# The Impact of COVID-19 on Various Aspects of Remote Work Software and Future development

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## ABSTRACT

The COVID-19 has a big shock to people's life. It not only changes people's lifestyle but also brings people lots of advantages and disadvantages. Workers have to switch from sitting in the office to staying at home and working on the Internet. Therefore, the effects that COVID-19 brings to remote working software are apparent. The goal of this paper is to evaluate the effect of COVID-19 brings to these kinds of companies. Also, after the COVID-19, the results indicate that the companies will continue to improve the pattern of remote working to ensure the efficiency of working and support the new ways of working to maximize business continuity management. Also, ensuring the safety of data is essential and a stable, robust data center infrastructure is needed to cope with unexpected challenges.

*Keywords: COVID-19, Software, Remote Working*

## 1. INTRODUCTION

The first COVID-19 patient appeared in Wuhan, China, on December 1, 2019, and the infection then rapidly spread nationwide. Subsequently, in March 2020, COVID-19 patients began to appear abroad and spread rapidly across countries. COVID-19 is highly contagious and has a long incubation period, and the virus has a very high transmission rate in public places. Scientists are advising people to stay home and isolate themselves as much as possible in conjunction with efforts to contain COVID-19. The Chinese government has chosen a policy of schools and work suspensions to prevent mass transmission of COVID-19. Therefore, the surge in the number of cases has affected all sectors of the economy. The economy stagnated because of the no-gathering policy, the transportation industry was suspended, and people were forced to stay at home. The basic social order was disrupted, and the streets were empty of people. According to the traffic and the no-gathering policy, they cannot commute to work and work normally, which affects the normal operation and profitability of the company. Because of the surge in the number of sick people, companies were slow to get back to work, so most companies came up with a new way to get their companies back on track-using telecommuting software. Although this method could not completely improve the efficiency of the workers, it could restore the basic operation of the company and reduce the probability of bankruptcy. In this way, people discovered that using remote working software is convenient. Users can do the daily work without leaving home, and there are some features of telecommuting software that can help workers improve their efficiency and make their work easier. This method has become popular all over the world and has become the need of people's office. A survey showed that 64% of companies quickly adopted new technologies and processes to ease the stress of telecommuting during an epidemic lockdown. Many people say that working online has saved them a lot of time. For example, time spent on the road to work is beneath. Digitizing information has helped them receive and process information more easily. This is not true for all professions. Some manual jobs still can not embark on the digital path because they do not have the information they need to digitize. These also have an impact on the teleworking software itself.

As for productivity, the COVID-19 had some impact. Jonge pointed out the influence of productivity that COVID-19 brings us as an effect of the sudden shift to

working remotely. He conducted a case study about how people work together through an online environment. The first part of the case study is to understand current employees' situation. The second interview goes more in-depth on certain factors that are ambiguous in the first round and explores the effect of a measure implemented after the first round. According to participants, the obstacles contain social connection, time management, work-life balance, and environment. Thus, Jonge made a conceptual model, which is used to focus on exploring the relationship between these variables and workers. Finally, Jonge noticed that the outcome of this research majorly related to three factors: management style, transparency, and culture. Also, how much the COVID-19 influences the productivity of workers can be different in levels. The conclusion that Jonge got is COVID-19 can have both positive and negative influences on productivity [1]. The epidemic has both good and bad effects on such office apps. Zia and Bilal explored the current usage, possible benefits, and impact of telecommuting along with the hindrances in the development of this phenomenon in Pakistan. The financial and social impact of telecommuting was also determined on telecommuters. This study utilizes a structured interview technique. By using the judgmental sampling method, data was collected from a specified sample of 54 telecommuters from Lahore. It was interesting to know that people who were involved in telecommuting reported unfamiliarity with the term. Based on findings, the study concludes that telecommuting is the latest and valuable business tool that provides a comfortable working environment along with financial benefits to the users but due to lack of awareness, it is not being used extensively in the country. Respondents also gave recommendations including training of employees, making them computer literate, develop infrastructure and create awareness about telecommuting to make its future promising [2]. Marzia L. and Giovanni P. wrote about many uncertainties and policy decisions about the initial pandemic in Italy. Due to the need to initially delay and control the pandemic, the Italian Ministry of Health issued a new policy, that is, companies, schools, shopping malls and other social areas in most areas are closed, and supermarkets for daily necessities also restrict the flow of people and distance. The epidemic has led to many panics, such as fights in prisons. In March, it was difficult to distinguish between asymptomatic and symptomatic patients. Therefore, the suggestions given by the Ministry of health are statistical data, recording patient characteristics and multinational cooperation. During this period, remote work software will help solve the inconvenience of study and work [3].

At the same time, some survey shows workers' attitudes towards online work. Crick and Knight made a questionnaire, to learn about the workers' views,

experiences, and perspectives of the move to online working. The first section of the questionnaires is to determine how participant characteristics impacted key variables. People who work for different jobs were asked to choose the answer from different lists. And then, demographic questions were followed. This question is to learn how prepared and confident they felt about the move to online working. In addition, respondents were asked to answer three opened-questions to gain their overall insight into the impact of the changes. According to this series of questionnaires, when Tom Crick and Cathryn Knight collected the data and analyzed it, they found that around 73.5% of people considered that it was no problem to transfer online, and they prepared well in it. And almost all the respondents gave positive responses toward transferring online. However, according to Tom Crick and Cathryn Knight, respondents also raised lots of concerns about using online software. One teacher said that computer science will boom. So teachers who were going to teach students through online websites worried that it would be hard to supervise students. The conclusion that Tom Crick and Cathryn Knight had is there were significant concerns regarding the impact on jobs, career progression, financial sustainability of institutions. However, the ability and quality of doing a job are more important. It would be easy to adapt it if the ability is high [4]. Felstead and Henseke, who want to critically assess two of the most prominent presumptions of the 'spatial revolution'. And they found that there are some existing pieces of evidence making people suspect these two theories. Firstly, they use the Labour Force Survey (LFS) series to investigate almost 40000 households and 45000 workers. And they also use the Skills and Employment Survey (SES) series to analyze well-being and well-life balance. In addition, they add three sets of covariates that correspond to the theories to show the effort that remote working contributes to well-being. And LES shows that the number of employees who use remote working increases and this number in all fields but factory-based work increases largely. Furthermore, the proportion working mainly in these conventional workplaces has been a downward trend. What's more, SES indicates that people who are remote working are more active, more hardworking, and more pleasurable than people who work in the office. Remote workers appear willing to work harder and longer, and they live a more pleasurable life [5].

Working hours on the Internet also vary. Other publishers talk about companies' examples of data collection. Putra et al. made one research about how COVID-19 affects the working hour of workers. This research uses quantitative methods, and data collection is carried out by using an online questionnaire distributed through social media. The reliability was measured by a software called SmartPLS. In this research, people found that the use of teleworking in the

majority of working time will be able to help employees in dealing with stress and disturbances such as injustice in the workplace. Telecommuting is a job that can be done in a place that doesn't take much time to get home and go to work, work that can be done at home or in at other locations, and facilitated by some networks and including other work equipment. Telecommuting is a work arrangement system that allows employees to be able to work from home or an approved place using technology information to communicate with superiors. So this will help to increase the productivity of workers [6]. Dingel and Neiman, who want to analyze the feasibility of working at home during COVID-19 and the difference in numbers of jobs that can be done at home among cities, begin to use responses to two surveys to know how many jobs can be done at home. The first survey is called the Work Context Questionnaire, and the second survey is called the Generalized Work Activities Questionnaire. They use these questions to classify whether this job can be done at home. Their classification implies that 37 percent of US jobs can plausibly be performed at home. There is significant variation across occupations. Managers, educators, and those working in computers, finance, and law are largely able to work from home. Farm, construction, and production workers cannot. And there is a great difference among cities in the United States. More than 45 percent of jobs in San Francisco, San Jose, and Washington, DC could be performed at home, whereas this is the case for 30 percent or less of the jobs in Fort Myers, Grand Rapids, and Las Vegas [7].

Air emissions are also taken into account. Kylili et.al analyze the establishment of impact indicators per hour of remote work per employee, in terms of $CO_2$ emissions to analyze the benefits of working at home. Firstly, they obtain the address of each employee and use ArcGIS to achieve the lowest energy needs in terms of transportation and the most cost-efficient. After calculation, they produce the result of $CO_2$ emissions of each place and scenario. They find that the environmental impact of the Scenarios 1 and 2 that incorporate remote working is significantly lower than the Basic Scenario and the $CO_2$ emissions are 51% lower for Scenarios 1 and 43% lower for Scenarios 2, which means that the order of savings that can be achieved in fuel resources and $CO_2$ emissions and the magnitude the potential is reduced in a selection of relevant environmental impacts per hour of remote working[8]. Professionals used surveys and collected data for different analyses. Zia and Bilal discussed the current use of telecommuting, possible benefits and effects, and obstacles to the development of this phenomenon in Pakistan. The financial and social impact of telecommuting also depends on the telecommuting person. This research uses structured interview technology. Using judgmental sampling methods, data were collected from a designated sample

of 54 remote workers in Lahore. Interestingly, people involved in telecommuting said they were unfamiliar with the term. Based on the survey results, the study concluded that telecommuting is the latest and valuable business tool that provides users with a comfortable working environment and economic benefits. However, due to a lack of awareness, telecommuting has not been widely used in the country. The interviewees also put forward some suggestions, including training employees, making them familiar with computers, developing infrastructure, raising people's awareness of remote offices, and making the future full of hope [9].

Silva and Merlot used the national travel survey data from 2005 to 2012 to analyze the impact of home-based remote work on the number of trips and miles traveled by single-worker families in the UK. Two path analysis models are developed, one considers weekly itinerary and travel distance according to the model, and the other considers weekly itinerary and travel distance according to purpose. These two models consider the background of remote work frequency, land use characteristics of homes and workplaces, commuting distance, level of car ownership, weekly travel, and travel distance. This framework allows us to explicitly model the endogenous relationships in the decision chain related to these variables. Research results show that home-based remote work is a strategy people use to cope with long and expensive commutes. Workers who live in inaccessible areas and have longer commutes tend to work from home more frequently. The main conclusion on the frequency of remote work points out that it increases weekly mileage, especially car mileage, but does not reduce commuting distance. These results indicate that home-based remote work is not an effective travel demand management strategy, especially because it seems to increase the use of cars. The overall main result is that teleworkers travel more through more polluting modes of transportation [9]. Do and Frank use a combination of public and restrictive data from the Centers for Disease Control and Prevention, and use national and sub-national racial and age-stratified COVID-19 mortality and case burden/advantages to assess workplace vulnerability assumptions. They also use personal information about previous health status and mortality in the case data to assess whether the observed patterns are consistent with other hypotheses. Therefore, their research results show that among the working-age group, the disproportionate burden of COVID-19 cases and Hispanic population mortality is the largest, which supports that workplace exposure plays a role in increasing susceptibility to COVID-19 mortality [10].

The COVID-19 is a big shock to people's life. It not only changes people's lifestyle but also brings people lots of advantages and disadvantages. Workers have to switch from sitting in the office to staying at home and working on the Internet. So the effects that COVID-19

brings to remote working software are apparently. The goal of this passage is to analyze what effect does the COVID-19 brings to this kind of company. Also, after the COVID-19 finishes, what should the companies and people do remains uncertain. How can companies repair their economics is still being discussed.

## 2. STOCK ANALYSIS

### 2.1. Before COVID-19

Zoom Cloud Meeting is software for online video or teleconference. It allows multiple people to attend at the same time, up to 1000 people for 30 hours of meetings. Before COVID-19, Zoom was successfully launched in April 2019. The highest is $104 on July 22, 2019. Zoom Video Communications' total assets for 2019 were $0.355B, which is not a large-cap. Zoom's share price soared 72% on its first day of listing, with a market capitalization of $16 billion At first, the stock price on April 15, 2019, was $65 per share. And until December 2019, the stock price was flat and there was no volatility.

Before 2020, the profit margin of Zoom has been lower than 5%, and the highest value is only 3.49%, so Zoom has always been a low-interest stock. However, the gross margin of Zoom always keeps high. It is always higher than 80% until 2021/01/31, so Zoom always could pay for the debts.

Bizconf video is a Chinese company providing voice conferences, online conferences, video conferences, and webcasts. In January 2017, the Bizconf video was launched. The initial price was 8.85 yuan, and then on March 19, 2017, the stock was 32.89 yuan. Until December 2019, the price is also very stable, with an average of about 25.3 yuan. Net income is 41,344,56 in 2016 and Net income growth is 84.45% in 2017, this is a surprising growth value. Gross Income is 79,183,912 in 2016 and Gross Income Growth is 35.76% in 2017. Sales/Revenue is 201,866,745 in 2016 and sales growth rate is 18.68% in 2017.

### 2.2. During COVID-19

On December 31, 2019, the COVID-19 was discovered and confirmed in Wuhan, China. The Chinese government launched emergency measures to restrict people from going to schools and companies in person to prevent the virus from spreading faster. As a Chinese company that provides services to Chinese people, BizConf Telecom has greatly increased market demand and personnel activity in China. The stock price rose directly from 27 CNY per share (12/29/2019) to 82 CNY per share (02/21/2020). During the epidemic period, that is, in 2020, BizConf Telecom's quarterly P/B ratio has always been higher than 5, and the P/S ratio has always been higher than 10. This shows that BizConf Telecom's stock is strong during this period

although it is overvalued. The market cap of BizConf Telecom has risen to more than 6 billion and will maintain such a market cap in 2020. When the COVID-19 in China improves, the stock price of BizConf Telecom gradually declined and returned to normal, but it still is higher than the initial stock price and market value.

In 2020, COVID-19 will gradually spread all over the world. Most country's governments also choose to control the development of the covid-19 by restricting the way people go to work and travel. In the past, Zoom was a slightly famous video communication software. Through this epidemic, the development prospect of Zoom has been greatly improved. Since December 2019, Zoom's stock price trend has continued to rise. The highest stock price of Zoom was $500 per share, in October 2020. According to data from Bernstein Research and Apptopia, Zoom's daily downloads have increased by 30 times, and user activity has soared from 10 million to 1.2 billion. Then, comparing with the Profit Margin, ROA, ROE, Net earning, Zoom gets all big and positive. The profitability of Zoom has soared extremely high. In 2019, the ratio of PB and PE even exceeded 100.

### 2.3. Comparison

With the above analysis, it indicates that the risks, profitability, and prospects of the stock at different stages. It can also see that these two stages show very different data in various aspects. Next, this paper will compare the data of these two phases to explore the development of the industry trend and the expansion of prospects before and during COVID-19.

By analyzing the various aspects of Zoom's stock in both phases, it reveals that the differences. Zoom went public less than a year before COVID-19, and there was not a significant change in the stock price during the year except at the time of the IPO. It was all up and down by a very small margin and the stock price was not high, fluctuating only between $65 per share. The opposite of this period is the COVID-19 period. The profit margin was less than 5% before COVID-19, but after COVID-19, it reached 26.61% all of a sudden. The spike in margins also made more people see the market for Zoom, so its stock price shot up rapidly from $65 and reached its peak quickly. But its risk didn't change much, because Zoom's gross margin was high, so it could afford to pay off its debt from its IPO to now. Zoom's debt ratio is not very high, or even very low, which has set the stage for future growth in Zoom's share price.

Next, this paper collected data from the Bizconf video, because Bizconf video was the first company to introduce Zoom in China. Because of this relationship, there are many similarities between the stock gains of

these two. Both of them had a flat stock price increase until COVID-19. However Bizconf video went public earlier than Zoom, so Bizconf video's earnings have been increasing year by year, but the stock price did not increase because the whole industry was neglected. However, during COVID-19, Bizconf video's share price was impressed by Zoom's share price surge and reached a peak in a short period. However, unlike Zoom, Bizconf video quickly dropped after reaching the peak and reverted to its pre-COVID-19 status, albeit with an increase in share price from the pre-COVID-19 period.
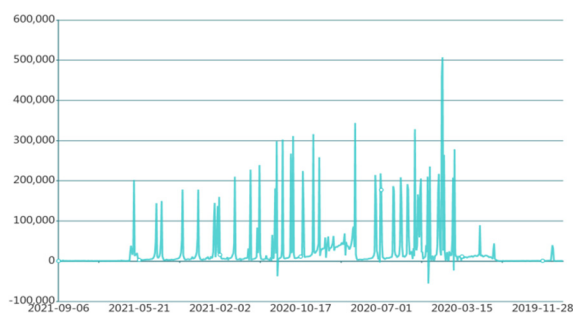
According to these comparisons, it should be concluded that the telecommuting industry as a whole did not take off before COVID-19, remaining in a steady but unremarkable position. After COVID-19, the whole industry's share price and profit have increased and some famous software skeletons and profits have surged.

## 3. EFFECTS OF COVID-19
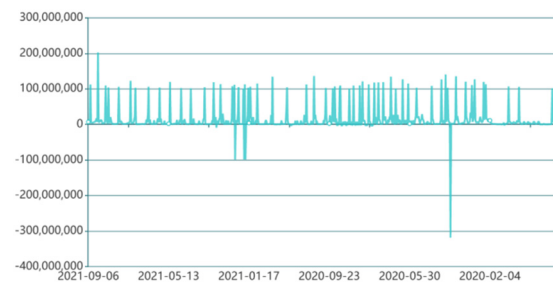
### 3.1. Increased Popularity and Soared Users

From the analysis of data of stocks, it is hard to deny that COVID-19 had made an incredible effect on remote working software, but we are not able to know whether this impact is beneficial or not. So we also ought to analyze what benefits or drawbacks that COVID-19 can bring to this whole industry.

It assumed that the complete industry will be gotten to be more well-known than before since increasingly people know these apps and use them although they were not famous before COVID-19 since working at home was not prevalent, which caused that the whole industry was underestimated. This paper collects data of daily downloads of remotely working software such as DingTalk, Voov Assembly, and Zoom to illustrate our assumption. It collected downloads from November 1, 2019, to September 6, 2021, on Android. During this time, there are four stages. The primary stage is before COVID-19, the second stage is during COVID-19 in 2020, the third stage will run from March 2020 to July 2021, the ultimate stage is during COVID-19 in 2021. Firstly, we collected data on Zoom.
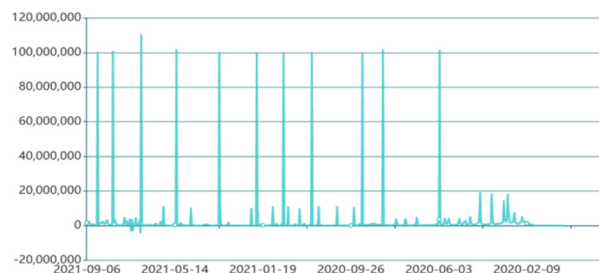


**Figure 1** Daily downloads of Zoom from November 01, 2019, to September 06, 2021[13]

In the first phase, as shown in Figure 1, it indicates that Zoom's daily downloads were very low and almost non-existent. However, by the time of COVID-19 in 2020, Zoom's downloads started to pick up. In the third phase, even with one or two massive uninstalls, the daily downloads remained at a high number. During the 2021 COVID-19 downloads maintained their previous trend.



**Figure 2** Daily downloads of DingTalk from November 01, 2019, to September 06, 2021[13]

Figure 2 reveals that DingTalk had a certain number of downloads before COVID-19. The lines representing tall downloads have gotten to be denser, which would suggest that its downloads increased both between or after COVID-19. DingTalk had three particularly large uninstalls, and this is one of the negative impacts of COVID-19 on the software.



**Figure 3** Daily downloads of Voov Meeting from November 01, 2019, to September 06, 2021[13]

Figure 3 reveals that Voov Assembly is similar to Zoom. Before COVID-19, Voov Meeting had exceptionally few users and needed visibility. However, after COVID-19, Voov Assembly has ended up more popular and has a promising market. The people realize the convenience of the Voov and they select to work online even though it isn't obligatory.

### 3.2. Increasing Trend during COVID-19

During COVID-19, many employees use various technologies to work remotely, including Zoom, Slack, and RingCentral. These companies tried to work from home. Zoom is one of the biggest winners of this crisis. At the beginning of 2020, its stock price has risen about 67%. Slack's stock price, which competes with Microsoft Teams, has risen about 11% in early 2020.

RingCentral is a company that provides cloud-based phone, video, and messaging services. Its stock price has risen 24% in March 2020.

### 3.3. Decreasing Trend after COVID-19

From May to September in 2020, as the new school year begins and many regions resume full or partial face-to-face teaching, telecommuting between teachers has decreased significantly. Those who work in computer or mathematics careers continue to telecommute at a high and sustained rate. The percentage of healthcare support staff and sales staff reporting any telecommuting has increased, although this change is not statistically significant. Although in a 2020 American poll, about 60% of hiring managers stated that they intend to rely more on remote work in the future. However, the increased spatial distance between employees may produce Adverse effects, for example. Communication barriers lead to a decline in innovation ability or the integration of work and personal, family, and social life. During a crisis, workers are often forced to work remotely. Although in the long run, many people may continue to telecommute, as long as the regulatory and other obstacles to telecommuting persist, many others may not want to do so. Since occupations consist of a series of different tasks, some of which can be completed remotely, and some may require or benefit from the actual existence, many occupations that cannot be fully completed through remote work are still suitable for regular or occasional remote work, such as sales staff or teachers. While doing management tasks at home, spend some time in face-to-face contact with customers and students. Laboratory researchers who need to conduct experiments can write papers at home. Therefore, after the end of COVID-19, telecommuting stocks will fall but will not return to their pre-COVID-19 prices.

## 4. TREATMENT AND IMPROVEMENT

### 4.1. Improving the Pattern

As for COVID-19, many companies had to turn to remote working to keep producing and working. There are several problems that companies have to concern and address due to COVID-19. The first problem is stability. The emergence of various new scene-based applications requires a higher level for the digital capabilities of enterprises. It would be hard to deal with this challenge if a company does not have a stable and robust data system. The second problem is continuity. Due to the "isolation" between workers and the office, the cooperation between workers is uncertain. Thirdly, security is one of the problems that people enterprises have to think about. Companies need to store and protect more and more data since the online working. This may cause some of the important information to

lose. Finally, it is experience. Telecommuting makes an innovation to users. In the future, enterprises need to think about how to make a "cost reduction and efficiency increase" and bring users new experiences at the same time. This is a huge challenge. There are some ways that enterprises can do to improve the efficiency of telecommuting. To be clear, eliminating the misunderstanding can enhance the efficiency of working and also a comprehensive overview of tasks.

### 4.2. Supporting New Ways

For example, the system of VMware Horizon on Dell EMC VxRail supports mixed-mode deployment, which allows people to use a new type of modern desktop, to achieve simple and fast delivery of virtual desktops and applications. It brings the best experience for users. Also, it provides convenient management and operation and can achieve rapid provisioning, automation, and simplified management. This software can help employers and employees deploy their virtual desktops and applications. What's more, the security can be ensured. A unique model that zero-trust further improve the security improves the security of the overall solution. Moreover, it provides a perfect user experience even when the network communication quality is poor by producing high-end graphics and image requirements, multimedia, 3D, GPU best practices in another aspect. Many people think this system has lots of advantages and can bring lots of benefits to both enterprises and users. People now still struggling with finding an effective way to maximizes business continuity management. Some scientists even did a study to find out what promote the development of telecommuting in the United State during COVID-19.

### 4.3. Ensuring the Safety of Data

Generally, protecting the data of the company is especially important. However, during the COVID-19, it is not easy to ensure the safety of data. It is crucial to business and customer relationships with a private-data. It can also help businesses go back to work in the office if the data is private. There are several ways to help ensure the right protection.

Making a strong password can protect accounts from being approached by cyber attacks. The essential thing that people should do is to get familiar with the data, since only when people know about the risks that the data is facing too, they would protect them successfully. What's more, except for the business and customer, third-party vendors can also get some valuable and sensitive data, so making sure whether third-party vendors are good stewards is important. Also, VPN can provide a secure channel to transmitted data. Finally, doing a security training to everyone despite different ways. Nearly ninety percent of losing important data is

because of human errors. Training the workers, teams, and employers can reduce the risks.

### 4.4.A Stable, Robust Data Center

A stable data center infrastructure to cope with unexpected challenges is needed. There are some apps that can not afford the large user flows and then their server crash because the maker of these apps does not assume there will be such a large user low one day before the COVID-19. For example, on March 10, 2020, DingTalk, the most popular platform for students and teachers to study and work during COVID-19, crashed because there almost all schools chose to use DingTalk to take the course and more than 10 million business organizations are using DingTalk to support working. Although DingTalk reinforce its server before the day that people began to work, the server also crashed. In addition, this affects people's studies and work. And not just DingTalk, other remote working software also has this phenomenon.

It is necessary to use these apps to achieve remote working during COVID-19. So it is a good opportunity for these apps to show the benefits they can bring people and let more people know them. While all platforms offered free service plans during COVID-19, these online meeting and teaching platforms that can impress people are expected to see significant profit growth after COVID-19. However, a failure server can not give people a good impression. Even though after COVID-19, there will be no large users flow, no one can convince that COVID-19 will not come back. So a steady data center infrastructure is required to be built and strengthened.

## 5. CONCLUSION

This paper investigates the impact of COVID-19 on companies and provides remote office services. Most Chinese people chose the remote transmission through home isolation. Therefore, most companies and people have experienced the significant changes during COVID-19. Also, the capital market observes the growth of the stocks of several companies that provide remote office services during the COVID-19 epidemic. Moreover, COVID-19 has greatly stimulated the development of telecommuting and will continue to affect people's way of life. Although there are still many problems, this is the inevitable trend in the future.

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