Trends and Economic Impacts Due to COVID-19 Virus and Cyber Attacks

C. Vipulanandan Ph.D., P.E.
Honorable Daniel Wong Endowed Professorship
"**Smart Cement**" Inventor
"**Vipulanandan Rheological Model**"
"**Vipulanandan Failure Model**"
Chief Editor – Advances in Civil Engineering
Director, Center for Innovative Grouting Material and Technology (CIGMAT)
Director, Texas Hurricane Center for Innovative Technology (THC-IT)
Professor of Civil and Environmental Engineering
University of Houston, Houston, Texas 77204-4003

Abstract

In the past twelve months, the coronavirus that causes severe acute respiratory syndrome (SARA-2 (COVID-19)) has impacted the entire world with the total human death of over 2 million. The COVID-19 virus is an organic structure with nucleic acid and protein coating and was transferred from bats to humans. There are many unknown factors including the modes of spreading (humans, animals, wind, water, wastewater, modes of transportation and many others) and critical environment. Also, there is an urgent need for developing gene therapy with the viral vector and also immunizing vaccine to control the COVID-19 virus disaster. It is also important to quantify the deaths, affected and recovered humans due to COVID-19 virus, and the modeling of the trends based on the location might help to better understand the critical parameters influencing the COVID-19 virus impacts. Also, the cyber-attacks have increased by six times during the COVID-19 pandemic. Because of the COVID-19 impact coupled with the cyber-attacks, the available resources are limited and also the changes in the rules and regulations have to be taken into account for planning the current and near future projects and educational activities at all levels.

Introduction

It is important to understand the impact of virus attacks and cyber-attacks, both are human based disasters. Within one-year COVID-19 has resulted in human deaths and also transforming all operations and activities including education of children online. Cyber-attacks have increased by six times during the COVID-19 pandemic. Virus attack and cyber-attacks can get initiated any ware around the world occupied by humans, about 5% of the earth surface. Hence monitoring is a major challenge before it starts spreading and impacting many humans in the region, unlike satellite monitoring of hurricane origin and pathway. Also, virus spreading among humans can have many pathways and there is an urgent need for understanding the basic and fundamental science behind the virus spreading based on the type of virus, origin and the environment. Over the past hundred years, over dozen viruses have impacted the humans around the world including major economic losses (Ang, 2020; Vipulanandan 2020; Ettlinger and Hensley 2021).

(a) Virus

Viruses are found wherever there is life and have probably existed since living cells first evolved on earth. Scientific studies have evolved over the past 150 years focused on the composition (neulic acid (DNA, RNA) with protein coat), structure, size compared to bacteria. By the end of the 19th century, viruses were defined in terms of infectivity (ability to produce infection), ability to pass filters, and requirement for living hosts. Also pig corneal tissue and hen kidney were used in vaccine production. Another breakthrough came in 1931, when the pathologist Ernest William Goodpasture and Alice Miles Woodruff grew **influenza** and several other viruses in **fertilized chicken eggs**. In 1949, John Franklin Enders, Thomas Weller, and Frederick Robbins grew **polio virus** in cultured human embryo cells, the first virus to be grown without using solid animal tissue or eggs. This work enabled Jonas Salk to make an effective **polio vaccine**. The second half of the 20th century was the golden age of virus discovery and most of the over 2,000 recognized species of animal, plant, and bacterial viruses were discovered during these years.

Opinions differ on whether viruses are a form of life, or **organic structures** that interact with living organisms. A complete virus particle, known as a virion, consists of nucleic acid surrounded by a protective coat of protein called a capsid. Although they have genes, they do not have a cellular structure, which is often seen as the basic unit of life. Viruses do not have their own metabolism, and require a host cell to make new products. Viruses display a wide diversity of shapes and sizes, called 'morphologies'. In general, viruses are **much smaller than bacteria**. Most viruses that have been studied have a diameter between 20 and 300 nanometres.

Virus is transferred as a result of human interaction with living cells including animals, birds, plants and bacteria where the virus is very active and represented as follows:

Living Cells (Animal/bird/plants/bacteria) + human ⟶ Virus Transferred

Various types of viruses have impacted the world over the past century.

Lessons Learned

There have been12 worst virus killers in the past century, based on the likelihood that a person will die if infected with one of them, the total number of people they have killed and also the rate of deaths. Also there is concern that the virus attacks represent a growing threat to humans.

Smallpox (Animal Unknown)

It is caused by variola virus (VARV) and was on earth 1000 BC. In 1980, the World Health Assembly declared the world free of smallpox. But before that, humans battled smallpox for years, and the disease killed about 1 in 3 of those it infected. **It left survivors with deep, permanent scars and, often, blindness**. Mortality rates were far higher in populations outside of Europe, where people had little contact with the virus

before visitors brought it to their regions. In the 20th century alone, **smallpox killed 300 million** people. It was something that had a huge burden on earth, not just death but also blindness, and that's what spurred the campaign to eradicate from the Earth.

Influenza (Birds, Ducks, Chickens)

During a typical flu season, up to **500,000** people worldwide will die from the illness, according to WHO. But occasionally, when a new flu strain emerges, a pandemic result with a faster spread of disease and, often, higher mortality rates. The most deadly flu pandemic Influenza, sometimes called the Spanish flu, began in 1918 and sickened up to 40% of the world's population**, killing an estimated 50 million people**.

Rabies (Cats, Cattle, Dogs, Bats based)

Rabies is caused by lyssaviruses, including the **rabies** virus and Australian bat lyssavirus. **Although rabies vaccines** for pets**, which were introduced in the 1920s**, have helped make the disease exceedingly rare in the developed world, this condition remains a serious problem in Asia and parts of Africa. **It destroys the brain**, it's a really, really bad disease. We have a vaccine against rabies, and we have antibodies that work against rabies, so if someone gets bitten by a rabid animal the person can be treated.

Dengue (Mosquitoes)

Dengue virus first appeared in the 1950s in the Philippines and Thailand and has since spread throughout the tropical and subtropical regions of the globe. Up to 40% of the world's population now lives in areas where dengue is endemic, and the disease — **with the mosquitoes that carry it** — is likely to spread farther as the world warms. **Dengue sickens 50 to 100 million people a year, according to WHO**. Although the mortality rate for dengue fever is lower than some other viruses, at 2.5%, the virus can cause an Ebola-like disease called dengue hemorrhagic fever, and that condition has a mortality rate of 20% if left untreated. **A vaccine for Dengue was approved in 2019 by the U.S. Food and Drug Administration** for use in children 9-16 years old living in an areas where dengue is common and with a confirmed history of virus infection, according to the **CDC.** In some countries, an approved vaccine is available for those 9-45 years old, but again, recipients must have contracted a confirmed case of dengue in the past. Those who have not caught the virus before could be put at risk of developing severe dengue if given the vaccine.

Marburg virus (Monkey based)

Scientists identified Marburg virus in 1967, when small outbreaks occurred among laboratory workers in Germany who were **exposed to infected monkeys imported from Uganda**. Marburg virus is similar to Ebola in that both can cause hemorrhagic fever, meaning that **infected people develop high fevers and bleeding throughout the body** that can lead to shock, organ failure and death. **The mortality rate in the first outbreak was 25%, but it was more than 80% in the 1998-2000 outbreak**

in the Democratic Republic of Congo, as well as in the 2005 outbreak in Angola, according to the World Health Organization (WHO).

Ebola virus (Bats, Chimpanzees, Apes, Monkeys based)

The **first known Ebola outbreaks in humans struck** simultaneously in the Republic of the **Sudan** and the Democratic **Republic of Congo** in 1976. **Ebola is spread through contact with blood or other body fluids, or tissue from infected people or animals**. The known strains vary dramatically in their deadliness. One strain, **Ebola Reston**, doesn't even make people sick. But for the **Bundibugyo strain**, the fatality rate was up to 50%, and it was up to 71% for the Sudan strain, according to WHO. The outbreak underway **in West Africa began in early 2014** and was the largest and most complex outbreak of the disease to date, according to WHO.

Human Immunodeficiency Virus - HIV (Chimpanzee, Monkey based)

In the modern world, the deadliest virus of all may be HIV. It is still the one that is the biggest killer. **An estimated 32 million people have died from HIV** since the disease was **first recognized in the early 1980s**. The infectious disease that takes the biggest toll on mankind right now is HIV. **Powerful antiviral drugs have made it possible for people to live for years with HIV**. But the disease **continues to devastate many low- and middle-income countries**, where 95% of new HIV infections occur.

Hantavirus (Mice)

Hantavirus pulmonary syndrome (HPS) **first gained wide attention in the U.S. in 1993,** when a healthy, young man died within days of developing shortness of breath. A few months later, health authorities isolated Hantavirus from a deer mouse living in the home of one of the infected people. More than 600 people in the U.S. have now contracted HPS, and 36% have died from the disease, according to the Centers for Disease Control and Prevention. The virus is not transmitted from one person to another, but the humans contract the disease **from exposure to the droppings of infected mice.** Previously, a different Hantavirus caused an outbreak in the early 1950s, during the Korean War. More than 3,000 troops became infected, and about 12% of them died.

Rotavirus (Chicken, Pigs, Cattle)

Although children in the developed world rarely die from rotavirus infection, the disease is a killer in the developing world, where rehydration treatments are not widely available. The WHO estimates that worldwide, **453,000 children younger than age 5 died** from rotavirus infection in 2008. But countries that have introduced the vaccine have reported sharp declines in rotavirus hospitalizations and deaths.

SARS-CoV (Bats)

The virus that causes severe acute respiratory syndrome, or SARS, first appeared in 2002 in the Guangdong province of southern China, according to the WHO. **The virus likely emerged in bats,** initially, **then hopped into nocturnal mammals called civets before finally infecting humans**. After triggering an outbreak in China, SARS spread to

26 countries around the world, infecting more than 8000 people and killing more than 770 over the course of two years.

The disease causes fever, chills and body aches, and often progresses to pneumonia, a severe condition in which the lungs become inflamed and fill with pus. SARS has an estimated mortality rate of 9.6%, and as of yet, **has no approved treatment or vaccine.** However, no new cases of SARS have been reported since the early 2000s, according to the CDC (Centers for Disease Control and Prevention).

MERS-CoV (Bats,Camels)

The virus that causes **Middle East respiratory syndrome**, or MERS, sparked an outbreak in **Saudi Arabia in 2012 and another in South Korea in 2015**. **The MERS virus belongs to the same family of viruses as SARS-CoV and likely originated in bats**, as well. The disease infected camels before passing into humans and triggers fever, coughing and shortness of breath in infected people.

MERS often progresses to severe pneumonia and has an estimated mortality rate between 30% and 40%, making it the most lethal of the known coronaviruses that jumped from animals to people. As with SARS-CoV and SARS-CoV-2, **MERS has no approved treatments or vaccine**.

SARS-CoV-2 (COVID-19) (Bats)

SARS-CoV-2 belongs to the same large family of viruses as SARS-CoV, known as **coronaviruses**, and was first identified in **December 2019 in the Chinese city of Wuhan (Figure 1)**. The virus likely **originated in bats**, like SARS-CoV, and passed through an intermediate animal before infecting people.

Since its appearance, the virus has infected tens of thousands of people in China and millions of others around the world. The ongoing outbreak prompted an extensive quarantine of Wuhan and nearby cities, restrictions on travel to and from affected countries and a worldwide effort to develop diagnostics, treatments and vaccines.

The **disease caused by SARS-CoV-2, called COVID-19**, has an estimated mortality rate of about 2.3%. **People who are older or have underlying health conditions** seem to be most at risk of having severe disease or complications. **Common symptoms include fever, dry cough and shortness of breath, and the disease can progress to pneumonia in severe cases**.

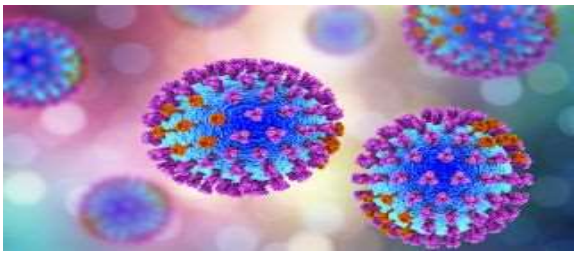


Figure 1 Image of COVID-19 Virus

The COVID-19 virus has really impacted the entire world in a very short time period. It has impacted all activities including education, business, construction and manufacturing. The oil price dropped to its minimum value of -$40 dollars a barrel on April 20, 2020 in the history of oil market. Hence there is an urgent need to understand the problem to make safe decisions to minimize losses.

Transfer Media

It started in China and then spread around the world in stages going across Indian Ocean and Atlantic Ocean from continent to continent. Initially it impacted many countries above the equator but now many countries below the equator are impacted. It is important to understand the modes of transfer of COVID-19 around the world in a very short time period. This will definitely help minimize the human deaths and infected cases. It is also important look at the ground conditions, environments, human activities and also international travel. In the U.S. coastal states have been impacted the most.

Virus therapy

There are two types of therapies characterized as gene therapy and cell therapy. Over the decades gene therapy has been developed for controlling various types of virus attacks. In addition to developing the gene therapy, it is also important to develop the viral vector to deliver the medication to the right location in the body. Also, artificial virus are used as part of the viral vector.

(b). Cyber-attacks

Cyber-attack is a human based disaster. With the advancement of technologies almost all operations are controlled using computers connected to the internet. The internet platform is connected to the world and once any computer opened it is connected to the world. **Philosophically, internet is considered as the battery charger** for all the connected computers. Internet platform will provide all the requested information with minimum time delay, transfer data and also control systems including the power grids and water supplies. All **the connectivity (electrical connection with computer language)** makes the system very **vulnerable to misuse** using the computer language, **known as cyber-attacks**. Cyber-attacks can result in minor to major losses of personnel information and also security of the operating systems impacting individuals, cities, businesses and entire country. Cyber-attacks happen rapidly and by knowing the problem **pre-planning with security filtering and blocking will help**. Virus attack will start slowly but can spread rapidly. Hence it is important to **develop comprehensive disaster management and rapid recovery plans** to minimize the losses. Cyber-attack will impact human mental balance. Unlike **contaminated** sites, cyber-attacks has no **rules and regulations**. For cyber-attack pre-planning based on past experience is important **for preparedness**. The **rapid recovery (RR)** due to **cyber-attack (loosing personal information to large operating systems).**

A cyberattack is a malicious and deliberate attempt by an individual or organization to breach the information system of another individual or organization. Usually, the attacker seeks some type of benefit from disrupting the victim's network. It can also endanger public health, contaminate the water, devastate natural resources, and disrupt the economy. **It will also affect the animals and birds.** In an increasingly technological era, the world has become more dependent **upon computer controlled operations to maintain our high standard of living**. Also cyber-attack can impact the security, manufacturing and transportation industries and all other businesses.

Objectives

The objectives were to investigate the trends and impact of COVID-19 virus and cyber-attacks based on the available data. The specific objectives are as follows:

(a) Identify the critical parameters to represent the COVID-19 virus impact. Also compare the confirmed cases and total deaths around the world, U.S., New York and Texas and develop models to predict the confirmed cases and the deaths.

(b) Economic impact of COVID related to jobs and Gross Development Products (GDP).

In this study, data collected on COV1D-19 impact over the past twelve months was used. The data was collected from various data bases and it included the world, U.S.A. and different states in the U.S.A.

COVID-19 Virus

Data Analyses

In March of 2020, European countries such as Italy, Spain and United Kingdom, above the equator and also very high Gross Domestic Product (GDP), had the largest impact based on the deaths and total number of confirmed cases. There was very little impact on the North and South American continent. Since April 2020, United States (North) and Brazil (South) in the American Continent became the badly affected countries in the world based on the deaths and confirmed cases. In June, Russia and India became two of the leading top 5 countries based on the number of people affected by the COVID-19 virus.

It is important to quantify and interpret the trends observed around the world and the U.S.A. in one year and it is analyzed in two periods. Period-1 was done from February 2020 to July 2020 (6 months) and Period-2 was done from August 2020 to January 2021. Both the total confirmed cases and deaths continuously increased around the world. In this study, the focus was on monthly changes in the confirmed cases and total deaths.

World Versus U.S.A.

Period-1 (February 2020 to July 2020)

It will be of interest to compare the impact of COVID-19 impact on the world and the U.S.A. with the highest GDP of $21.5 trillion (Year 2019). The difference in the total cases and total deaths numbers between the world and the U.S.A (equal = world-U.S.A.) will be the confirmed total cases and deaths the rest of the world.

World

There are over 210 countries around the world with a total population of 7 billion. The COVID-19 has impacted the countries in many different ways based on the location, environment, economic activities (GDP) and population density. In Table 1, the confirmed cases per month and death rates per month are summarized.

Confirmed Cases: The confirmed cases continue increase every month and the highest increase was in July which was **6.8 M/m**.

Death Cases: The death rate peaked in April and was **159K/m.** The death rates have reduced in May, June and July to about **146K/m**, **122k/m** and **371K/m**. The death rate was maximum in July, more the 2.3 times the previous maximum of 159K/m. The total death was **673,233** as of July 31, 2020.

United States of America (USA)

U.S.A. had its highest rate of confirmed cases and deaths in April (Tax Month in the U.S.A) (Table 1).

Confirmed Cases: The confirmed cases in April were **905K/m**. In the month of May, the confirmed cases decreased to **757K/m**. In the month June the confirmed cases have increased to **877K/m.** The confirmed case in July increased to **1.8M/m**. The highest confirm cases per day were on July 1, and it was 51,091.

Table 1. Comparing the COVID-19 Impact on the World and U.S.A. During the Period-1

Date	World		United States		Remarks
	Confirmed Cases	Total Deaths	Confirmed Cases	Total Deaths	
1/31/2020	8,234		0	0	**World** confirmed and deaths cases increased by **78K/m** and 8K/m. **U.S.** confirmed and deaths were **68/m** and **Zero**.
2/15/2020	69,050		15	0	
2/29/2020	86,009	8,000	68	0	
3/15/2020	168,941		3,613	69	**World** confirmed cases and deaths increased by **786K/m** and **68.5K/m. U.S.** confirmed and deaths were over **190 K/m** and **5K/m**.
3/31/2020	871,976	74,565	189,967	5,151 (6.9%)*	

4/15/2020	**2,066,00**		**648,003**	**32,712**	**World** confirmed cases and deaths increased by **2.4M/m** and **159K/m**. **U.S.** confirmed and death were **905K/m** and **58.7K/m** (Highest death rate for the U.S.A.)
4/30/2020	**3,268,000**	**233,704**	**1,095,023**	**63,856 (27.3%)***	
5/15/2020	**4.538,000**	**283,001**	**1,484,285**	**88,507**	**World** confirmed cases and death increased by **2.9M/m** and **146K/m**. **U.S.** confirmed and death rate were **757K/m** and **42.6K/m.**
5/31/2020	**6,162,000**	**380,000**	**1,852,029**	**106,432 (28.0%)***	
6/15/2020	**8,010,000**	**425,093**	**2,186,553**	**120,247**	**World** confirmed cases and death increased by **4.3M/m** and **122K/m**. **U.S.** confirmed and death rate were **877K/m** and **23.7K/m**.
6/30/2020	**10,450,000**	**502,048**	**2,728,856**	**130,122 (26.8%)***	
7/15/2020	**13,561,000**	**582,000**	**3,463,480**	**137,420**	**World** confirmed cases and death increased by **6.8M/m** and **171K/m**. **U.S.** confirmed and death rate were **1.8M/m** and **22.5K/m**.
7/31/2020	**17,297,276**	**673,233**	**4,495,014**	**152,670 (23%)***	
Remarks	Millions of humans have been affected in short period of time	Very high death and rate of deaths and the highest was 171K/m	U.S. has the highest confirmed cases.	U.S. has the highest total deaths	**COVID-19 has impacted the world. U.S.A. has the highest confirmed cases and total deaths (No. 1) and matched with the world GDP rating.**

- *Percentage death in the U.S.A. based on the World Deaths

Death Cases: The death rate in April was **58.9K/m**. The highest death rate for a day was **2683/day** on April 21 and on April 15 it was **2631/day**. In the month of May, the death rate was **42.6K/m** and in June it has reduced to **23.7K/m**. In July the death rate was **22.5K/m**. The highest percentage of death was 28% based on the world death in May.The total death is over **152,670**, about 23% of the world deaths and is the highest in the world and **matched with the GDP ranking**. The U.S. population is only 4.5% of the world population, so the death rate is over 5 times higher and hence doesn't match with the total population, which is ranked 3rd in the world.

Period -2 (August 2020 to January 2021)
World

The data are summarized in Table 2.

Confirmed Cases: The confirmed cases continued to increase every month and the highest increase was in January 2021 which was **19.4 M/m**.

Death Cases: The death rate peaked in January 2021 to **402.8K/m,** 2.5 times the July death cases**.** The death rates continued to increase except September. In December the death rate was to **277K/m**. The total death was 102,107,858 on January 31, 2021.

United States of America (USA)

U.S.A. had its highest rate of confirmed cases and deaths in January 2021, more than 6 times and 1.6 times the cases in April (Tax Month in the U.S.A) (Table 2).

Confirmed Cases: The confirmed cases in January 2021 was **6.2M/m**. In the month of August, the confirmed cases decreased to **1.5M/m**. In the month of October and December the confirmed cases increased to **2.1M/m** and **4.6M/m** respectively. Total confirmed cases at the end of January 2021 was close to 26 million (Table 2).

Table 2. Comparing the COVID-19 Impact on the World and U.S.A. During the Period-2.

Date	World		United States		Remarks
	Confirmed Cases	Total Deaths	Confirmed Cases	Total Deaths	
7/31/2020	17,297,276	673,233	4,495,014	152,670	**World** confirmed cases and death increased by **8.0M/m** and **175K/m**. **U.S.** confirmed and death rate were **1.5M/m** and **30.8K/m**.
8/16/2020	21,481,494	771,532	5,361,742	169,486	
8/31/2020	25,330,679	848,030	6,021,465	183,399 (21.6%)*	
9/28/2020	33,125,652	998,074	7,115,337	204,758 (20.5%)*	**World** confirmed cases and death increased by **7.8M/m** and **150K/m**. **U.S.** confirmed and death rate were **1.5M/m** and **30.8K/m**.
10/18/2020	39,842,711	1,111,874	8,140,728	219,599 (19.8%)*	**World** confirmed cases and death increased by **13.4M/m** and **227.6K/m**. **U.S.** confirmed and death rate were **2.1M/m** and **29.7K/m**.
12/31/2020	82,686,157	1,805,002	19,740,468	342,312 (19.0%)*	**World** confirmed cases and death increased by **17.1M/m** and **277.3K/m**. **U.S.** confirmed and death rate were **4.6M/m** and **49.1K/m**.
1/31/2021	102,107,858	2,207,834	25,932,793	436,799 (19.8%)*	**World** confirmed cases and death increased by **19.4M/m** and **402.8K/m**. **U.S.** confirmed and death rate were **6.2M/m** and **94.5K/m**.
	Over hundred	Very high total death	U.S. has the highest	U.S. has the	**COVID-19 has impacted the world. U.S.A. has the**

Remarks	Millions of humans have been affected in one year.	and rate of deaths and the highest was 402.8K/m	confirmed cases.	highest total deaths	**highest confirmed cases and total deaths (No. 1) and matched with the world GDP rating.**

- *Percentage death in the U.S.A. based on the World Deaths

Death Cases: The death rate was highest in January 2021 and was **94.5K/m** and in April it was **58.9K/m**. In August the death rate was **30.8K/m**. The total death at the end on January 2021 was over **436,799**, about 19.8% of the world deaths and is the highest in the world and **matched with the GDP ranking**. The U.S. population is only 4.5% of the world population, so the death rate is over 4 times higher and hence doesn't match with the total population, which is ranked 3rd in the world.

January 2021 has been the worst month for the world and the U.S.A. for the total confirmed cases and total deaths. Total deaths around the world have been over 2.2 million and the U.S.A. had 19.8% of the total deaths.

New York Versus Texas

Period-1 (February 2020 to July 2020)

New York Versus Texas

In the U.S.A. the coastal states were more impacted by the COVID-19. For comparison, State of New York (GDP no.3 in the U.S.) was selected to represent the east coast with the Atlantic Ocean and Texas (GDP no.2 in the U.S.) along the Gulf of Mexico (GOM). Both these states are also impacted by hurricanes and flooding. Data are summarized in Table 3 and Table 4.

New York State (GDP 1.7 Trillion, 8% of U.S. GDP and #3 in the U.S.)

New York State has had the highest confirmed cases and deaths in the U.S.A.

Confirmed Cases: New York had its highest rate of confirmed cases in April (Tax Month in the U.S.). The confirmed cases in April were 234K/m (26% of U.S.). In the month of June, the confirmed cases and the death rates have reduced to 79K/m, and 6.7K/m. The last few weeks death rate has dropped to below 40/day. The highest confirm cases per day was on **April 15, and it was 11,661** with death rate of 888/day. The total confirmed cases on July 31 was over 443,000 (July 31), 10% of the U.S. confirmed cases.

Death Cases: New York had its highest rate of deaths in April (Tax Month in the U.S.). The death rate was 21.1K/m (36% of U.S.). The highest death rate for a day was 1025/day on April 17 and on April 15 it was 888/day. In the month of June, the death rate has reduced to 6.7K/m. The last few weeks death rate has dropped to below 40/day. The total deaths is over 32,765 (July 31), 23% of the U.S. deaths.

The population in New York city is about 8.4 million and the population density is 27,558 people/square miles. This is about 7.6 times higher than Houston, largest city in Texas.

Texas State (GDP 1.89 Trillion, 11.3% of U.S. GDP and #2 in the U.S.)

Texas has very high confirmed cases comparable to New York, but the total deaths are much lower.

Confirmed Cases: Texas had its highest rate of confirmed cases of **276K/m in July** (Table 2). The confirmed cases in May was 36.4K/m. In the month June the confirmed cases have increased to 102K/m. The highest confirm cases per day was on July 28, and it was 11,037 with death rate of 45/day. The total confirmed cases were over 443,000 (July 31), comparable to New York and 10% of the U.S.

Death Cases: Texas had its highest rate of deaths in July of 4.5K**/m**. The highest death rate for a day was 154/day on July 15 and on April 15 it was 30/day. In the month June the death rate was 810/m. The last few weeks death rate has increased, and the maximum was 499/day on July 13. The total deaths are 6998 (July 31), about 21.4% of the New York deaths.

The population in Houston, largest city in Texas is 2.3 million and the population density is 3,634 people/square miles. Houston population is 27.4% and population density is 13% of New York City. The Houston death percentage is in between the population and population density.

Table 3. Comparing the COVID-19 Impact on New York and Texas During the Period-1

Date	Texas		New York		Remarks
	Confirmed Cases	Total Deaths	Confirmed Cases	Total Deaths	
2/29/2020	0	0	20	0	**Texas** confirmed cases and deaths were 3.7K/m and 56/m. **New York** confirmed and deaths were 77K/m and 2.7K/m
3/15/2020	73	0	740	10	
3/31/2020	3,666	56	76,946	2677	
4/15/2020	16,009	375	218,562	15,500	**Texas** confirmed cases and deaths increased by 24.8K/m and **746/m**. **New York** confirmed cases and death were **234K/m** and **21.1K/m** (Highest for New York)
4/30/2020	28,455	802	310,839	23,780	
5/15/2020	46,787	1,308	356,016	28,411	**Texas** confirmed cases and death increased by **36.4K/m** and **884/m**. **New York** confirmed, and death rate were **79K/m** and **6.7K/m.**
5/31/2020	64,899	1,686	389,903	30,509	

6/15/2020	**91,380**	**2,016**	**406,081**	**31,548**	**Texas** confirmed cases and death increased by **102K/m** and **810/m**. **New York** confirmed and death rate were **27.9K/m** and **1.6K/m**.
6/30/2020	**167,269**	**2,496**	**417,836**	**32,129**	
7/15/2020	**302,817**	**3,625**	**430,277**	**32,495**	**Texas** confirmed cases and death increased by **276K/m** and **4.5K/m**. **New York** confirmed and death rate were **26K/m** and **636/m**. (Highest for Texas)
7/30/2020	**443,026**	**6,998 (4.6%)***	**443,745**	**32,765 (21.5%)***	
Remarks	Confirmed cases were highest in July	Deaths were highest in July	Highest confirmed cases in the U.S.	Highest deaths in the U.S.	**COVID-19 has impacted the coastal states with high GDP rating and populations**

- *Percentage death in the State based on the U.S. Deaths

Period -2 (August 2020 to January 2021)

New York

Confirmed Cases: In August the confirmed cases were **16.6K/m** and it has increased to **433.8K/m** in January 2021, the highest confirmed cases in one year. The total confirmed cases were over 1.4 million (January 31), about 5.5% of the U.S. cases.
Death Cases: Death rate in New York has decreased In August it was 196/m. It increased to 1.8K/m in December and in January it was 5.5K/m lower than the deaths in April (Tax Month in the U.S.). Total death was 9.9% of the U.S deaths.

Texas

Confirmed Cases: Texas had its highest rate of confirmed cases of **596K/m in January 2021** (Table 4). The confirmed cases in August was **160K/m** and it has continuously increased to 596K/m. The total confirmed cases were over 2.3 million (January 31), much higher than New York and was about 10% of the U.S. cases.

Death Cases: Texas had its highest rate of deaths in January 2021 of **9.0K/m**, double the rate in July. The total death was 36,887, 8.4% of the U.S. deaths and 85% of the New York deaths.

Table 4. Comparing the COVID-19 Impact on New York and Texas During the Period-2

Date	Texas		New York		Remarks
	Confirmed Cases	Total Deaths	Confirmed Cases	Total Deaths	
7/30/2020	**443,026**	**6,998**	**443,745**	**32,765**	**Texas** confirmed cases and death increased by **160K/m**
8/19/2020	**585,454**	**10,517**	**457,600**	**32,937**	

8/23/2020	**603,025**	**11,801**	**460,312**	**32,961**	and **4.8K/m**. **New York** confirmed, and death rate were **16.6K/m** and 196**/m**.
9/05/2020	**665,382**	**13,696**	**471,267**	**33,073**	**Texas** confirmed cases and death increased by **167K/m** and **4.06K/m**. **New York** confirmed, and death rate were **29.6K/m** and 254**/m**.
9/28/2020	**770,230**	**15,861**	**489,864**	**33,215**	
10/18/2020	**867,751**	**17,554**	**519,783**	**33,477**	**Texas** confirmed cases and death increased by **195K/m** and **3.4K/m**. **New York** confirmed, and death rate were **59.8K/m** and **524/m**.
12/31/2020	**1,759,131**	**27,898**	**998,524**	**37,868**	**Texas** confirmed cases and death increased by **357K/m** and **4.1K/m**. **New York** confirmed, and death rate were **191.5K/m** and **1.8K/m**.
1/22/2021	**2,214,767**	**34,165**	**1,328,000**	**41,848**	**Texas** confirmed cases and death increased by **596K/m** and **9.0K/m**. **NewYork** confirmed, and death rate were **433.8K/m** and **5.5K/m**. (Highest confirmed cases and deaths in Texas and highest confirmed cases in New York)
1/31/2021	**2,355,309**	**37,381 (8.4%)***	**1,432,343**	**43,701 (9.9%)***	
Remarks	Confirmed cases were highest in January 2021	Deaths were highest in January 2021	Highest confirmed cases in the U.S**.**	Highest deaths in the U.S.	**COVID-19 has impacted the coastal states with high GDP rating and populations**

- *Percentage death in the State based on the U.S. Deaths

Vipulanandan p-q Model

It is important to predict the observed trends for both the total confirmed cases and total deaths (Y) with time (t) using analytical models. Preliminary investigation was done using Vipulanandan p-q model (Vipulanandan et al. 2018). The model parameters can be used to evaluate the important parameters that are impacting the COVID-19 confirmed cases and the total deaths.

$$Y = \left[\frac{\frac{t}{t_f}}{q_2+(1-p_2-q_2)\frac{t}{t_f}+ p_2 \left(\frac{t}{t_f}\right)^{\left(\frac{p_2-q_2}{p_2}\right)}} \right] Y_f \qquad (1)$$

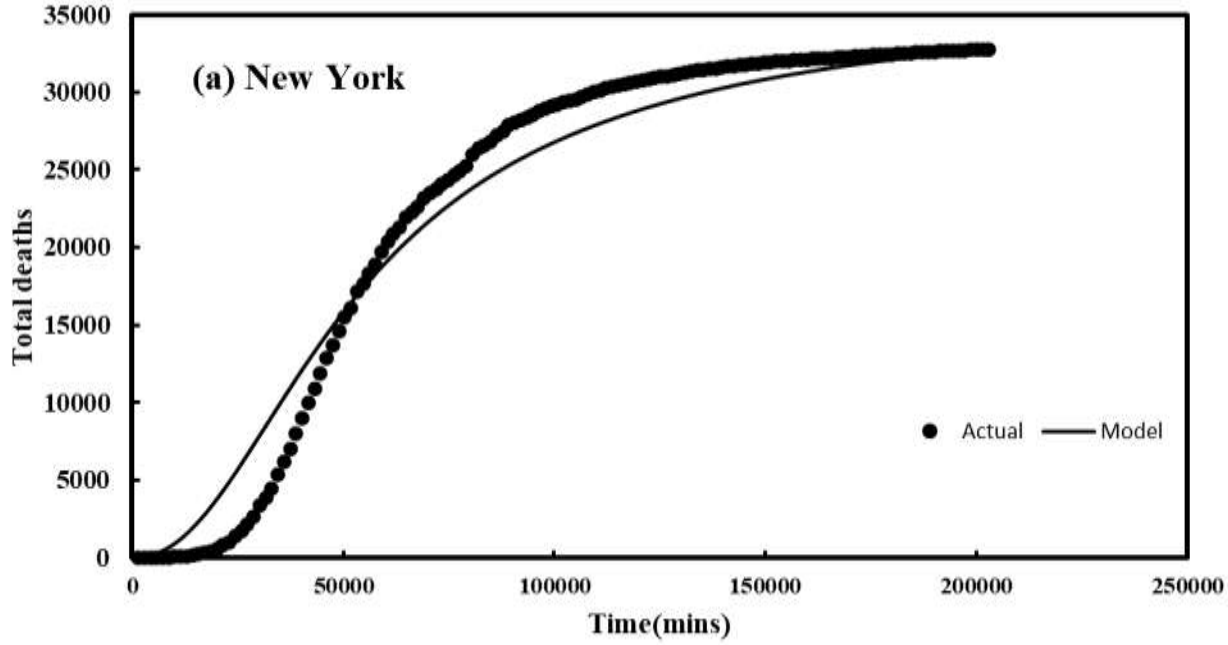
Model parameters (p_2, q_2 and Y_f) will be related to the critical variables such as population, population density, GDP (economic activity), temperature, relative humidity, food, transport facilities, animals and others.

Period-1 (February 2020 to July 2020)

The model predictions are compared to the data in Figure 2 for New York and Texas. Also, the model parameters are summarized in Table 4. The Model parameter ratio q_2/p_2 was 2.29 and 0.60 for New York and Texas respectively and represents the shape of the trends for the equal time period. Also, both model parameters decreased with the increased death.

Table 4. Vipulanandan p-q Model parameters for the death predictions for Period-1

State	Maximum Death (Y_f)	Time for Max. Death (t_f) (min.)	p_2	q_2	R^2	RMSE (Number of people)	Remarks
New York	32,765	203,040	0.035	0.08	0.98	1,970	Rate of deaths initially increased but decreased with time
Texas	6,998	185,760	2.5	1.5	0.98	253	Rate of deaths increased with time
Remarks	New York had the highest number of deaths in the U.S.	Middle of March to end of July about 4.5 months.	Decreased with number of deaths.	Decreased with number of deaths.	Coefficient of verification was very high and good	Represents the accuracy of the predictions	Predicted the total deaths with time very well.



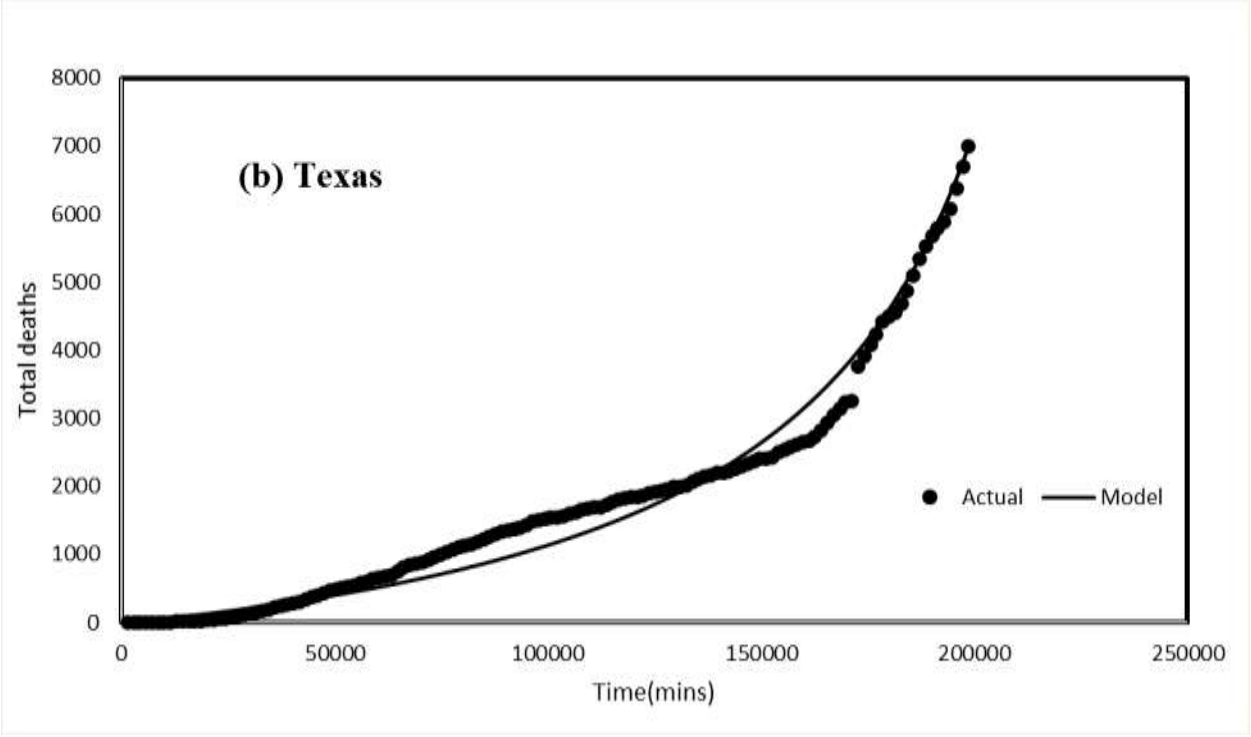


Figure 2. Total Deaths with Time (a) New York and (b) Texas

Figure 2. Vipulanandan p-q model predictions are compared to the death data (a) New York and (b) Texas

Period -2 (August 2020 to January 2021)

The Vipulanandan p-q model (Eqn. (1)) was used with a modification where Y and Yf were replaced with $(Y-Y_1)$ and (Y_f-Y_1) where Y_1 represents the deaths in July 2020. The death during the Period-2 is in New York was 10,936 compared to Texas which was 30,383, 2.8 times (280%) higher than New York, just the opposite of Period-1. So, the total death during Period-2 in New York was 33% of the total death during Period-1. So, the total death during Period-2 in Texas was 434% of the total death during Period-1.

The model predictions are compared to the data in Figure 3 for New York and Texas. Also, the model parameters are summarized in Table 5. The Model parameter ratio q_2/p_2 was 0.1 and 0.45 for New York and Texas respectively and represents the shape of the trends for the equal time period. Also, both model parameters increased for New York and decreased for Texas indicating the trends in the deaths during the Period-2.

Table 5. Vipulanandan p-q Model parameters for the death predictions for Period-2

State	Maximum Death (Y_f)	Time for Max. Death (t_f) (min.)	p_2	q_2	R^2	RMSE (Number of people)	Remarks
New York	43,701	264,960	1	0.1	0.96	637	Total death during Period-2 was 33% of Period-1
Texas	37,381	185,760	2	0.9	0.98	1138	Total death during Period-2 was 434% of Period-1.
Remarks	New York had the highest number of deaths in the U.S.	Middle of March to end of July about 4.5 months.	Decreased with number of deaths.	Decreased with number of deaths.	Coefficient of verification was very high and good	Represents the accuracy of the predictions	Model predicted the total deaths with time very well.

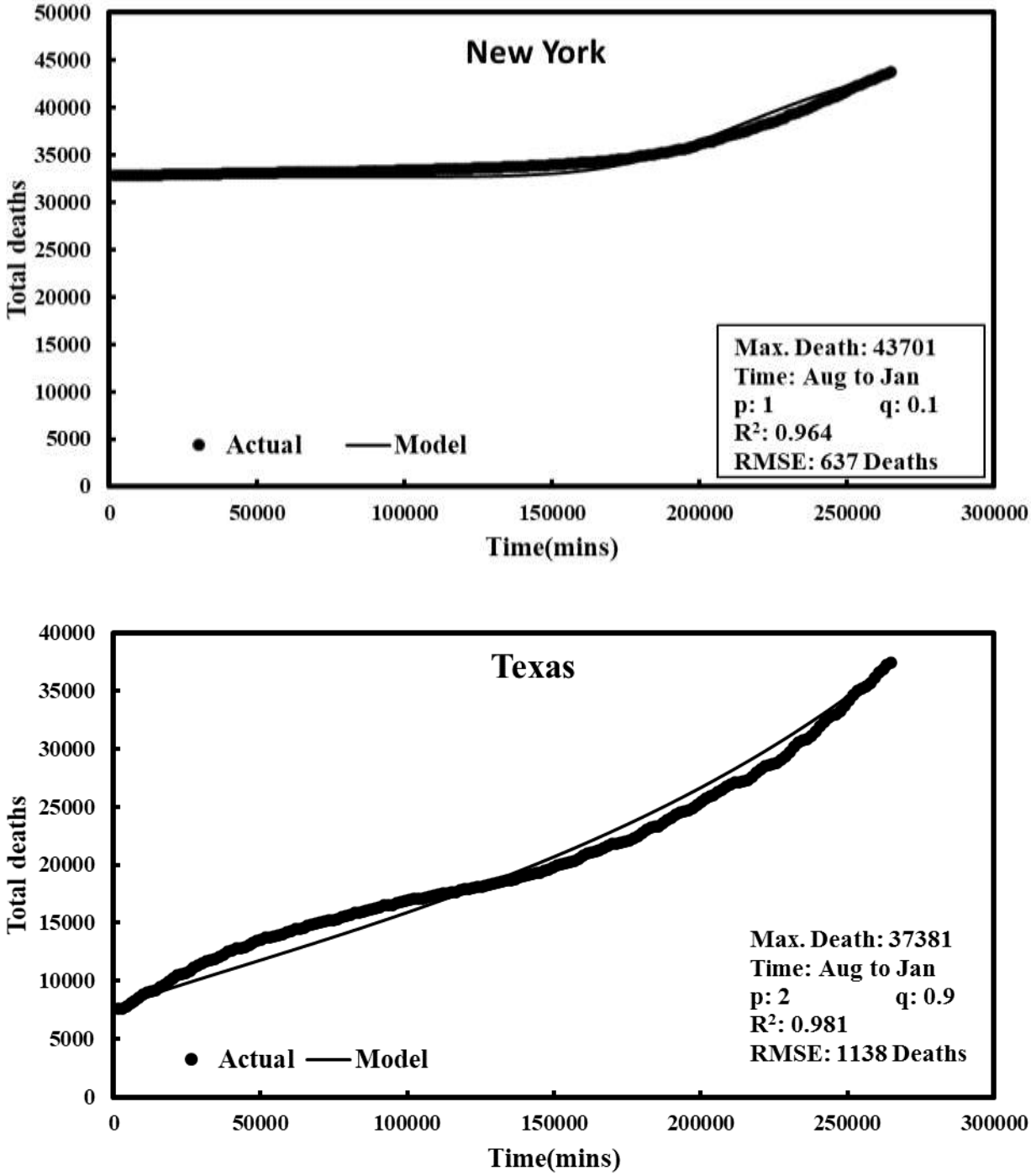


Figure 3. Vipulanandan p-q model predictions are compared to the death data (a) New York and (b) Texas

Potential Methods of Spreading

It is important to know how the COVID-19 virus was spread around the world in very short time period. COVID-19 is a 120 nm organic nanoparticle. Transmission Electron Microscope (TEM) has been used to determine the particle size of COVID-19.

There is no life to this virus and can be considered as an **organic dust particle**. There is no clear evidence of the surface charge, but the bacteria, organic micro size particle is negatively charged. There is ongoing investigation of COVID-19 virus attachment to various surfaces including metals and mail packages. As shown in Fig. 1, in addition to humans, number of other factors may influence the COVID-19 spread. There is no life to COVID-19 like the dust particle so the stability of the COVID-19 under various environments (temperature, pH, humidity) must also investigate to develop control methods. The filters and face masks that are used have to be effective with the nanoparticles or must have some coating to capture organic nanoparticle. The potential methods of spreading are shown in Figure 3. All these must be investigated in much more detail with available data around the world and in the U.S. because U.S. is the worst impacted country ranked number one GDP in the world.

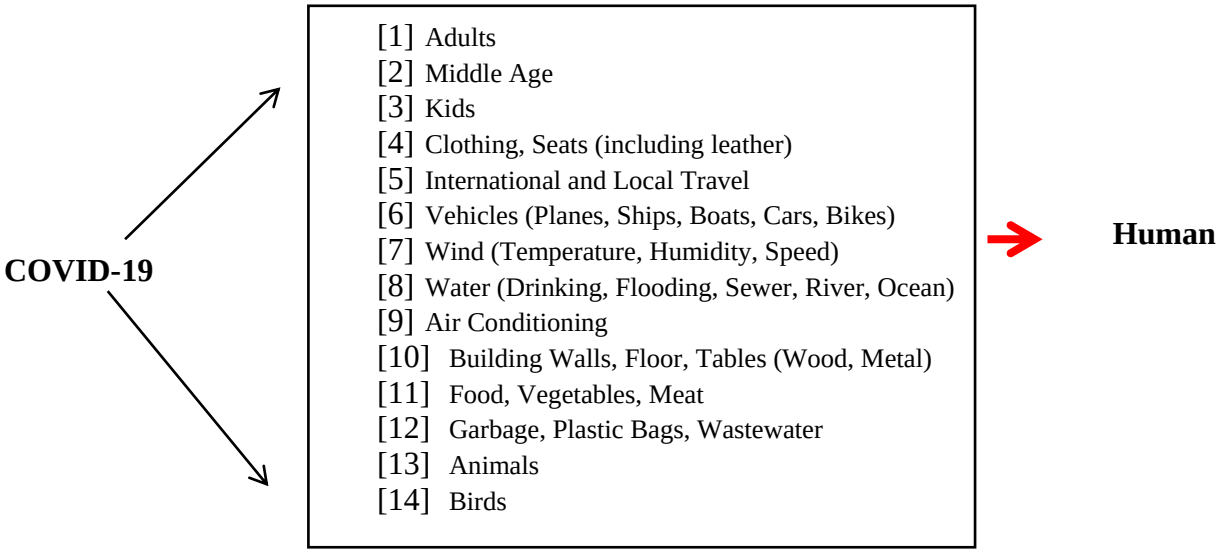


Figure 3. Potential Method of COVID-19 Spreading in the World

Critical parameters

(1). Need to develop a **gene therapy** with a **viral vector** to control the spread of COVID-19 virus.

(2). Identify the critical modes of spreading of the COVID-19 virus.

(3). Develop vaccine to improve the immune system of the humans.

(4). For the affected humans develop a disaster response (DR) and rapid recovery (RR) processes for hurricanes, fires and others including cyber-attacks.

Economic Impact of COVID-19 and Cyber Attacks

The global virus pandemic and cyber-attacks have disrupted business activities worldwide. The economic impact has varied across regions, and the consequences have been largely dependent on a region's economic position.

Using survey data from the World Economic Forum's 20th Global Competitiveness Report, this graphic showcases the economic impact of COVID-19 worldwide. This year's survey was conducted between February and July 2020 and includes responses from 11,866 business executives across 126 economies (Ang, 2020).

As you'll see, the data was collected with the specific focus of contrasting the pandemic's effects on developing economies compared to advanced economies.

(a) Top Negative Impacts

By comparing business leaders' responses in 2020 to their answers over the last three years, some clear trends have emerged (Table 6).

In **advanced economies**, the top negative economic impact of COVID-19 and cyber-attacks have been a decline in competition, followed by reduced collaboration between companies and a growing challenge in finding and hiring skilled workers.

Table 6. List of Negatively Impacted Factors and Remarks

Rank	Factor	% Change (2020 vs. 3-Yr Avg)	Remarks
1	Competition in network services	-2.9%	(1). Increased use of online platforms. (2). Bigger retailers are dominating.
2	Collaboration between companies	-2.6%	(1). Less demand for goods and supplies. (2). Bigger retailers are dominating.
3	Competition in professional services	-2.3%	(1). Less demand for services. (2). Unemployment has increased.
4	Competition in retail services	-1.8%	(1). Increased use of online platforms. (2). Bigger retailers are dominating.
5	Ease of finding skilled employees	-1.5%	(1). Travel restrictions. (2). Reduce pay.
Remarks	Top 5 negative impact on the economic activities	Up to negative 3% impact.	Many factors including travel

			restrictions.

What's driving this reduced competition in advanced economies?

One factor could be the increased use of online platforms. Ecommerce is heavily dominated by a select number of bigger retailers with massive boosts in their online sales, while many smaller businesses have been struggling.

While negative impacts on advanced economies are centered around market concentration and talent gaps.

It's important to note that in the 2018 and 2019 surveys, organized crime and business costs related to crime and violence were trending downward. Because of this, the World Economic Forum suggests that we consider this year's increase in these areas as a temporary COVID-induced setback rather than a long-term issue.

(b) Top Positive Impacts of COVID-19

Despite the struggles brought on by COVID-19, the pandemic has also triggered positive change. In fact, business leaders perceived more positive developments this year than negative ones.

In **advanced economies**, the top positive impacts were government responsiveness to change, followed by internal collaboration within companies.

Table 7. List of Postively Impacted Factors and Remarks

Rank	Factor	% Change (2020 vs. 3-Yr Avg)	Remarks
1	Government's responsiveness to change	8.2%	(1). Increased use of online platforms. (2). Impacting the commercial activities.
2	Collaboration within a company	4.6%	(1). Increased use of online platforms. (2). Job losses.
3	Venture capital availability	4.4%	(1). Reduced activities in starting companies. (2). Closing of small companies.
4	Social safety net protection	4.2%	(1). Travel restrictions. (2). Reduced

			potential for expansion.
5	Soundness of banks	4.0%	(1). Increased use of online platforms. (2). More interaction with the customers.
Remarks	Top 5 positive impacts	Varied from 4% to 8.2%.	Building solid foundations for future growth.

Interestingly, internal collaboration has improved while external collaboration got worse. This is likely because companies had to adapt to changing work environments, while also learning how to collaborate with one another through remote working.

U.S.A. Impact

Jobs

The country as a whole is also down more jobs than in the Great Recession, with employment reduced by 10 million jobs, 6.5% off the February level.

Net job loss in states has ranged from Hawaii, Michigan, and New York—which are each down over 10% from their February employment levels—to Alabama and Mississippi, which have lost fewer than 2% of their jobs. Idaho and Utah have seen slight job increases. Twenty-seven states have lost more than 5% of their jobs. The job gains seen after the initial collapse in March and April reversed in many states in each of the last two months as growth steadily, and substantially, tailed off over the second half 2020 across the country.

The hardest hit sector continues to be Leisure and Hospitality (hotels and restaurants), in which, nationally, the Accommodation and Food Services industry had lost 22% of its employment (over 3 million jobs) and the Arts, Entertainment, and Recreation industry has lost 32% (close to 800,000 jobs) as of December. Michigan, Vermont, and Minnesota have all seen over 40% declines in their Accommodation and Food Services employment.

In December, the total job lost was 140,000.

In almost every state, lower wage industries have lost far more jobs than high wage industries.

Gross Domestic Product (GDP)

Economic activity, as measured by Gross Domestic Product, is down significantly from the end of 2019 to the third quarter of 2020. Nationally, GDP remains 3.4% lower than it was at the end of 2019 following a small drop in the first quarter of 2020, a cataclysmic drop in the second quarter, and a rebound in the third quarter.

Official data on the overall level of economic activity lag employment data, but through the first three quarters of 2020 the Gross Domestic Product (GDP) was down for every state except Utah. The size of 49 states' economies shrunk through the first three quarters of 2020, with declines in GDP ranging from 0.2% to 8.8%.

Changes range from the 0.1% gain for Utah to losses of over 5% for Hawaii (8.8%), Wyoming (7.8%), New York (6.1%), Oklahoma (5.6%), and Louisiana (5.3%). Texas and California losses were 3.6% and 3.7% respectively.

CONCLUSIONS

Based on the experiences from the worst hurricane in the State of Texas history, fire disasters and the recent COVID-19 pandemic data analyses following conclusions are advanced:

1. Confirmed cases and death rates peaked in January 2021 around the world and the U.S.A. because of COVID-19.
2. Real-time monitoring is critical for minimizing the cyber-attacks and COVID-19 pandemic.
3. Identify the transfer mechanisms of COVID-19 among humans to minimize the impact and also loss of lives.
4. COVID-19 virus pandemic resulted in job losses and also reduced the GDP. Major losses occurred in year 2020.

ACKNOWLEDGEMENT

This study was supported by the Center for Innovative Grouting Materials and Technology (CIGMAT) and the Texas Hurricane Center for Innovative Technology (THC-IT) at the University of Houston.

REFERENCES

1. Ang, C. (2020), "The Economic Impact of COVID-19: Positives and Negatives," (https://www.visualcapitalist.com).

2. Ettlinger, M. and Hensley, J. (2021) "COVID-19 Economic Crisis: By State" (https://carsey.unh.edu)

3. May, M. (2020), "Gene Therapy Developers," GEN Magazine, pp. 18-19.

4. Seymour, A. (2020), "New Hope for COVID-19 Antivirals," GEN Magazine, pp. 10-13.

5. Vipulanandan, C., and Ali, K., (2018) "Smart Cement Grouts for Repairing Damaged Piezoresistive Cement and the Performances Predicted Using

Vipulanandan Models" Journal of Civil Engineering Materials, American Society of Civil Engineers (ASCE), Vol. 30, No. 10, Article number 04018253.

6. Vipulanandan, C., and Amani, N., (2018) "Characterizing the Pulse Velocity and Electrical resistivity Changes In Concrete with Piezoresistive Smart Cement Binder Using Vipulanandan Models" Construction and Building Materials, Vol. 175, pp. 519-530.

7. Vipulanandan, C., and Mohammed, A., (2018) "Smart Cement Compressive Piezoresistive Stress-Strain and Strength Behavior with Nano Silica Modification, Journal of Testing and Evaluation, ASTM, doi 10.1520/JTE 20170105.

8. Vipulanandan, C. (2020) "Impact of COVID-19 Virus and Cyber Attacks on the Multiple Disaster Management and Rapid Recovery Plans," Proceedings THC-2020 Conference on Hurricane, Major Disasters, Coastal Protection and Rapid Recovery in Texas and Coastal Region," pp. 3-28 (http://hurricane.egr.uh.edu)