.2020.100428

[6] Acciaro, M., Ferrari, C., Lam, J. S. L., Macario, R., Roumboutsos, A., Sys, C., ... Vanelslander, T. (2018). Are the innovation processes in seaport terminal operations successful? Maritime Policy & Management, 45, 787–802.

[7] Arduino, G., Aronietis, R., Crozet, Y., Frouws, K., Ferrari, C., Guihéry, L., Kapros, S., et al. (2013). How to turn an innovative concept into a success? An application to seaport- related innovation. Research in Transportation Economics, 42, 97–107.

[8] Vanelslander, T., Sys, C., & Carlan, V. (2016). Innovation among seaport operators: AQCA approach for determining success conditions. International Journal of Transport Economics, 43, 291–314.

[9] Assunta Di Vaio & Luisa Varriale. (2019). Digitalization in the sea-land supply chain: experiences from Italy in rethinking the port operations within inter-organizational relationships, Production Planning & Control, DOI: 10.1080/09537287.2019.1631464

[10] Bughin, J., Catlin, T., Hirt, M., & Willmott, P. (2018). Why digital strat- egies fail. McKinsey Digital. Retrieved from https://www.mckinsey. com/business-functions/mckinsey-digital/our-insights/why-digital- strategies-fail.

[11] Kane, G, C., Palmer, D., Phillips, A, N., Kiron, D., & Buckley, N. (2015). Strategy, not technology, drives digital transformation. MIT Sloan Management Review and Deloitte University Press, July 2015.

[12] Wiles, J. (2018). Mobilize every function in the organization for digitali- zation digital business. Gartner. Retrieved from https://www. gartner.com/smarterwithgartner/mobilize-every-function-in-the- organization-for-digitalization/.

[13] Vial, G. (2019). Understanding digital transformation: A review and a research agenda. Journal of Strategic Information Systems, 28(2), 118–144.

[14] Dominik M. Wielgos & Christian Homburg & Christina Kuehnl. (2021). Digital business capability: its impact on firm and customer performance. Journal of the Academy of Marketing Science. https://doi.org/10.1007/s11747-021-00771-5

[15] Wang, Y., & Sarkis, J. (2021). Emerging digitalisation technologies in freight transport and logistics: current trends and future directions. Transportation Research Part E: Logistics and Transportation Review, 148, 102291.

[16] Sarkis, J., Kouhizadeh, M., & Zhu, Q. S. (2020). Digitalization and the greening of supply chains. Industrial Management & Data Systems.

[17] Fruth, M., & Teuteberg, F. (2017). Digitization in maritime logistics—What is there and what is missing? Cogent Business & Management, 4(1), 1411066.

[18] Kayikci, Y. (2018). Sustainability impact of digitization in logistics. Procedia manufacturing, 21, 782-789.

[19] Opresnik, D., & Taisch, M. (2015). The value of big data in servitization. International journal of production economics, 165, 174-184.

[20] Nagy, J., Oláh, J., Erdei, E., Máté, D., & Popp, J. (2018). The role and impact of Industry 4.0 and the internet of things on the business strategy of the value chain—the case of Hungary. Sustainability, 10(10), 3491.

[21] Nagy, J., Oláh, J., Erdei, E., Máté, D., & Popp, J. (2018). The role and impact of Industry 4.0 and the internet of things on the business strategy of the value chain—the case of Hungary. Sustainability, 10(10), 3491.

[22] Richey, R. G., Morgan, T. R., Lindsey-Hall, K., & Adams, F. G. (2016). A global exploration of big data in the supply chain. International Journal of Physical Distribution & Logistics Management.

[23] Yu, W., Chavez, R., Jacobs, M. A., & Feng, M. (2018). Data-driven supply chain capabilities and performance: A resource-based view. Transportation Research Part E: logistics and transportation review, 114, 371-385.

[24] Seyedghorban, Z., Tahernejad, H., Meriton, R., & Graham, G. (2020). Supply chain digitalization: past, present and future. Production Planning & Control, 31(2-3), 96-114.

[25] Cagliano, A. C., Mangano, G., & Rafele, C. (2021, April). Determinants of digital technology adoption in supply chain. An exploratory analysis. In Supply Chain Forum: An International Journal (Vol. 22, No. 2, pp. 100-114). Taylor & Francis.

[26] Yang, M., Fu, M., & Zhang, Z. (2021). The adoption of digital technologies in supply chains: Drivers, process and impact. Technological Forecasting and Social Change, 169, 120795.

[27] Wang, Y., & Sarkis, J. (2021). Emerging digitalization technologies in freight transport and logistics: current trends and future directions. Transportation Research Part E: Logistics and Transportation Review, 148, 102291.

[28] Tawfik Borgi, Nesrine Zoghlami, Mourad Abed. (2017). Big Data for Transport and Logistics : A Review. International Conference on Advanced Systems and Electric Technologies (IC_ASET), 44, 44-49

[29] Meng Xiao Feng & Ci Xiang(2013). Big Data Management: Concept, Technology and Challenge. Computer Research and Development (01),146-169.

[30] Meier, C. 2016. "Digital Supply Chain Management." In Digital Enterprise Transformation. A Business-driven Approach to Leveraging Innovative IT, edited by Uhl, A. and L. A. Gollenia. London: Routledge.

[31] Barykin, S. Y., Bochkarev, A. A., Dobronravin, E., & Sergeev, S. M. (2021). The place and role of digital twin in supply chain management. Academy of Strategic Management Journal, 20, 1-19.

[32] Della Valle, F., & Oliver, M. (2021). A guidance for blockchain-based digital transition in supply chains. Applied Sciences, 11(14), 6523.

[33] Harris, I., Wang, Y., & Wang, H. (2015). ICT in multimodal transport and technological trends: Unleashing potential for the future. International Journal of Production Economics, 159, 88-103.

[34] Yang, C. S. (2019). Maritime shipping digitalization: Blockchain-based technology applications, future improvements, and intention to use. Transportation Research Part E: Logistics and Transportation Review, 131, 108-117.

[35] Marmolejo-Saucedo, J., & Hartmann, S. (2020). Trends in digitization of the supply chain: A brief literature review. EAI Endorsed Transactions on Energy Web, 7(29).

[36] Stavros Ioannis Valsamidis. (2020). The Key Drivers for the Digitalization of the Supply Chain. International Journal of Operations Research and Information Systems. Volume 11, Issue 3, 14, 1-18.

[37] Li Xiaozhong.(2021). Digital Economy Development and Corporate Value Enhancement - from Life Cycle Theory angle. Economic Issue (03),116-121. doi:10.16011/j.cnki.jjwt.2021.03.016.

[38] Salvi, A., Vitolla, F., Rubino, M., Giakoumelou, A., & Raimo, N. (2021). Online information on digitalisation processes and its impact on firm value. Journal of Business Research, 124, 437-444.

[39] Ricci, F., Scafarto, V., Ferri, S., & Tron, A. (2020). Value relevance of digitalization: The moderating role of corporate sustainability. An empirical study of Italian listed companies. Journal of Cleaner Production, 276, 123282.

[40] Truant, E., Broccardo, L., & Dana, L. P. (2021). Digitalisation boosts company performance: an overview of Italian listed companies. Technological Forecasting and Social Change, 173, 121173.

[41] Wu Fei, Hu Huizhi, Lin Huiyan & Ren Xiaoyi.(2021). Corporate Digitalization Transformation and Capital Market Performance - from Empirical Evidence on Stock Liquidity. Management World(07),130-144+10. doi:10.19744/j.cnki.11-1235/f.2021.0097

[42] Moldabekova, A. , Philipp, R. , Reimers, H. E. , & Alikozhayev, B. . (2021). Digital technologies for improving logistics performance of countries. Transport and Telecommunication Journal, 22(2), 207-216.

[43] Wilbur Chen & Suraj Srinivasan. (2022). Going Digital: Implications for Firm Value and Performance. https://ssrn.com/abstract=4177947.

[44] Kohtamäki, M., Parida, V., Patel, P. C., & Gebauer, H. (2020). The relationship between digitalization and servitization: The role of servitization in capturing the financial potential of digitalization. Technological Forecasting and Social Change, 151, 119804.

[45] Hossnofsky, V., & Junge, S. (2019). Does the market reward digitalization efforts? Evidence from securities analysts 'investment recommendations. Journal of Business Economics, 89(8), 965-994.

[46] Anna Moker, Prisca Brosi & Isabell M. Welpe. (2020). It Depends on the Size: How Firm Strategic Emphasis on Digital Transformation Predicts Market Capitalization. Proceedings of the 53rd Hawaii International Conference on System Sciences. URI: https://hdl.handle.net/10125/64415.