Using Microsoft Power BI and Data Visualization Tools to Study How Online Shopping was Affected During COVID-19 Period: A Comparison in Three Countries Between 2019 and 2020

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Abstract

This paper studies how online shopping and e-commerce were affected during COVID-19 pandemic in three countries which are China, the United States, and the United Kingdom. The paper will compare between the data in 2019 as a pre-pandemic situation and in 2020 as the peak of COVID-19. This is approached by collecting data from 28 international databases and online resources using Google Scholar website. The paper will utilize two software for data visualizations method and data analytics which are Microsoft Excel and Microsoft Power BI. Microsoft Power BI was selected as a data visualization tool since it helps to collaborate in intuitive ways and has ability to produce visualizations in different types such as bar-graph and pie-charts. As a result of COVID-19, online sales in the three counties have increased. In China, it increased from $1,232.6 to $1,414.3 billion, in the United States increased from $598.0 to $791.7 billion, and in the United Kingdom increased from $89.0 to $130.6. In addition, e-commerce has increased. In China, it increased to $2297.0 billion, in the United States increased to $795.0 billion, and in the United Kingdom increased to $180.0 billion.

Keywords
Online shopping, e-commerce, sales, COVID-19, Microsoft Power BI.

1. Introduction
In early 2020, COVID-19 spread worldwide through human-to-human contact. This virus started in late 2019 in the Hubei province of China, and its effect over the world is still unstoppable and uncontrolled. It puts the world and human health in a baleful condition, as it leads to extreme illnesses such as high fever that may lead to death. Moreover, COVID-19 pandemic has changed the nature of purchasing for the whole world within a month (Shahzad et al. 2020). The impact of COVID-19 has led the economy to fallouts, and financial constraints have affected both the businesses and individual firms. However, this led to change the way firms work, as digital and online solutions were introduced for their business e-commerce activities. In other words, during the pandemic, a large number of businesses who switched to online businesses survived. For example, COVID-19 pandemic has increased the growth of e-commerce and online shopping, where customers connect their laptops and/or wireless devices to the internet to search for websites and online retailers, to place an order for their requirements of goods and service (Suji, 2019). After that, they complete their transaction through online payments without direct contact between the seller and the buyer, which is ideal for not spreading the virus (Jaller and Pahwa, 2020). COVID-19 persuades customers to use the internet and make it a habit in their daily routine due to convenience, easiness, and fast speed (Abiad et al. 2020). For example, ordering has become very easy as a customer can order from anywhere in the world, and the order will be delivered as soon as possible to the customer's house. This paper will study how COVID-19 has changed the nature of online shopping, by describing historical data from 2019 and 2020 in three countries which are China, USA, and the UK. Software such as Microsoft Power BI generated graphs using databases to describe how online retail sales increased in 2020 in the three mentioned countries in comparison to 2019 online retail sales. Furthermore, it studies the e-commerce of three countries to present it through Microsoft Power BI interactive visualization map.

1.1 Objectives
The paper aims to study the effects of COVID-19 on online shopping, by utilizing historical databases of online shopping sales in 2019 as a situation prior to COVID-19 to compare it with online shopping sales in 2020 where the peak of COVID-19 was. The paper also aims to describe the e-commerce data in 2020 of three countries. In addition, the paper aims to describe what happened between the two years in the three countries in terms of online shopping sales and e-commerce through a data visualization software such as Microsoft Power BI to summarize the observations in clear bar-chart, interactive map, and pie-chart.

2. Literature Review
This section of the paper discusses research and articles from several resources on how online purchases changed by providing examples from specific sectors. Also, the theoretical and empirical literature on e-commerce dynamics and e-commerce performance evaluation are reviewed in this section. Through its pivotal role in both acceleration and deceleration of e-commerce, COVID-19 has altered business as a whole. This section also provides an overview on COVID-19 cases and how it impacted the online sale, along with its effects on e-commerce, individuals, and the society. The literature review discusses the software used which is Microsoft Power BI.

Many studies have been done on online purchases, such as the study by Cordes and Musies (2021). The study stated that based on the customer's search history, the online shopping must meet the customer's needs. While most businesses concentrate on the education, revenue, and the reviews of their customers, online shopping has concentrated on the customer's culture, mentality, risk, and trust (Cordes and Musies 2021). In addition to having internet access, additional factors may impact the customer's online purchasing habits. For example, according to Munawar et al. (2021), some key factors play a role in the customer's online shopping habits which are demographic traits such as their age, gender, occupation, perception of risk, and reward factors (Munawar et al. 2021). Furthermore, after COVID-19 pandemic, people changed their shopping style. For instance, Abou-Zeid (2021) reported that 60% of shoppers reduced their visits to physical store, 70% reduced their out-of-home consumption, and 40% of shoppers increased their online shopping in 2020. Another example of the online shopping changes in 2020 due to the pandemic is that 70% of the online purchases are for ordering hygiene products (Abou-Zeid 2021). Even before restaurant closures, people worldwide began to change their eating and drinking habits, with 60% of people eating meals at home after the COVID-19 outbreak while 80% limiting their outings to socialize. As a result, internet product categories are gradually shifting toward health-related products. Furthermore, due to the pandemic, around 60% of the world's population is ready to continue their new habits, such as ordering food online or shopping from websites. Also, there has been an increase in the percentage of people shopping online compared to traditional purchasing methods (Nayal et al. 2021).

Moving on to the e-commerce, studies of e-commerce implementation are linked to e-commerce adoption (Alam 2021). The number of companies using e-commerce grows daily. When companies grow, e-commerce becomes more difficult and time-consuming. As a result, e-commerce is viewed as a constraint rather than an opportunity for growth by many businesses. Organizations are not deterred by the cost of implementing e-commerce, but rather by the relative advantages it provides for them (Tashanova et al. 2020). Furthermore, organizations are often unable to identify the organizational and management structural changes that may be required as a result of e-commerce implementation because they lack an e-commerce strategy. As Munawar et al. (2021) stated, the entire e-commerce implementation process cannot be divided in order to ensure its success. In addition, they advocate for a more current and comprehensive depiction of the implementation process than is currently available (Munawar et al. 2021).

Regarding COVID-19, historical data on COVID-19 cases world-wide indicates that March and April 2020 were the first peak of the pandemic, where over five million new COVID-19 cases were suspected. During that time period, nearly 80% of actual cases in the US were undiagnosed. In most countries, the COVID-19 Tracking Project provides additional data on patients hospitalized in Intensive Care Units (ICU) and on ventilators (Nayal et al. 2020). Also, COVID-19 Racial Data Tracker shows the race and ethnicity of those affected by COVID-19, as these measures and figures give an overview on the pandemic's global spread (Cordes and Musies 2021). Because of the COVID-19 crisis, many people have reduced their physical contact with one another. The traditional brick-and-mortar retail industry has been temporarily halted in many countries as a result of self-imposed social distancing and strict confinement measures. For example, sales in the retail and food service industries dropped 6% between February and April 2020, compared to the same months in 2019. On the other hand, sales at grocery stores and non-physical store retailers increased by 16% and 12%, respectively (Wang et al. 2021).

Relating to e-commerce, the impact of COVID-19 varies depending on the product category and the seller. Consumption of personal protection equipment such as disposable gloves, groceries, and information and communications technology (ICT) equipment have increased, whereas consumption of travel, sports, and formal clothing have decreased (Abou-Zeid 2021). Food supply chains in many countries have shifted to e-commerce, with farmers selling directly to consumers through digital technology as well as restaurants providing food delivery services to customer's homes. To elaborate, a 30% increase in accumulated food sales between January and April 2020 (Acciarini et al. 2021). Regarding medicines and supplements, online sales increased significantly in 2020 in comparison to 2019 (Umair et al. 2021).

Lastly, the data visualization tool utilized in this paper is Microsoft Power BI. This software is utilized to answer the question "what happened" to online shopping and e-commerce before and after COVID-19 pandemic. The software can analyze large databases arranged in tables and exported from Microsoft Excel, which are then transformed into simple and clear visuals such as histogram, world-map, and pie-charts in Microsoft Power BI. It brings different databases together in a way that is easy to understand, visually appealing, and interactive. Excel spreadsheets, cloud-based and on-premises hybrid data warehouses, or a combination of the two are all possibilities for data exporting to Microsoft Power BI (Alam 2021). Because Microsoft Power BI has an evaluation mechanism, it is used to display

historical data to summarize what happened in the past and to describe the current situation. Example of the visuals that Microsoft Power BI can produce is histogram which is a graph that shows the distribution of a set of parameters in terms of their exact value. Another example is the pie-chart which is a graph to show a group of parameters in percentage of a whole. Regarding the interactive visualization world-map, the map on Microsoft Power BI presents all countries and cities depending on the level of details the user needs, along with bubbles of different sizes to describe a set of ranges (Umair et al. 2021).

3. Methods

The data on how online shopping was affected due to COVID-19 pandemic was collected from 17 international databases and online resources using Google Scholar website to write the literature review. The historical data was gathered on three countries which are the United States of America, China, and the United Kingdom. The aim is to study online shopping prior to COVID-19 period in 2019 and to compare it with the post-pandemic situation in 2020, along with the effects of COVID-19 on e-commerce. The collected data and information present historical data on online retails sales, physical retail sales, and total e-commerce sales between 2019 and 2020 in the three selected countries, along with a public survey on shopping post-pandemic. The data were filtered in Microsoft Excel to meet the research objectives prior to utilizing Microsoft Power BI as a data visualization tool. The research was then conducted using a descriptive analytics type to explain what happened in the past in regards to online shopping and total e-commerce due to COVID-19 through the extracted graphs from Microsoft Power BI. Results and conclusions were deduced, followed by suggesting few recommendations and forward plans. Figure 1 presents the workflow that was followed to complete this paper.

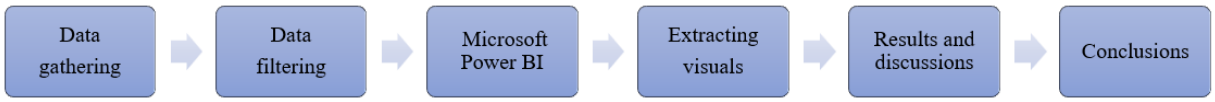

Figure 1. The paper's workflow.

4. Data Collection

COVID-19 has impacted online shopping and e-commerce in the world by changing the way of businesses. In addition, online shopping sales and e-commerce have increased during the peak of COVID-19 in 2020. People are buying from home to avoid going out unnecessarily, and are keeping social distance when necessarily going out to avoid the infection of the virus. According to the World Health Organization (WHO), in 2019 the percent of online sales was 16%. However, it has increased to 19% during the peak time of COVID-19 in 2020. Table 1 illustrates online shopping sales in 2019 and 2020, retail sales in 2019 and 2020 which is referred to the physical store sales, and total e-commerce sales after COVID-19 pandemic. Table 1 compares changes in the online sales in three countries which are the United Kingdom, United States of America, and China (UNCTAD 2020).

Table 1. Online retail sales, retail sales, and e-commerce in the UK, USA, and China in 2019 and 2020.

Country	Online retails sales in 2019 ($ billion)	Online retails sales in 2020 ($ billion)	Retails sales in 2019 ($ billion)	Retails sales in 2020 ($ billion)	Total e-commerce sales in 2020 ($ billion)	e-commerce sales ranges ($ billion)
UK	89.0	130.6	564.0	560.0	180.0	<500
USA	598.0	791.7	5,452.0	5,638.0	795.0	500-1,000
China	1,233.6	1,414.3	5,957.0	5,681.0	2,297.0	>1,000

To elaborate, 2019 is referred to the year prior to COVID-19 where there is no impact of the pandemic on online shopping. As presented in table 1, online retail sales in the United Kingdom were $89.0 billion, $598.0 billion in the United States of America, and $1,233.6 billion in China. Similarly, retail sales in the United Kingdom were $546.0 billion, $5,452.0 billion in the United States of America, and $5,957 billion in China. However, in 2020, where there is an impact of COVID-19 on online shopping, online shopping sales increased in all three countries. Online retail sales have become $130.6 billion in the United Kingdom, $791.7 billion in the United States of America, and $1,414.3 billion in China.

E-commerce is selling and buying of goods and services, along with transforming data or funds through electronic networks. COVID-19 has impacted e-commerce in the world. E-commerce over the internet is growing very rapidly, people are staying at home and ordering online avoiding direct marketing. Table 1 shows the total e-commerce sales in 2020 in the three selected countries. The United Kingdom had $180.0 billion as the total e-commerce sales in 2020, while the United States had $795.0 billion, and $5,681.0 in China. The ranges of the total e-commerce sales are used for the interactive visual world-map for the results section of this paper.

The project group members have collected data from a survey related to this term project content about the online shopping that was conducted by UNCTAD (2020). The data will be discussed later in the results and discussion section.

5. Results and Discussion

5.1 Numerical Results

A. Increasing Online Sales in 2020

As observed from Table 1, online shopping has increased dramatically in 2020 where the peak of the pandemic was. Online shopping sales increased in the three countries in 2020 by $41.6 billion in the United Kingdom, $193.7 billion in the United States, and $180.7 billion in China. Also, the percentage of online shopping sales to retail sales in the three countries increased in 2020 by 7.5%, 3%, and 4.2% in the United Kingdom, the United States, and China, respectively. It is clear that online shopping had a huge increase in 2020 compared to 2019. This happened after COVID-19 spread all over the world, precisely when countries issued guidelines and procedures and wells as lockdowns. As a result, people resorted to online shopping to satisfy their needs when the physical stores were closed. Another reason is because people were afraid of getting infected when leaving their homes. Also, online shopping is an easy and fast process which is clean and safe at the time of a pandemic. All these reasons lead to an increase in the dependency on online shopping (Jennifer McAdams 2021, UNCTAD 2020).

B. Increasing the E-commerce Sales

Not only online shopping sales increased in 2020 but also the e-commerce aspects increased in 2020. As presented in Table 1, ranges of e-commerce in 2020 in the three countries were high, especially in China where it has the biggest range of sales in billion dollars. This is because China has the largest population and low delivery costs for e-commerce. Another reason is because China was the center of COVID-19 start, so the population was the first to highly depend on e-commerce. Regarding the United States, the ranged of e-commerce were between $500-100 billion, which came after China but before the United Kingdom when comparing the three countries. After COVID-19 spread in the United States, shops closed. As a result, people shifted their focus to depend on e-commerce (Jia Wertz 2020).

The same behavior was observed in the United Kingdom, where also COVID-19 had a big impact on sales. After the lookdown took place when the pandemic started, people were not left with any other options other than e-commerce (Daniela Coppola 2020).

C. Changing the Concept and Dependency of Online Shopping

After COVID-19, the behavior of selling and shopping changed. Due to the lockdowns in 2020, people shifted to the only available solution which was online shopping. Despite decreasing the restrictions related to COVID-19 in late 2020, people were still using online shopping (Jennifer McAdams 2021, UNCTAD 2020).

The percentage of people buying online in China was around 62%, which was calculated as the sum of percentages of people who totally agree and agree on the survey question: “I only buy online post COVID-19”. This percentage reflects more than half of the survey sample size. This large percentage appeared due to the enhanced online shopping in China, huge population, and low delivery cost (UNCTAD 2020).

5.2 Graphical Results

A. Increasing Online Sales in 2020

Figure 2 shows the comparison of online retail sales in the years 2019 and 2020 in three counties. Online sales in China increased from $1,233.6 billion in 2019 to $1,414.3 billion in 2020. Same behavior was observed in the United States, where online sales increased from $598.0 billion in 2019 to $791.7 billion in 2020. Similarly, the United Kingdom increased $89.0 billion in 2019 to $130.6 billion in 2020 (UNCTAD 2020).

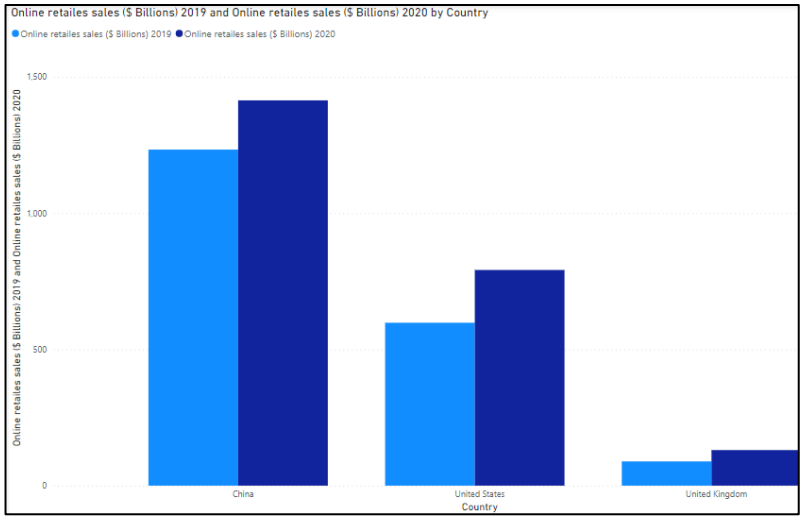

Figure 2. Online retail sales in 2019 versus 2020 in the three selected countries.

Figure 3 presents a comparison between the percentages of online sales relative to the retail sales in 2019 in the three counties, while Figure 4 presents the same comparison but in 2020. As observed from Figure 3, in China, the percentage of online sales to the retail sales was 20.7%. However, in 2020, the percentage increased to 24.9%, as presented in Figure 4. Similarly, the percentage in the United States increased from 11% in 2019 to 14% in 2020. Same behavior was observed in the United Kingdom where the percentage inclined from 15.8% in 2019 to 23.3% in 2020 (UNCTAD 2020).

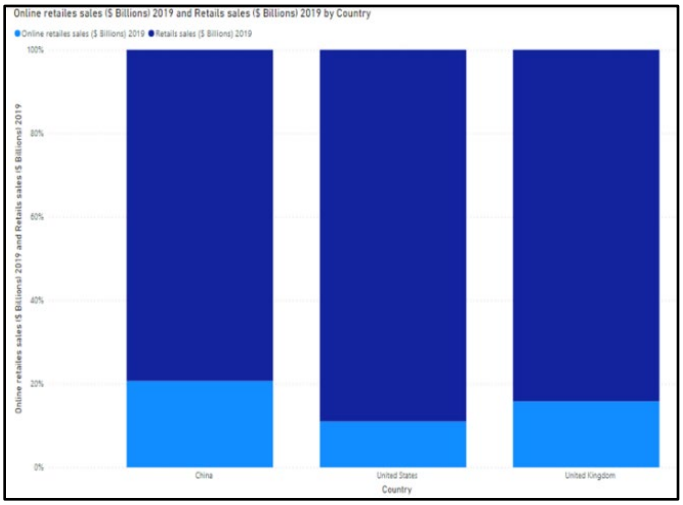

Figure 3. Percentages of online share to the retail sales in 2019 in three countries.

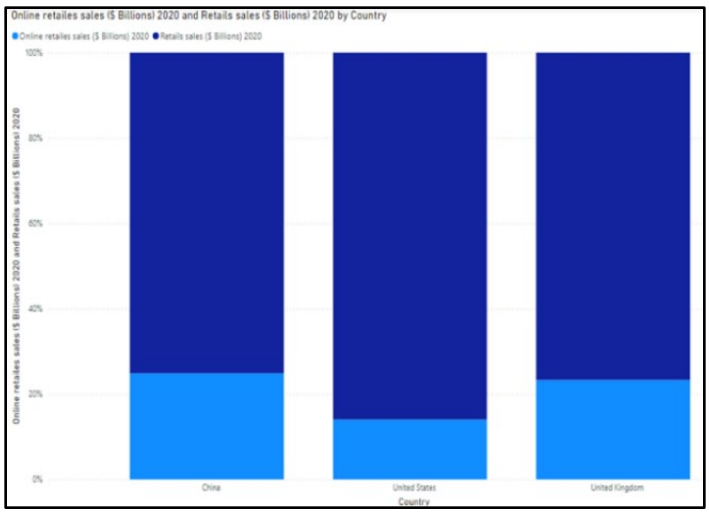

Figure 4. Percentages of online share to the retail sales in 2020 in three countries.

B. Increasing the E-commerce Sales

As the online sales increased, the e-commerce sales increased in the three countries. As shown in the Figure 5, the e-commerce sales range in China in 2020 was greater than $1000 billion, while in the United States the e-commerce sales range was between $500-1000 billion, and in the United Kingdom was less than $500 billion (UNCTAD 2020).

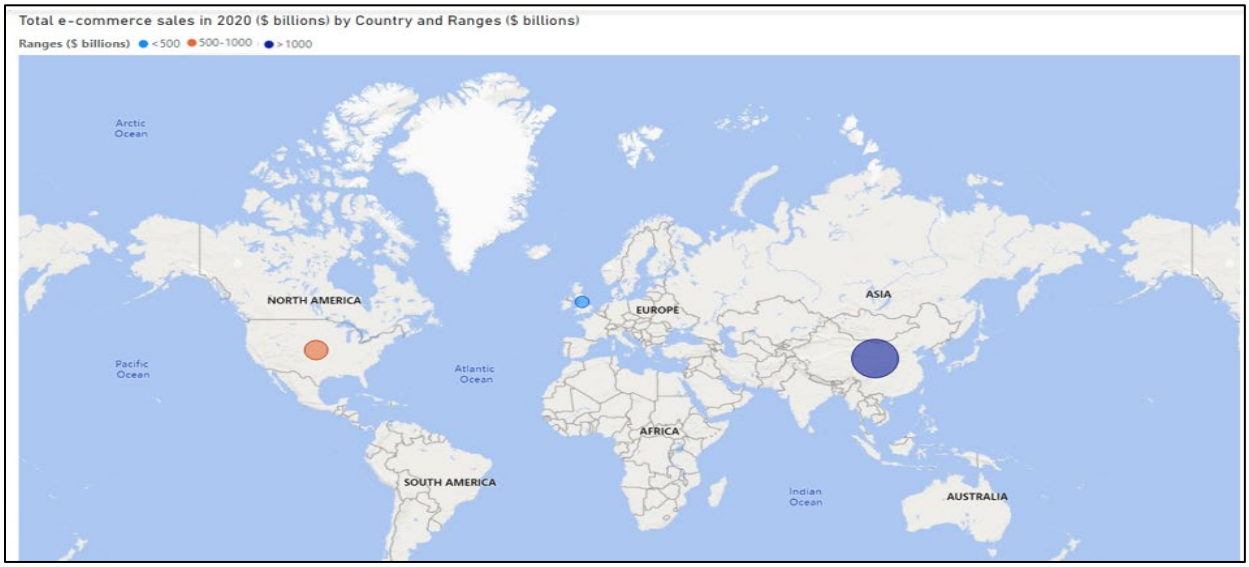

Figure 5. The visualization world-map for the e-commerce sales ranges in 2020 in three countries.

C. Changing the Concept and Dependency of Online Shopping

A survey was conducted online in China when COVID-19 started. This survey aimed to deduce how the public are thinking about online shopping after COVID-19, by asking the public about their feedback on the following sentence: “I only buy online post COVID-19”. The pie-chart in Figure 6 presents their answers. Around 11% of the sample size totally agreed, 51% agreed, 33% neither agreed nor disagreed, 4% disagreed, and only 1% totally disagreed UNCTAD 2020).

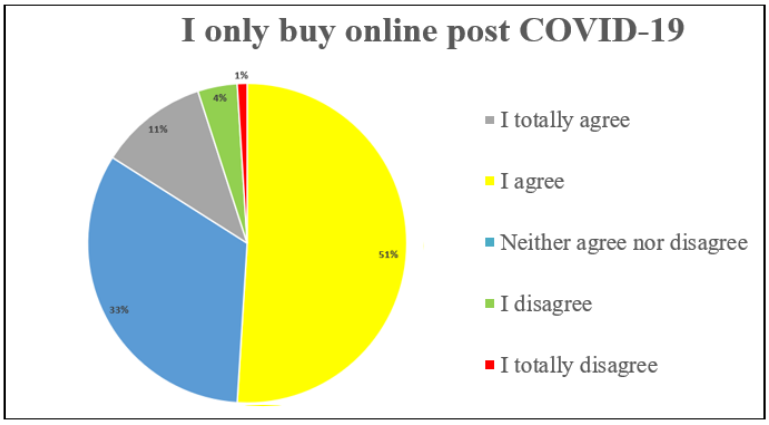

Figure 6. Pie-chart to represent the percentages of each answer of the survey.

5.3 Proposed Improvements

Since there is a huge reliance on the online market, the following are few recommendations for future businesses and economy related endeavors.

1. All businesses should now focus on creating online platforms that clearly indicate their goal to show what their product is, as this step is now a necessity to flourish in the current circumstances.
2. Ensure the security of the online transactions by the businesses in order to avoid cyber related thefts and/or frauds.
3. Research the topic of e-commerce even further using other data analytics approaches such as the diagnostic and the predictive analytics in order to get a better understanding of the reasoning behind the change and forecast the future demand for this type of commerce. Some of the suggested software are MATLAB and VENSIM.

5.4 Validation

Businesses are recommended to validate the significance of online platforms through hiring an Information Technology (IT) specialist to gradually and smoothly combine the physical retailing with the online retailing. This is alignment with Alam (2021) study.

6. Conclusion

By analyzing the data that was collected pre-COVID-19 in 2019 and comparing it with the data that was collected post-COVID-19 in 2020, it was concluded that the demand for all sorts of e-commerce is being sought right now and is the preferable option for many countries across the globe in comparison to shopping in physical stores. The percentages that were deduced as a result of the analysis show an increase of 3.0%, 4.2%, and 7.5% post-COVID-19 in each of the United States, China and the United Kingdom, respectively. The positive change in the percentages took place due to the circumstances that people were going through. For example, some were forced to revert to online shopping due to lockdowns and store closures, while others were afraid of contacting infected people while they go out and purchase the things they need. Furthermore, others preferred online shopping because e-commerce was convenient and easily accessible. Upon further analysis, it was also deduced that this change will not be a temporary one, but rather a permanent one with lasting effect. More people continue to rely on e-commerce even though the current COVID-19 conditions have slightly lifted and some countries are returning back to how the life routine used to be. This information was based on a survey result in which participants were asked if they would continue to shop online, and the majority of the participants by 62% indicated that they either strongly agree or agree with the statement "I only buy online post-COVID-19". This means that the effects of COVID-19 are going to have a lasting impact specifically on the economic sector in the future. Hence, the research contribution was illustrated in section 5.3.

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Biographies

Maryam Mohdsaeed Abdulla is a Qatari engineer. She is a chemical engineer by degree and a petroleum engineer by profession. While studying at Texas A&M University, she was sponsored by Maersk Oil where she got her summer internship. During the internship and rotating in different departments, the love of leadership had spiked. She graduated from Texas A&M University in chemical engineering in 2016 with a GPA of 3.42, while having a plan of leadership career at the back of her mind. Right after graduating, she worked at Occidental Petroleum at a petroleum engineer for three years. After that, she moved to work for QatarEnergy, where she got recognized for being a hard worker, and hence received awards. Her two top projects at QatarEnergy are reinjecting flared gas into the reservoir and a campaign of acid stimulation in sandstone reservoir. Currently, she is pursuing her graduate studies as Engineering Management Masters Student in the college of engineering at Qatar University. This degree will help her in shifting from the technical career to the managerial path, where she aims to be a leader in the oil and gas industry. Outside the working environment, she is enthusiastic in physical fitness, traveling, reading, and learning new languages.

Zahra Al-Ansari is a graduate student at Qatar University in the discipline of Engineering Management. This choice was done to further broaden her perspective in the engineering sector as well as the management sector by gaining more knowledge in both fields simultaneously. She has received her undergraduate degree from Texas A&M

University at Qatar in Electrical Engineering. She is very curious and likes to be faced with tough challenges. She aspires to become a future leader to manage people to accomplish some of the achievements that she believes are going to positively reflect on her country, Qatar. She is currently working in the Heavy Maintenance department as a Production Planning Engineer in is Qatar Airways. Her job requires an employee to have and nourish skills which are heavily related to the degree that she is pursuing which include: planning, scheduling, conducting meetings with multiple stakeholders, managing and directing a large number of people to complete the projects that are carried successfully and in a timely manner. By acquiring this degree all of the skills that she desires to master are going to be greatly enhanced as the focus of the program that she has enrolled in is on these specific skills.

Reem Baraka is a chemical engineer graduate from Qatar University. While she was taking her undergraduate courses, she learned various technical skills that are relevant to experimental lab tasks, problem-solving skills based on engineering methodology, and used many engineering software such as AspenTech and MATLAB. She graduated as a chemical engineer in 2020. While she was working on her senior project, she discovered that she has an interest in solving technical problems and project optimization, which made her decide to apply for the Master's Degree in Engineering management. She started this program in 2021 at Qatar University and expecting to obtain her degree in the first half of 2023. Although she didn't obtain the degree yet, she has learned many new concepts and software that combine her prior knowledge of chemical engineering alongside the new skills in business and management techniques. She will complete her learning journey by getting a Ph.D. abroad in the same field. Because she is passionate about learning and researching, she aims to become an instructor at Qatar University. Her number one task once she becomes an instructor is to teach student that studying is a continuous process which doesn't end at a certain age.

Fatima Al-Muslamani got her bachelor degree from Architectural program. What she is interested in the most, is that architecture gives the opportunity to learn and be creative. The main reason of choosing to study Masters in Engineering Management is to think outside the box and to change the traditionally building designs to more modern and organic ones. On the other hand, she likes the construction side of the buildings. Architects usually assigned as project managers, as the team depends on them on how the overall construction process will go, sometimes they are the ones who need to be in contact with civil, mechanical, and electrical engineers. This is what she is aspiring it. Moreover, to achieve this goal, she is studying masters in Engineering Management at Qatar University as well. After Graduating, she is welling to be an engineering manager and works in a government to know more about the opportunities and challenges in this sector. Also, to obtain sufficient experience that qualifies her to designs and constructs the buildings herself, to establish an office for construction. Furthermore, perusing graduate degree will help in advancing the development of the state of Qatar.

Murat Kucukvar is a Professor of Industrial and Systems Engineering at Qatar University and working on quantitative sustainability assessment, particularly social, economic, and environmental sustainability assessment of emerging technologies. In the past, he also established the Sustainable Systems Solutions Lab in the City University of Istanbul and many of his graduate students worked on the regional and global sustainability assessment of energy, manufacturing, and transportation sectors. In a recent review paper, Kucukvar was also ranked among the world's ranked scientists for the research related to carbon footprint analysis and global climate change impacts of energy and manufacturing supply chains. He published in several interdisciplinary journals such as Energy, Applied Energy, Energy Conversion and Management, Renewable and Sustainable Energy Reviews, and Journal of Industrial Ecology, which is among the highly cited journals in the field of energy, environment, and sustainability. He is also managing over 2.2 $M value of projects related to e-mobility and sustainability assessment, obtained from the QNRF and industry partners. He is recently listed among the top 1% of scientists in the world in the fields of Energy, Environmental and Earth Sciences, and Sustainability, according to the global ranking published by Stanford University, USA.