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**TERM PAPER REPORT ON ENGINEERING STRATEGIES FOR HANDLING COVID-19 FORENVIRONMENTAL HEALTH AND ECONOMIC SUSTAINABILITY**

**BY**

**COLLINS DAVID.C**

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**ENGR. DR. OYEBODE**

**AFE BABALOLA UNIVERSITY, ADO-EKITI, EKITI STATE.**

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**CERTIFICATION**

This is to certify that this term paper report was carried out by **COLLINS DAVID.C** of the Department of Mechanical/Mechatronics Engineering with Matric number **17/Eng05/010** in partial completion of the continuous assessment of the Engineering Law and Managerial Economics (ENG384) course under the supervision of Engr. Oyebode, Afe Babalola University, Ado-Ekiti. Nigeria during the 2019/20 academic session.

Engr. Oyebode

Lecturer-in-Charge

**DEDICATION**

This presentation is dedicated to me, family and my lecturers who have imparted the knowledge of this course on me.

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My gratitude and appreciation goes to God almighty for seeing me through this period of time with his grace and kindness, Engr. Dr. Oyebode, the lecturer in charge of the ENG 384 course.

**ABSTRACT**

The coronavirus disease 19 (COVID-19) is a highly transmittable and pathogenic viral infection caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), which emerged in Wuhan, China and spread around the world. Genomic analysis revealed that SARS-CoV-2 is phylogenetically related to severe acute respiratory syndrome-like (SARS-like) bat viruses, therefore bats could be the possible primary reservoir. The intermediate source of origin and transfer to humans is not known, however, the rapid human to human transfer has been confirmed widely. There is no clinically approved antiviral drug or vaccine available to be used against COVID-19. However, few broad-spectrum antiviral drugs have been evaluated against COVID-19 in clinical trials, resulted in clinical recovery. In the current review, we summarize and comparatively analyze the emergence and pathogenicity of COVID-19 infection and previous human coronaviruses severe acute respiratory syndrome coronavirus (SARS-CoV) and Middle East respiratory syndrome coronavirus (MERS-CoV). We also discuss the effects of the virus and a few engineering strategies for environmental heath and economic sustainability.

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**CHAPTER 1**

**What is COVID-19:**

 COVID-19 is an acronym that stands for coronavirus disease of 2019. It is the name given by the World Health Organization (WHO) on February 11, 2020, for the disease caused by the novel corona virus SARS-CoV-2, which started in Wuhan, China, in late 2019 and has since spread worldwide.

 On December 31, 2019, a strange new pneumonia of unknown cause was reported to the Chinese WHO Country Office. A cluster of these cases originally appeared in Wuhan, a city in the Hubei Province of China. These infections were found to be caused by a new corona virus which was given the name “2019 novel corona virus” (2019-nCoV).

**Comparative analysis of emergence and spreading of coronaviruses:**

 In 2003, the Chinese population was infected with a virus causing Severe Acute Respiratory Syndrome (SARS) in Guangdong province. The virus was confirmed as a member of the Beta-coronavirus subgroup and was named SARS-CoV. The infected patients exhibited pneumonia symptoms with a diffused alveolar injury which lead to acute respiratory distress syndrome (ARDS). SARS initially emerged in Guangdong, China and then spread rapidly around the globe with more than 8000 infected persons and 776 deceases. A decade later in 2012, a couple of Saudi Arabian nationals were diagnosed to be infected with another coronavirus. The detected virus was confirmed as a member of coronaviruses and named as the Middle East Respiratory Syndrome Coronavirus (MERS-CoV). The World health organization reported that MERS-coronavirus infected more than 2428 individuals and 838 deaths. MERS-CoV is a member beta-coronavirus subgroup and phylogenetically diverse from other human-CoV. The infection of MERS-CoV initiates from a mild upper respiratory injury while progression leads to severe respiratory disease. Similar to SARS-coronavirus, patients infected with MERS-coronavirus suffer pneumonia, followed by ARDS and renal failure.

 Recently, by the end of 2019, WHO was informed by the Chinese government about several cases of pneumonia with unfamiliar etiology. The outbreak was initiated from the Hunan seafood market in Wuhan city of China and rapidly infected more than 50 people. The live animals are frequently sold at the Hunan seafood market such as bats, frogs, snakes, birds, marmots and rabbits. On 12 January 2020, the National Health Commission of China released further details about the epidemic, suggested viral pneumonia. From the sequence-based analysis of isolates from the patients, the virus was identified as a novel coronavirus. Moreover, the genetic sequence was also provided for the diagnosis of viral infection. Initially, it was suggested that the patients infected with Wuhan coronavirus induced pneumonia in China may have visited the seafood market where live animals were sold or may have used infected animals or birds as a source of food. However, further investigations revealed that some individuals contracted the infection even with no record of visiting the seafood market. These observations indicated a human to the human spreading capability of this virus, which was subsequently reported in more than 100 countries in the world. The human to the human spreading of the virus occurs due to close contact with an infected person, exposed to coughing, sneezing, respiratory droplets or aerosols. These aerosols can penetrate the human body (lungs) via inhalation through the nose or mouth.

**Available vaccines:**

 There is no available vaccine against COVID-19, while previous vaccines or strategies used to develop a vaccine against SARS-CoV can be effective. Recombinant protein from the Urbani strain of SARS-CoV was administered to mice and hamsters, resulted in the production of neutralizing antibodies and protection against SARS-CoV. The DNA fragment, inactivated whole virus or live-vectored strain of SARS-CoV, significantly reduced the viral infection in various animal models. Different other strains of SARS-CoV were also used to produce inactivated or live-vectored vaccines which efficiently reduced the viral load in animal models.

 However, there are few vaccines in the pipeline against SARS-CoV-2. The mRNA based vaccine prepared by the US National Institute of Allergy and Infectious Diseases against SARS-CoV-2 is under phase 1 trial. INO-4800-DNA based vaccine will be soon available for human testing. Chinese Centre for Disease Control and Prevention (CDC) working on the development of an inactivated virus vaccine. Soon mRNA based vaccine’s sample (prepared by Stermirna Therapeutics) will be available. GeoVax-BravoVax is working to develop a Modified Vaccina Ankara (MVA) based vaccine. While Clover Biopharmaceuticals is developing a recombinant 2019-nCoV S protein subunit-trimer based vaccine.

**Basic protective measures against the new coronavirus**

 Stay aware of the latest information on the COVID-19 outbreak, available on the WHO website and through your national and local public health authority. Most people who become infected experience mild illness and recover, but it can be more severe for others. Take care of your health and protect others by doing the following:

* Wash your hands frequently

Regularly and thoroughly clean your hands with an alcohol-based hand rub or wash them with soap and water. Washing your hands with soap and water or using alcohol-based hand rub kills viruses that may be on your hands.

* Maintain social distancing

Maintain at least 1metre (3 feet) distance between yourself and anyone who is coughing or sneezing. When someone coughs or sneezes they spray small liquid droplets from their nose or mouth which may contain virus. If you are too close, you can breathe in the droplets, including the COVID-19 virus if the person coughing has the disease.

* Avoid touching eyes, nose and mouth

Hands touch many surfaces and can pick up viruses. Once contaminated, hands can transfer the virus to your eyes, nose or mouth. From there, the virus can enter your body and can make you sick.

* Practice respiratory hygiene

Make sure you, and the people around you, follow good respiratory hygiene. This means covering your mouth and nose with your bent elbow or tissue when you cough or sneeze. Then dispose of the used tissue immediately. Droplets spread virus. By following good respiratory hygiene you protect the people around you from viruses such as cold, flu and COVID-19.

* If you have fever, cough and difficulty breathing, seek medical care early

Stay home if you feel unwell. If you have a fever, cough and difficulty breathing, seek medical attention and call in advance. Follow the directions of your local health authority. National and local authorities will have the most up to date information on the situation in your area. Calling in advance will allow your health care provider to quickly direct you to the right health facility. This will also protect you and help prevent spread of viruses and other infections.

* Stay informed and follow advice given by your healthcare provider

Stay informed on the latest developments about COVID-19. Follow advice given by your healthcare provider, your national and local public health authority or your employer on how to protect yourself and others from COVID-19. National and local authorities will have the most up to date information on whether COVID-19 is spreading in your area. They are best placed to advise on what people in your area should be doing to protect themselves.

**Protection measures for persons who are in or have recently visited (past 14 days) areas where COVID-19 is spreading:**

Follow the guidance outlined above.

Stay at home if you begin to feel unwell, even with mild symptoms such as headache and slight runny nose, until you recover. Why? Avoiding contact with others and visits to medical facilities will allow these facilities to operate more effectively and help protect you and others from possible COVID-19 and other viruses.

If you develop fever, cough and difficulty breathing, seek medical advice promptly as this may be due to a respiratory infection or other serious condition. Call in advance and tell your provider of any recent travel or contact with travelers.

Calling in advance will allow your health care provider to quickly direct you to the right health facility. This will also help to prevent possible spread of COVID-19 and other viruses.

**CHAPTR 2**

**LITERATURE REVIEW**

**Automation:**

Automation is the technology by which a process or procedure is performed with minimal human assistance. Automation or automatic control is the use of various control systems for operating equipment such as machinery, processes in factories, boilers and heat treating ovens, switching on telephone networks, steering and stabilization of ships, aircraft and other applications and vehicles with minimal or reduced human intervention.

Automation covers applications ranging from a household thermostat controlling a boiler, to a large industrial control system with tens of thousands of input measurements and output control signals. In control complexity, it can range from simple on-off control to multi-variable high-level algorithms.

**Artificial Intelligence:**

Artificial intelligence (AI), the ability of a digital computer or computer-controlled robot to perform tasks commonly associated with intelligent beings. The term is frequently applied to the project of developing systems endowed with the intellectual processes characteristic of humans, such as the ability to reason, discover meaning, generalize, or learn from past experience. Since the development of the digital computer in the 1940s, it has been demonstrated that computers can be programmed to carry out very complex tasks, for example, discovering proofs for mathematical theorems or playing chess with great proficiency. Still, despite continuing advances in computer processing speed and memory capacity, there are as yet no programs that can match human flexibility over wider domains or in tasks requiring much everyday knowledge. On the other hand, some programs have attained the performance levels of human experts and professionals in performing certain specific tasks, so that artificial intelligence in this limited sense is found in applications as diverse as medical diagnosis, computer search engines, and voice or handwriting recognition.

**Mechanization in agriculture:**

Mechanization is a multi-dimensional concept and widely used in agriculture. There is, however, a major difference between the application of mechanization in developed and developing countries The developing countries tend to design their own strategies in food security given the challenges they face in all aspects of their economy including feeding a growing population, reducing poverty, protecting the environment, managing the effects of climate change and fighting malnutrition all which may further contribute to a reduction in economic growth and political instability. The goal of the strategies, with the help of appropriate technologies, is to lead to a sustainable agricultural development and, ultimately, food security. The policy making in each country should be based on its own conditions. This article uses Iran as an example of a developing country and considers the country’s specific climate as well as political and economic conditions to present development-oriented policies for achieving sustainable food security based on agricultural mechanization that may be adaptable to other developing countries. The main objective of this paper is to identify and provide guidelines to the current and future challenges of Iran’s food security, and it argues that for any strategy to succeed in producing a sustainable agricultural production, it will need a proper analysis and a formulation of an appropriate mechanization plan.

**CHAPTER 3**

**Effects of COVID-19 on industries and economic sustainability:**

 Beyond the tragic health hazards and human consequences of the COVID-19 pandemic, the economic uncertainties, and disruptions that have resulted come at a significant cost to the global economy. The United Nations Trade and Development Agency (UNCTAD) put the cost of the outbreak at about US$2 trillion in 2020. Most central banks, finance ministries and independent economic experts around the world have taken solace in the prediction that the impacts might be sharp but short-lived, and economic activities would return to normal thereafter. This line of thought mirrors the thinking of the events that shaped the 2007 global financial crisis. However, when compared to COVID-19, the 2007 crisis could be described as minor and manageable. The tumultuous events that COVID-19 has spread across the globe cuts across every facet of human existence and the consequences may linger beyond the second half of 2020.

 The slowdown in the global economy and lockdown in some countries, such as Italy, Spain and most Euro zone economies and beyond, as a result of COVID-19 has also taken its toll on the global demand for oil. The decline in oil demand is estimated to surpass the loss of nearly 1 million barrels per day during the 2007-08 recession. This is also coming at a time when two key players in the global oil industry – Russia and the OPEC cartel – are at loggerheads on the decision to cut output. The unequivocal oil price war started between these two global oil market giants may have more dire consequences on the oil price that has started to dive.

 Sector-specific implications and impacts could vary. For example, the impacts on the global aviation and tourism sectors are a result of the implications of the pandemic on global travel. As discretionary spending by consumers continues to decline, cruise companies, hotels, and hospitality are facing declining demand and patronage. For example, in Hungary alone, about 40 to 50% of hotel reservations have been canceled. Also, the pandemic is placing up to 8 million jobs in the leisure and hospitality sector at risk, with travel crashes and cancellations expected to continue. Moody's Analytics, a rating agency, stated that more than half of the jobs in the United States which is about 80 million may be in jeopardy.

 The virus is also taking its toll on health facilities and infrastructures across the globe. Italy is currently the largest affected country with a number of deaths surpassing China, since the outbreak of coronavirus. Across northern Italy, the virus has pushed the country's National Health Service to a breaking point, emphasizing the test that other countries, especially developing and low-income countries, might face in their approach to contain the virus spread. Most hospitals and health facilities that could not handle the hazards are resulting to operating below their capacity by taking a few regular health-related cases or shutting down. What could be more devastating is the fact that the economic pains that accompanied the virus might not go away soon as envisaged.

 The conventional policy measures currently being taken such as reducing interest rates and costs of borrowing, tax cuts and tax holidays are quite remarkable. However, these conventional policy measures are quite potent when there are demand shocks. There are limitations to the successes that can be recorded when demand shocks are combined with supply shocks. It is already apparent from the emergence of the current crisis that there are implications on the economy from both the demand and supply sides. Some of the demand factors include social distancing with consumers staying at home, limitations in spending and decline in consumption. On the supply side, factories are shutting down or cutting down production and output, while in other instances, staff work from home to limit physical contact.

 The decision to close educational institutions and schools around the globe in an attempt to contain the pandemic has also led to a soaring number of children, youth and adults not attending schools. According to UNESCO Monitoring report on COVID-19 educational disruption and response, the impact of school closures in the over 100 countries that have implemented the decisions around the world has impacted over half of the global students' population. These educational disruptions are being escalated particularly for the most vulnerable members of society.

**Bracing up for COVID-19 consequences on the Nigerian economy**

 For most developing economies, the chances of sliding into a downturn are gradually expected as the global coronavirus outbreak puts severe pressure on the economy. For Nigeria, the country is still sluggishly grappling with recovery from the 2016 economic recession which was a fall out of global oil price crash and insufficient foreign exchange earnings to meet imports. In the spirit of economic recovery and growth sustainability, the Nigerian federal budget for the 2020 fiscal year was prepared with significant revenue expectations but with contestable realizations. The approved budget had projected revenue collections at N8.24 Trillion, an increase of about 20% from 2019 figure. The revenue assumptions are premised on increased global oil demand and stable market with oil price benchmark and oil output respectively at $57 per barrel and 2.18 Million Barrels Per Day.

 The emergence of COVID-19 and its increasing incidence in Nigeria has called for drastic review and changes in the earlier revenue expectations and fiscal projections. Compared to events that led to recession in 2016, the current state of the global economy poses more difficulties ahead as the oil price is currently below US$30 with projections that it will dip further going by the price war among key players in the industry. Unfortunately, the nation has grossly underachieved in setting aside sufficient buffers for rainy days such as it faces in the coming days. In addressing these daunting economic challenges, the current consideration to revise the budget downward is inevitable. However, certain considerations that are expected in the review must not be left out. The assumptions and benchmarks must be based on realizable thresholds and estimates to ensure optimum budget performance, especially on the non-oil revenue components.

 Furthermore, cutting expenditures must be done such that the already excluded group and vulnerable are not left to bear the brunt of the economic contraction. The economic and growth recovery program which has the aim of increasing social inclusion by creating jobs and providing support for the poorest and most vulnerable members of society through investments in social programs and providing social amenities will no doubt suffer some setbacks. Besides, the downward review of the budget and contractions in public spending could be devastating on poverty and unemployment. The last unemployment report released by the National Bureau of Statistics (NBS), ranks Nigeria 21st among 181 countries with an unemployment rate of about 23.1%. The country has also been rated as the poverty capital of the world with an estimated 87 million people living on less than $2 a day threshold.

 The decision to cut the retail price of gasoline under a price modulation arrangement is a welcome development. The cut is expected to curb rising inflation, especially food price inflation which will mainly benefit the poor. However, rather than the price capping regime introduced, by which it is expected of the Petroleum Products Price Regulation Agency (PPPRA) to constantly issues monthly guide on appropriate pricing regime. It is expected that the government will use this opportunity to completely deregulate the petroleum industry in line with existing suggestions and reports. In the event that the global economy becomes healthier and crude oil prices increases, the government might return to the under-recovery of the oil price shortfall by the Nigerian National Petroleum Corporation (NNPC), a policy that annually costs the government huge revenue and recurring losses to the NNPC.

 Basically, the Nigerian government essentially must lead economic diversification drive. It is one practicable way to saddle through the current economic uncertainties and instabilities. What the consequences of COVID-19 pandemic should further offer the Nigerian economic managers and policymakers, is that the one-tracked, monolithic reliance on oil is failing. Diversification priorities to alternative sectors such as agriculture, solid minerals, manufacturing and services sectors should be further intensified.

**CHAPTER 4**

**Handling COVID-19 for environmental health and economic sustainability**

 Taking a critical look at the current situation, the best and most effective measure for preventing the spread of the virus is through social distancing. This is best achieved by imposing compulsory lockdowns. These lockdowns affect a lot institutions and gatherings including; schools, markets, manufacturing industries and businesses, religious gatherings and social functions etc. It also affects rates in demand and supply of several commodities and a decline in mobility which is a major source of employment. An increase in everyday necessities such as food, water and toiletries matched with a decrease in their availability due to the lockdown may slowly lead to a breakdown of law and order if prolonged. However the following strategies can be adopted to contain the situation:

**Automation and Artificial Intelligence:**

 Tackling the problems associated with imposing lockdowns requires hand-on relevant and efficient technology. High demand should hence be placed on automation and artificial intelligence, in order to achieve productivity with less human contact and effort, as well as aid delivery and dispensing of items at sale points and aid transportation.

 Simple safe devices and methods should be adopted to help easy and faster detection prevention and control of possible cases of the virus such as; the drive through tests, hand sanitizer dispensers, smart helmets (as implemented in China).

**Communication and connectivity:**

 Communication and connectivity is a necessity of this period. It is of great importance that the public be kept informed with the latest updates on information regarding measures for their personal safety, as the virus is being studied and as it evolves. It is also important that individuals are aware of the new laws enacted to contain the situation.

 Apart from ensuring public awareness, connectivity is also required to keep institutions and businesses on course. To reduce the effect of the lockdown, platforms should be made available to aid online learning for secondary and tertiary institutions, also businesses can also be done using these online platforms as meetings, conferences etc can be held via a good connection, as well as transactions.

**Intensive increase in agricultural mechanization:**

 Agriculture should be given greater priority as more agricultural produce are required and its availability is a necessity. Farmers should still be allowed to work under strict conditions and aided with equipments for greater production.

**Focus for the economy:**

 Henceforth the government should focus its resources on self sustaining sectors of the economy of which agriculture is a major component. A sector is self sustaining when it generates revenue not only from exports but also from consumption within the country. Agriculture should be given great consideration, as lockdowns will affect export, it will still play an important role in keeping the nation fed and sustain the economy.

 The oil sector should also hence be converted to a self sustaining sector. The need for refineries in the country cannot be over emphasized. As other countries impose lockdowns and travel bans, exporting crude oil for refining would no longer be possible. This would lead to a decrease in supply of petroleum products for the country and since the Nigerian economy is focused on crude, it would greatly affect internal revenue of the country.

**CHAPTER 5**

**Conclusion:**

The COVID-19 virus which started in China has spread globally and the resulting deaths are still on the rise. It is therefore highly important that strict measures are put in place to stop the spread of the virus. Individuals should be made to realize that there is currently no vaccine available for its treatment. However the effects of the virus can be greatly reduced by adopting the strategies stated in the previous chapter.

**Recommendation:**

The effects of a pandemic cut across every facet of human existence. To reduce the effects as well as prevent further spread of the virus, it is important that individuals play their role of strict adherence to personal preventive measures and also the enacted laws which include; lockdowns and travel bans.

Furthermore, handling a pandemic requires hands-on reliable and efficient technology, hence engineering solutions and strategies should be adopted to aid the prevention and control of the virus.

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