

# GLOBAL JOURNAL

OF SCIENCE FRONTIER RESEARCH: I

## Interdisciplinary

Matrix Across COVID-19

Global Issues Arising Therefrom

Highlights

Global Pandemics Corona Virus

Survey Concerning Sexual Harassment

Discovering Thoughts, Inventing Future

VOLUME 20

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# Global Pandemics Corona Virus (COVID-19) Pandemonium Disruption Educational Sector Blues and Global Issues Arising Therefrom

By Kwesi Atta Sakyi, Dr Geoffrey Mweshi & David Musona

ZCAS University

**Abstract-** In this paper, we survey the topic of pandemics with specific reference to the Global Corona Virus pandemic which is dubbed COVID-19, and we trace the background of pandemics in the past. Our objective in this paper is to share our experiences as well as to examine the impact of the pandemic on businesses, especially the educational sector, and also on other sectors. In this paper, we take a multidisciplinary approach as well as a compendious approach of surveying a broad swathe of issues. At the same time, we use a narrative approach, providing commentaries and descriptive analysis, and a flashback of history in the literature review. We rely mainly on secondary data for the discussion and analysis as the nature of the topic is still fresh and delicate for us to conduct primary research. Besides, we believe that the problem at hand is on-going, all encompassing, and it may be premature at this stage for us to come to some definitive conclusions. The theoretical model which we use in the analysis is the macro-environmental model which is popularly and variously called the PEST, PESTLE, PESTEL, SLEPT, or STEEPLE model, popular in management studies and used by Social Scientists in their exegesis and discourses.

**Keywords:** *climate change, recession, depression, quantitative easing, leadership, politics, human rights, ethics, strategic communication, pandemics, statesmanship, interdependence, malthusian spectre, unemployment, doomsday, keynesian economics, welfare economics, new world order, PESTEL, capitalism.*

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GLOBALPANDEMICS CORONAVIRUS COVID19 PANDEMONIUM DISRUPTION EDUCATIONAL SECTOR BLUES AND GLOBAL ISSUES ARISING THEREFROM

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# Global Pandemics Corona Virus (COVID-19) Pandemonium Disruption Educational Sector Blues and Global Issues Arising Therefrom

Kwesi Atta Sakyi <sup>α</sup>, Dr. Geoffrey Mweshi <sup>σ</sup> & David Musona <sup>ρ</sup>

**Abstract-** In this paper, we survey the topic of pandemics with specific reference to the Global Corona Virus pandemic which is dubbed COVID-19, and we trace the background of pandemics in the past. Our objective in this paper is to share our experiences as well as to examine the impact of the pandemic on businesses, especially the educational sector, and also on other sectors. In this paper, we take a multidisciplinary approach as well as a compendious approach of surveying a broad swathe of issues. At the same time, we use a narrative approach, providing commentaries and descriptive analysis, and a flashback of history in the literature review. We rely mainly on secondary data for the discussion and analysis as the nature of the topic is still fresh and delicate for us to conduct primary research. Besides, we believe that the problem at hand is on-going, all encompassing, and it may be premature at this stage for us to come to some definitive conclusions. The theoretical model which we use in the analysis is the macro-environmental model which is popularly and variously called the PEST, PESTLE, PESTEL, SLEPT, or STEEPLE model, popular in management studies and used by Social Scientists in their exegesis and discourses. We chose this model because the COVID-19 pandemic impacted on lives around the globe, and it affected every facet of life, hence the need to take a holistic approach that is exploratory, and based on Grounded Theory. Our findings and discussions concentrated on the effects of lockdowns on businesses, especially on the educational sector, as well as on social aspects of following scientific recommendations such as observing social distance, wearing masks, washing hands, avoiding gatherings, and avoiding unnecessary travel. In this paper, we also examined how lecturers' and students' work were affected under the circumstances, as well as discussing the novelty ways which lecturers and students adopted to cope with the challenging situation of the new normal. Furthermore, we discussed issues of political leadership, the direction of geopolitics, and general responses to the outbreak of the pandemic. In this paper, we concluded that the disruptive nature of the pandemic had brought about a paradigm shift in the way business is conducted, and challenged people to explore new methods of sustaining themselves, their businesses, their lifestyles, and their jobs. Furthermore, we were bold to make some forecasts, based on historical trends, in order to warn people to be on

the alert. We ended the paper by making recommendations to stakeholders and first-line or frontline disaster response agencies and authorities.

**Keywords:** climate change, recession, depression, quantitative easing, leadership, politics, human rights, ethics, strategic communication, pandemics, statesmanship, interdependence, malthusian spectre, unemployment, doomsday, keynesian economics, welfare economics, new world order, PESTEL, capitalism.

## I. INTRODUCTION

In this paper, we chose to adopt a title that will do justice to the topic from a multidisciplinary point of view, and at the same time, help us take a stand with a bias or slant towards the educational sector, where we ply our trade as lecturers or academics. In fact, it will be a big lie and understatement to submit that the outbreak of this pandemic which is dubbed COVID-19 will leave the world the same as it was prior to the outbreak, towards the tail end of 2019.

Indeed, the year 2020 will go down in history as unprecedented in the annals of human history, in terms of how the pandemic shook the depths and foundations of human civilization, and caused hysteria, pandemonium, disruption, bedlam, and horror so much so that 2020 can fittingly be called *Anuus Mirabilis* or the Horrible Year, in terms of the number of deaths from the disease around the world, which is now estimated in the region of about approximately 500,000 worldwide, with countries that are severely affected including USA, Brazil, Spain, Italy, Iran, UK, France, Russia, China, South Korea, and Turkey, among many others (See Tables 2 and 4 below).

Sometime ago, some great philosophers observed that man's greatest enemy is man himself, and that the history of mankind teaches man that man never learns from the lessons of history, and thus history inexorably repeats itself many times, leading to the often-quoted saying that there is nothing new under the sun. Isaac Newton, the great English scientist, was on record as having said that he could predict with accuracy the orbits or paths of the heavenly bodies but when it came to the lunacy and stupidity of human beings, he was nowhere near predicting where their paths would go.

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It is extremely sad to note that while many women heads of state have shown sterling leadership in the face of COVID-19, many of our male political leaders world-wide, have failed the acid test of leadership, sadly so in so-called advanced and developed countries. Wild bush fires in Australia, Spain, France, Brazil, California, and Africa were inexplicable before the outbreak of the COVID-19 pandemic, and some people speculated that these incidents could be the work of Aliens or extra-terrestrial beings who are at war with humans because of the callousness of a few towards the majority poor, vulnerable and weak.

We think some aliens from space are watching us and giving us warning signs, as the onset of the Corona Virus pandemic is unprecedented, and perhaps a wake-up call to all humankind to get our act together to mend our selfish ways. Treaties which were signed in the past on Biological and Chemical warfare, as well as those on the non-proliferation of nuclear missiles, need to be re-examined. However, an unseen miniscule virus has shown humankind how powerless and extremely weak we are, against the forces of nature.

We saw in this pandemic, how economic gains in the USA were wiped out totally by COVID-19, leading to a forecast of 30% decrease in growth of GDP in the USA, and 3% decrease in growth world-wide (World Bank; IMF; World Economic Forum).

Prior to the pandemic outbreak in Wuhan in China in December 2019, the UK had entered the last phase of the protracted Brexit imbroglio, which had raged for three years, and when everyone was about to heave a sigh of relief, boom, COVID-19 struck like a bolt from the blue, to hit all of humankind. Prior to the COVID-19 pandemic outbreak, the USA had emerged from a dramatic presidential impeachment trial, which drew a chasm across the rank and file of American society (CNN, 2019).

The Congressional hearings were a tell-tale saga with the writing on the wall that the evidence against the incumbent president's impeachment meant that there was going to be a change of the guards. That was not to be because of the vast powers invested in the Executive monarch of America. Before the pandemic outbreak, USA-Russia relations were heavily frayed, with heavy economic sanctions slapped on Russia. The earlier tango dance between North Korea and USA was also put on the back burner.

USA-China relations became an off and on affair, like a Ping-Pong game, with no clear direction given, concerning trade relations and the tit-for-tat war of imposing economic sanctions. The rest of the world became spectators to conflicting signals which were given to the rest of the world. Matters came to a head when the news broke out that a new devastating virus had emerged from nowhere in China, in the city of Wuhan, in Hubei Province.

According to WHO, the virus was an unknown strain of H1N1. We think that with many glaciers thawing all around the globe, ancient virulent viruses, which had lain dormant for millions of years, have suddenly been released into the world, hence medical scientists having no clue to COVID-19. This informs us to pay particular attention to the issue of global warming and climate change.

The pandemonium, hysteria, and disruption which Covid-19 has caused in the world will take many years for it to be forgotten, and also it will take several years to recover from its devastating impact. Henceforth, going forward, the whole human-made systems of the world have been shaken at their foundations, as this is the time to seriously reflect deeply, and reinvent the world, as well as sharpen our reflexes, in order to come up with better-honed technology to deal with such disruptions. We have been shown to be highly vulnerable to the forces of nature, and that our current civilization and technology are not good enough to withstand severe natural disruptions.

Even with regard to wild raging bush fires, we have shown our incompetence and incapacity of dousing such random wild fire outbreaks that cover millions of hectares. COVID-19 has exposed the frailty of human-made institutions, and has also pointed out to us that we live in a world of interdependence, complementarity, and that we are fast-moving towards global convergence, which will one day bring a New World Order of one world government that is controlled by the internet, Artificial Intelligence (AI) and Machine Learning (ML) (Kissinger, 2015; Huttington, 2007; Toffler, 1995)

#### a) *Educational Sector Blues*

According to Light (2020), a regression analysis which he carried out in 50 USA states showed a good fit between the normal Gaussian Curve and his estimate of variables that caused the spread of the COVID-19 virus in the USA. Light (2020) found out that Coffee hubs, where people sit to socialize, were among the potent sites for the spread of the virus. Also, his results showed that the states with lots of universities in big cities, with many international students, were highly infectious areas. Furthermore, Light (2020) revealed that those above 65 years were not so mobile, so they were not great spreaders but that they were most vulnerable to the COVID-19 pandemic.

The old people are the most vulnerable due to their weak immune systems. This informs us that schools, colleges, and universities are epicentres of the spread of the virus, therefore foreign students have to be quarantined when they arrive either way in their home countries or their host study countries. Already, some countries are planning to expel millions of foreign students who are mainly from Asia, principally from China, India, South Korea, and Japan.

This will be lose-lose situation for the countries involved. The USA will cease to be a major attraction for foreign students who want to study overseas in prestigious Ivy League and Russell Group universities such as Harvard, MIT, Yale, Caltec, Princeton, Oxford, Cambridge, McGill, Imperial College, and Cornell, among many others. There will be a shift from American universities to the UK and European universities, particularly to the Scandinavian countries and Canada, which offer stable political and social environments.

#### b) *Conspiracy Theories and Global Trending Issues*

Prior to the outbreak of the Corona Virus pandemic, the world was going through a series of crisis including wars in Syria, Yemen, South Sudan and Afghanistan. The USA and the Taliban were trying to broker a peace deal in Afghanistan, which was often made unworkable by violations in Afghanistan. In the Middle East, the intractable hostility between the Israelis and Palestinians knew no limit, after decades of belligerent and bellicose stance on either part.

Some eminent economists were calling for a New World Economic Order to replace moribund economic arrangements such as crude one-sided capitalism in world trade arrangements, which heavily favour the rich countries in the North, at the expense of the poor majority in the Southern hemisphere (Piketty, 2014). Before the Corona Virus outbreak, oil prices had plunged to their lowest level in recorded history, around 20 dollars per barrel. The world geopolitical order beggared belief, as USA-Russia and USA-China relations reached their nadir or doldrums, all in the name of the needless show of flexing muscles to show who really rules and dominates the world scene in a post-Cold War unipolar world.

To us as observers, that was the apogee of leadership failure and lack of illustrious leadership or statesmanship. The old brinkmanship style of leadership was nowhere to be found, and the world was poorer for that. In Africa, political leadership in many African countries had sunk to rock bottom, with wanton corruption scandals being the order of the day. As a result of massive corruption, many masses suffer deprivation, want and lack of access to basic social amenities such as medical care, access to clean water, and all-weather passable roads.

The USA wielded the big stick of economic sanctions to punish Iran, Cuba, China, Russia, and Venezuela, while the whole world looked on helplessly, as the act disrupted world trade and distorted the face of economic diplomacy. The world at large is worse off for this act of America. Many innocent souls were lost and continue to be lost in senseless proxy wars in Yemen and Syria. Looming large in the background of all these human atrocities, was an Act of God, global warming, which caused lots of wild bush fires, droughts, hurricanes, glacier thaws, locust and army worm

infestations, among a legion of catastrophes and calamities.

We wonder whether or not the world is seeing the spectre of the end of human species, which was written about long ago by Thomas Robert Malthus wrote in 1789, which made economics to earn the opprobrious epithet of the *Dismal Science* (Hunt et al., 2011). We wonder again whether COVID-19 was sent by God as a sign and warning to humankind, to flatten the curve of the bulge in human hubris, and human inhumanity, shown to other people by way of racial segregation, pillage, mistreatment, oppression and suppression, annihilation through ethnic cleansing, among other atrocities.

The COVID-19 pandemic, in our own estimation, may be a sure sign from outer space, perhaps from aliens who are watching over us, and who are the original owners of the earth, and creators of humankind. For the first time in our lives, we were told by astronomers and scientists that our closest neighbour galaxy, Andromeda, came closest to our Milky Way Galaxy, and our earth after 500 million years (Wikipedia, n.d.). Perhaps cosmic influence from outer space could explain the Corona Virus pandemic conundrum. Many years ago, a British economist by the name of Jevons, tried to propound a theory that economic behaviour of consumers was directly correlated with the changing phases of the moon, a claim which some cynics deemed as spurious correlation (Hunt & Lautzenheiser, 2011; Moroney, 1962; Stafford, 1978; Yeoman, 1968; Francis, 2015).

## II. LITERATURE REVIEW

#### a) *Global Pandemics*

We notice a trend in Influenza outbreaks which follows a 100-year cycle. The deadly influenza of 1919 is followed by this COVID-19 in 2020, a year with repeating digits of 2020, like that of 1919. If we go by this trend, then we should expect a bigger influenza outbreak in the year 2121, 100 years from now. Or is it sheer coincidence? Some of the deadly epidemics and pandemics in our recent history include the SARS and MERS in Asia, Ebola in the Congo and parts of West Africa, Measles in the USA, cholera in Haiti, India, Zimbabwe, and Bangladesh (Wikipedia, n.d.). Table 1 below shows a record of some of the deadly pandemics in recorded history.



Table 1: A random selection of pandemic outbreaks in historical times

	Year	Pandemic	Location	Impact
1.	1200 BC	Influenza epidemic	Babylon, Persia, Mesopotamia	
2.	429-426 BC	Plague of Athens	Greece, Egypt, North Africa	
3.	165-150 AD	Antonine Plague	Roman Empire	
4.	165-180 AD	Smallpox	Roman Empire	25-100 million deaths
5.	541-542 AD	Plague of Justinian	Europe, West Asia	
6.	1346-1353 AD	Black Death, Bubonic Plague	Europe, Western Asia	75 million to 200 million deaths
7.	1510	Influenza	Europe, North Africa,	5 to 8 million deaths
8.	1596-1602	Spanish Plague	Spain	600,000 -700,000 deaths
9.	1772-1773	Persian Plague	Persia	2 million deaths
10.	1812	Russian Typhus	Russia	300,000 deaths
11.	1812-1819	Ottoman Plague	Turkey	300,000 deaths
12.	1855-1960	Bubonic Plague	Worldwide	12 million deaths in India and China
13.	1918 -1919	Influenza	Worldwide	50 million deaths with 675,000 deaths in USA and 100,000 deaths in Ghana (Gold Coast)
15.	1957 – 1958	Influenza	Worldwide	4 million deaths
16.	1968-1970	Hong Kong Flu	Hong Kong	
17.	1981 to date	HIV/AIDS	Worldwide	32 million to 44 million deaths

(Source: Wikipedia-List of Epidemics)

One of the deadliest pandemics recorded in history was the Black Death, which occurred from 1347 to 1353 in Europe. It was estimated to have claimed between 75 million and 200 million lives of people, about 60% of the population of Europe (Britannica.com; nationalgeographic.com). It was believed to have been caused by the bacterium, *Yersina pestis*, which is found among wild rodents. Britannica.com (n.d.) stated that in 1347, 12 ships arrived in Messina, Sicily in Italy, from the Black Sea area in Asia. The pandemic spread very fast, as there were no antibiotics and disinfectants at the time. The only precautions taken then were isolation and quarantine. It is considered to be the greatest catastrophe that ever happened to the human race (Britannica.com, n.d.).

### III. METHODOLOGY

Our objective in this paper is to examine some pertinent issues pertaining to the COVID-19 pandemic, by sharing our insights and experiences as well as discussing some of the topical issues which have impacted the world of work, particularly the education sector. We decided to adopt a secondary desk research approach, due to the nature of the topic, which is a novelty. We did this because, for us to approach the topic from the Social Sciences perspective, we needed to adopt a multidisciplinary approach in order to cover a wide array of issues, and to provide some theoretical underpinnings as framework for analysis. We wanted an encyclopaedic and compendious approach that would integrate the COVID-19 experience into a synthesis from the Social Science perspective, in an exploratory and innovative way.

The approach we adopted here in this paper is partially anecdotal, and partially, a narrative commentary, with observational analysis of issues as they unfolded. The approach is also qualitative, as no

primary data was collected for analysis. There is no existing theory about pandemics; that being the case, we approached this survey article from our own observations and personal insights, as direct participants in the unfolding scenario. However, we came up with some models from management, economics, and geography to explain some issues and to apply them to enrich our discussion and analysis. Finally, we put forward recommendations at the end to help frontline response organisations enhance their disaster-preparedness awareness.

### IV. FINDINGS AND ANALYSIS

We can see from Table 2 below that South Africa and Egypt have the highest number of Corona-related deaths of 6,650 and 1,994 deaths respectively in Africa, with other African countries recording less than 1,000 cases of deaths in each country.

**Table 2:** Statistics of Corona Cases in African Countries as on August 11<sup>th</sup> 2020

	Country	Infections/Cases	Ranking	Deaths	Ranking
1.	Congo DR	2,113	10	17	10
2.	Egypt	43,326	2	1,994	2
3.	Ethiopia	23,591	5	420	3
4.	Ghana	41,212	3	215	7
5.	Ivory Coast	6,666	8	35	9
6.	Kenya	26,928	4	423	4
7.	Nigeria	17,457	6	303	5
8.	South Africa	341,974	1	6,650	1
9.	Tanzania	461	12	0	12
10.	Uganda	1,297	11	9	11
11.	Zambia	8,210	7	241	6
12.	Zimbabwe	4,748	9	104	8

(Source: Johns Hopkins University Online)

Here, we apply the Spearman Rank Coefficient formula for rho:

$$\rho = 1 - \frac{6 \sum d_i^2}{n(n^2 - 1)}$$

(Source: <https://www.statisticshowto.com/wp-content/uploads/2015/01/rank-correlation-coefficient-formula.jpg>)

The Pearson's Product-Moment correlation formula, which uses raw score data is tedious to work with. Below is the Pearson product-moment correlation coefficient formula (Hussey et al., 2014; Lucey, 2002):

$$r = \frac{n(\sum xy) - (\sum x)(\sum y)}{\sqrt{[n\sum x^2 - (\sum x)^2][n\sum y^2 - (\sum y)^2]}}$$

(Source: <https://www.statisticshowto.com/wp-content/uploads/2009/11/pearsons.gif>)

However, our experience informs us that both formulas produce identical results. We notice that the correlation coefficient for African countries, between number of Infections and number of Deaths is 0.8601. This implies that the mortality rate is affected by the number of infections in Africa.  
R= 0.8601

**Table 3:** Spearman Correlation Rankings for African Countries between PCI and Deaths

	Country	Deaths	Ranking	PCI	Ranking
1.	Congo DR	2,113	10	545	12
2.	Egypt	43,326	2	3020	2
3.	Ethiopia	23,591	3	857	10
4.	Ghana	41,212	7	2202	5
5.	Ivory Coast	6,666	9	2286	3
6.	Kenya	26,928	4	1816	6
7.	Nigeria	17,457	5	2230	4
8.	South Africa	341,974	1	6001	1
9.	Tanzania	461	12	1122	9
10.	Uganda	1,297	11	777	11
11.	Zambia	8,210	6	1291	8
12.	Zimbabwe	4,748	8	1464	7

The correlation coefficient between Deaths and per capita income (PCI) for African countries is 0.60839, which also shows some strong correlation of 0.60839. (R= 0.60839)

This suggests that African countries are affected negatively by the impact of the corona virus because of their weak economies, and high levels of poverty. We make bold to put forward this model for Africa.

Corona Deaths = f (poverty (P), levels of health and other public and social infrastructure (I), lifestyle (L) or

$$CD = P \cdot I \cdot L$$

Where CD represents deaths from Corona Virus

P represents poverty levels

I represents quality and quantity of social and public infrastructure available

L represents lifestyle of the people

This model suggests direct links between corona virus deaths, and levels of poverty, quality and quantity of public and social infrastructure, and lifestyles. African governments therefore have to work hard to improve on these variables by working with the UN and other multilateral agencies, using the 17 UN Sustainable Development Goals (SDGs) as drivers of change and development.

Table 4: Statistics of Corona Cases in Non-African Countries as on August 11<sup>th</sup> 2020

	Country	Infections/Cases	Ranking	Deaths	Ranking
1.	Brazil	3,057,470	2	101,752	2
2.	China	88,906	10	4,689	11
3.	France	239,349	9	30,327	6
4.	Italy	250,825	8	35,209	5
5.	Iran	328,844	5	18,616	8
6.	Mexico	485,836	4	53,003	3
7.	Russia	890,799	3	14,973	9
8.	S. Korea	6,636	12	146	12
9.	Spain	322,980	6	28,576	7
10.	Turkey	24,1997	11	5,858	10
11.	UK	313,392	7	46,611	4
12.	USA	5,094,400	1	163,463	1

(Source: Johns Hopkins University Online)

For the Non-African countries, including some of the BRICS countries (Brazil, Russia, India, China, and South Africa), the correlation coefficient between corona-related Deaths and Infections is 0.73427, (R = 0.73427), which suggests a strong correlation for

these developed, and emerging countries. This compares favourably well with the figure for the African countries, which was (R = 0.8601). The higher figure for African countries suggests that their poor health infrastructure is a cause of deaths from COVID-19.

Table 5: Spearman Correlation Rankings for Non-African Countries between PCI and Deaths

	Country	Deaths	Ranking	PCI	Ranking
1.	Brazil	101,752	2	8,717	11
2.	China	4,689	11	10,261	8
3.	France	30,327	6	40,494	3
4.	Italy	35,209	5	33,190	4
5.	Iran	18,616	8	5,520	12
6.	Mexico	53,003	3	9,863	9
7.	Russia	14,973	9	11,585	7
8.	S. Korea	146	12	31,762	5
9.	Spain	28,576	7	29,614	6
10.	Turkey	5,858	10	9,042	10
11.	UK	46,611	4	42,300	2
12.	USA	163,463	1	65,281	1

The correlation coefficient between per capita income (PCI) and Deaths for the emerging and developed Non-African countries is (R = 0.26573), showing weak correlation. We can therefore conclude that per capita income in these affluent countries, has nothing directly to do with deaths, even though levels of wealth and high PCI could influence lifestyles, and precipitate underlying diseases from opulence such as cancer, high blood pressure, cardio-vascular diseases, and diabetes, diseases associated with obesity, over-indulgence, and addiction to high cholesterol diets. We therefore make bold to suggest the following model for the developed and emerging countries:

Corona Deaths = f (Lifestyle (L), Underlying Diseases (U), and Wealth (W))

$$CD = L*U/W$$

The emerging and developed countries need to work on lifestyles such as eating habits, holiday travel, and taking care of underlying diseases such as Diabetes, Hypertension, Cardiovascular diseases and Cancer. Having too much wealth is also a problem in

the sense that it influences lifestyles, particularly those associated with over-indulgence in drinking, eating, smoking, over-dependence on drug supplements and prescriptions, and unhealthy social habits such as self-isolation from family members.

## V. THEORETICAL MODELLING

### a) Growth formula

When we want to estimate the population growth of an organism, we either use the compound interest formula

$$P_1 = P_0 (1 + r)^n \quad (\text{source})$$

where  $P_1$  is the current population to be estimated

$P_0$  is the previously known population

$r$  is the rate of growth

$n$  is the number of years since the last known population size,  $P_0$ .

We can also use the alternate formula  $A_1 = A_0 e^{rt}$

where  $e$  is the base of natural logarithm and  $t$  is the same as  $n$  in the previous formula, representing time.

These two formulae can be used to estimate the population of a country in normal times.

b) *Decay formula*

The decay formulas are used for a population that is decreasing, such as in the case of the Corona virus pandemic. However, the above two growth formulas have to be modified for them to become decay formulas thus, a change in sign from the positive to the negative sign, thus:

$$P_1 = P_0 (1 - r)^n \quad \text{and} \quad A_1 = A_0 e^{-rt}$$

c) *Normal Curve Formula*

The normal curve equation can be used to produce a regression of an event to find out whether the situation occurred normally or not, by making some reasonable assumptions about the variables that are chosen in the examination of the phenomenon (Light, 2020). The moment generating function for tracing all the Z points on the normal curve is given as the integral from negative infinity to positive infinity of

$$M(t) = E(e^{Tx}) = 1/\sigma \sqrt{2\pi} \int_{-\infty}^{\infty} e^{tx} e^{-(x-\mu)^2/2\sigma^2} dx$$

Stirling's approximation for estimating the area under the normal curve is:

$$n! = \sqrt{2\pi n} \cdot n^n e^{-n} = N = 1 \text{ or } (n/e)^n \sqrt{2\pi n} \text{ for large } n \text{ (Britannica, n.d.; Spiegel 1982: 27; Yamane, 1973)}$$

d) *Gravity Model*

The gravity model is used in geography to estimate the Force of interaction between and among cities, as it measures both stock and flow concepts of population interactions among cities.

$$F = g M_1 M_2 / d^2$$

Where F is the force of attraction between two population concentrations or locations,

g is a gravitational constant such as the force of gravity

M<sub>1</sub> represents mass of population in one location

M<sub>2</sub> represents another mass of population

d represents the distance between the two masses of population (this distance is squared in the formula)

The model can be useful in identifying centres which serve as magnets to draw people to them, and in this way, measures can be put in place to check movements of people to cities, in order to slow down spread of diseases such as COVID-19.

e) *Keynesian Multiplier Model*

Following the Great Depression of 1929, which economists had failed to predict, James Maynard Keynes, wrote his book *Growth, Employment and Investment* in an attempt to come up with a credible theory as a solution. He proffered the idea of demand-side economics, and government direct intervention in

the market, an idea which was anathema and anti-thesis to the supply-siders or neo-capitalists (Froeb & McCann, 2009; Begg et al. 2011; Beardshaw et al., 2001; Lipsey & Crystal, 2010).

Keynes argued that, through government intervention, by undertaking massive national infrastructure projects such as building roads, railways, power stations, universities, ports and airports, the economy could be kick-started to influence many other sectors, an idea he called the multiplier concept (Anderton, 2000; Maunder, et al., 2000; Mankiw, 2008; Petersen & Lewis, 1999; Sloman & Garratt, 2010). Keynes diagnosed the problem to be one of under-consumption, and lack of investor confidence in the markets, which needed government intervention. The supply-side monetarists thought otherwise, and said that the depression was caused by shortage of money supply as a result of wrong policies by the Federal Reserve Bank (history.com, n.d.; Keat et al, 2013; Frank & Bernanke, 2007; Witztum, 2005).

There are two types of multipliers, namely the open economy multiplier, and the closed economy multiplier (Gough, 2000; Grant, 2008; Hayes, n.d.; Pindyck & Rubinfeld, 2013). The former is expressed as the reciprocal of withdrawals or leakages from the national circular flow of income or GDP, namely Savings, Tax, and Imports:

$$K_o = 1/S+T+M$$

while the closed economy multiplier is:

$$K_c = 1/S.$$

In a closed economy, we assume that there are no inflows and outflows or no external trade, and no government intervention in the market (Begg et al. 2013; Salvatore, 2014; Anderton, 2000; Maunder et al., 2000; Baye, 2010). This is because in a closed economy, using the Circular Flow of Incomes and Goods and Services, we have Injections (J = I+G+X) and Withdrawals (W = S+T+M). In the closed economy model, we assume G, X, T, and M do not exist. G represents government expenditure, T represents tax revenue to government, X represents value of exports and M represents the value of imports. In this scenario, we find that the closed economy multiplier in the autarky or no trade situation has a bigger bang or impact via the multiplier.

It can be seen that the closed economy multiplier has a bigger bang or impact than the open economy multiplier (Begg et al., 2011; Beardshaw et al, 2001). Therefore, in a post-COVID-19 recovery phase, we think that it will be germane to apply the Keynesian multiplier concept, in leading economies to recovery, by having massive government injections via Open Market Operations, whereby the Central Bank buys or redeems bonds and treasury bills, so as to help pump money into the circular flow of goods, services and money in the

economy. At the same time, government can issue new bonds for moneybags and financial institutions to buy, in order to raise huge sums for reinvestment (Mankiw, 2008; Witztum, 2005; Watkin, n.d.). Furthermore, the government, through the central or Federal Reserve Bank could resort to quantitative easing or printing money and lending it to government for improving liquidity in the economy through bailouts for sinking private sector firms. Also, we can see a situation whereby, to create more domestic jobs, some countries might practise mercantilist policies by restricting external trade by imposing restrictions on imports.

#### f) Corona Virus Pandemic Response Model

We are convinced that the following factors directly (positively), and indirectly (negatively), influenced national response to the emergency:

##### Positive factors:

- i. High Quality of National Infrastructure (HI)
- ii. High Levels of Innovation (HL)
- iii. Reliance on Scientific evidence (RS)
- iv. Innovative Technological Interventions such as use of drones for deliveries of samples (IT)
- v. High Emergency Response Pre-Preparedness (ER)

- vi. High GDP (GP)
- vii. High Literacy Rate (LR)
- viii. Liberal Centralist Approach to Policy Implementation (LC)
- ix. Proactive Leadership (PL)

##### Negative Factors:

- Poverty (PV)
- Politicisation of Issues (PI)
- Bureaucracy (BU)
- Cynicism (CY)
- Long Geographical Distances (LG)
- Weak Internal Supply Chains (WS)
- Decentralised Governance System (DG)
- Religious Fanaticism (RF)
- Collectivist Approach to Living (CL)
- High Levels of Self-Indulgence (SI)
- Low Levels of Personal Hygiene (LH)
- Lack of Access to Water (LW)
- Poorly-Equipped Hospitals (PH)

We derive this model for Corona Virus Response:

$$CVR = F(HI*HL*RS*IT*ER*GP*LR*LC*PL/PV*PI*BU*CY*LG*WS*DG*RF*CL*SI*LH*LW*PH)$$

In an econometric model, we can apply this in an equation with beta coefficients and X variables as:

$$Y = b_0 + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7 + b_8X_8 + b_9X_9 - b_{11}X_{11} - b_{12}X_{12} - b_{13}X_{13} - b_{14}X_{14} - b_{15}X_{15} - b_{16}X_{16} - b_{17}X_{17} - b_{18}X_{18} - b_{19}X_{19} - b_{20}X_{20} - b_{21}X_{21} - b_{22}X_{22} - b_{23}X_{23}$$

## VI. DISCUSSION

### a) Policy Dilemmas and Philosophical Reflections

*"Imagination is more important than knowledge. For knowledge is limited, whereas imagination embraces the entire world, stimulating progress, giving birth to evolution."*

Albert Einstein (Wikiversity.org, n.d.)

We acknowledge the veracity of the above quotation by Einstein that imagination or serendipity is more important than knowledge. When Einstein made that statement, he was challenging us to develop fertile minds to be able to challenge our faculties in order to break new ground. Knowledge gives us insight about true and factual knowledge, which in turn enlightens our path towards the journey to the destination of innovation, creativity, discovery and breakthroughs. Sometimes, the rigour of the scientific method or empirical research methods of verification keep us entrapped and fettered to the chains of old and moribund ideas.

Therefore, it is advisable sometimes to forsake scientific objectivity in science, and to look up to fiction, day-dreaming and myth or superstition to be able to step outside the limits or circumference of known knowledge, and venture into the murky waters of

unchartered oceans, to be able to break new grounds. This is what we term academic risk-taking. First, it is imperative and important to acquire as much knowledge as possible, to be able to gain insight for making educated guesses.

Academic risk-taking requires us to sometimes put forward pseudo-truths inadvertently, so that other researchers are challenged to prove or disprove them. In this way, we come across proofs, dis-proofs, counter-proofs, and counter-dis-proofs. This back and forth tango dance eventually ends up in an endpoint of convergence of knowledge, and its extension, despite earlier divergences.

In this period of COVID-19, researchers, academicians and scientists all over the world are challenged to don on their gear in finding lasting solutions to COVID-19-related challenges and disruptions, especially in finding a vaccine for the pandemic. Table 6 below captures some of the vaccine development projects around the world. These involve billions of dollars provided by governments and the private sector sponsors, such as the Gates Foundation.



Table 6: COVID-19 Vaccine Development Projects

Company	Country	Comment
1. Fosun Pharma	China	
2. BioNTech	Germany	
3. Pfizer	USA	
4. Sinopharm	China	
5. Johnson & Johnson	USA	
6. GlaxoSmithCline	USA	
7. University of Oxford	UK	
8. University of Cambridge	UK	
9. Imperial College	UK	
10. Gates Foundation	USA	
11. CEPI	Norway, India, Gates Foundation	
12. Moderna	USA	
13. Merck	Switzerland	
14. AstraZeneca	Switzerland	
15. Military	China	
16. CloverBioPharm	China	
17. Sinovac	China	
18. CanSinoBiologia	Canada, China	
19. Governments	Japan, Canada, Brazil, India, Australia, Russia, Singapore, South Korea, South Africa	

(Source: [cfr.org/background/what-is-the-world-doing-to-create-covid-19-vaccine/p16189](https://www.cfr.org/background/what-is-the-world-doing-to-create-covid-19-vaccine/p16189); [history.today](https://www.historytoday.com))

The period of COVID-19 represents a period of decision making under uncertainty and lack of adequate data to go by. It presents policy dilemmas to policy makers. In this scenario, we need to resort to philosophical concepts to guide us on the way forward. For example, Aristotle came up with his theory of Eudamonism or philosophy that, man by nature, seeks the highest form of happiness and pleasure, as the essence of living. Thus, policy makers in these gloomy times should make it their duty to seek the highest form of happiness for those they govern, by reducing the pain of losses from COVID-19 related deaths, by supporting families with some form of support and interventions, such as monetary payments or doles or social cash transfers to vulnerable people in society.

Also, they should seek the greatest good for the greatest number or follow the concept of utilitarianism, which was championed by John Stuart-Mills and Jeremy Bentham (Hunt & Lautzenheiser, 2009). In all scenarios, some collateral damage cannot be avoided. However, the damage should be minimized as much as possible by providing frontline workers with adequate personal protective equipment (PPE), and providing adequate incentives for these workers who risk their lives to save others. We can here make reference to the Trolley problem analogy, which was developed at MIT in the US, to exemplify the dilemma of choosing between two evils, with the injunction always to choose the lesser of two evils.

In making decisions, we believe that policy makers should subject their actions to transparency, and also they should examine their actions through critical thinking by weighing the pros and cons in a

holistic manner, and yielding to technical advice based on scientifically-proven facts. Their motives should be pure, altruistic, and in line with the law, norms and professed policy as enshrined in the manifesto of the ruling government. We have witnessed many instances of double standards by high profile public figures and leaders, whose actions during COVID-19, ran counter to what they professed to stand for.

We believe much can be achieved by these leaders if they subject their actions to philosophical examination, by using philosophical and scientific tenets and approaches such as epistemological, deontological, ontological, and teleological principles. For example, an epistemological approach examines the logic and rationality of an action. A deontological approach looks at means and actions taken in solving a problem, whether they are legal, ethical or humane (Stanford.edu; Wikipedia, n.d.).

An ontological view examines issues from world viewpoint of what is socially feasible and acceptable or the philosophy of being and existence, which is metaphysical and spiritual (Wikipedia), while a teleological view examines results and consequences of actions, in order to judge them as being moral or ethical (Britannica). Here, our attention is not focused much on the means used in achieving those results, but on the morality of the consequences of our actions (Britannica.com; Wikipedia, n.d.).

#### b) Great Depression

The Great Depression of October 1929 was unprecedented in world history, as it started in the USA with the bubble burst of the booming stock market on Wall Street, which earlier on had evoked great optimism

and euphoria, with people having orgies of parties to celebrate their huge financial gains on the stock market. The joy or euphoria of celebrations suddenly evaporated, and it turned into a nightmare scenario of weeping and gnashing of teeth, as shares plummeted to their lowest levels ever. Many businesses collapsed as they went bankrupt (Hunt & Lautzenheiser, 2009; Wikipedia, n.d.).

Millions of people went out of jobs, and there were endless queues of people lining up at soup centres for free helpings, while farmers who could not find market for their milk emptied kegs of them into the drainages. Life was reduced to its lowest ebb. Shall we say that the outbreak of COVID-19 has also brought about an unprecedented scenario of lockdowns on businesses, schools and colleges, air travel, restaurants, bars, and hotels, and it has affected greatly the hospitality and tourism sectors, more than other sectors. What COVID-19 has done to the world cannot be imagined as the world post-COVID will never be the same again (history.com). The huge financial and social losses are incalculable and unquantifiable.

We need to revisit some of the New Deal economic recovery measures which former presidents Harry Truman and Franklin Delano Roosevelt took, such as the construction of the Hoover Dam, and expansion of the Federal railway systems across the length and breadth of America (Britannica, n.d.; Wikipedia, n.d.; Hunt et al. 2009). COVID-19 has flattened the economic landscape of the world so much so that we need new economic models other than capitalism to overcome the huge losses incurred (cf. Piketty, 2014). This new model should be a Pan-continental arrangement of countries working together to rebuild the world economy, irrespective of political ideologies (Kissinger, 2015; Huttington, 2007). We need a proto-welfarism system modelled on the Canadian and Scandinavian systems, in order to survive post-COVID (Piketty, 2014.; Fukuyama, 1993; Grant, 2008)

#### STEEPLE- Origin of model

The acronym STEEPLE was first put forward by Johnson, Scholes, and Wittington in their famous book, *Exploring Corporate Strategy*. The model is used by firms and organisations to scan the macro environment when engaging in their strategic plans, so that they have sustainable, viable, and environmental-fit plans (Cole, 2004; Rue & Byars, 2009). Amitai Etzioni of Harvard, called it *environmental scanning*, while Rosabeth Moss Kanter called it *tuning in into* the environment (Britannica.com)

##### i. Social

Socially, COVID-19 has been traumatic and disruptive in separating families, especially during critical moments when families should be closer together such as during weddings, funerals, ceremonies, and hospitalization, among others.

Observing social distancing has created cold relationships, giving impression of not caring for one another, and this may have affected conjugal relations as well as familial relations, such as one between mother and daughter. The agony of not having a chance to hug or kiss a loved one in a moment of joy and celebration has been psychologically agonizing and traumatizing.

After surviving COVID-19, every human being needs to go for psycho-social counselling, on how to adjust and embrace the new normal. Children will need to be reassured that they are loved and cared for. Socially, wearing masks has come to stay, and masks will be part of the dressing paraphernalia for a long time to come. Many years ago, we had a premonition that air quality would become so bad that oxygen masks would be on sale, to help people breathe. We guess that those in the mask-making business will be having booming business, and as such, investors can invest their money safely in businesses that engage in producing masks, oxygen tanks, Personnel Protective Equipment (PPEs) and medical supplies.

Entrepreneurs can flock to the shops of seamstresses and tailors to engage them before they get snapped up by competitors. The youth can learn skills in demand as seamstresses and tailors, and they will always have their jobs on demand. During the COVID-19 outbreak, all manner of clothing materials were used for making masks, with plain ones much preferred while multi-coloured ones looked like women's bra or G-strings, which made some people look weird and scary. Many familiar faces suddenly became unrecognizable. The wearing of masks politics took centre stage on our TV screens, with some security personnel enforcers of wearing face masks in some shops in America, being put in harm's way by being shot and killed by resisters of mask-wearing.

Many holiday makers around the world were marooned, and distanced from their loved ones, warning us that we should ponder carefully now before making any future holiday plans. Holiday makers who arrived in other countries were looked down upon with scorn as they were deemed as suspects of COVID-19, and veritable carriers of the virus. Some were taken into forced quarantine, in some extreme cases. Even some returning citizens were caught in the flak, as they were not so welcome in their own countries, and were given the rigmarole and run around, by asking them to produce certification, showing that they had tested COVID-19 negative in their country of origin.

As a result, many of our friends or African Diasporians were marooned, and they could not visit or return to their native countries to see their loved ones. COVID-19 caused many weddings, social gatherings and birthday celebrations to be either put on hold, or such celebrations were made low key, which was not satisfactory by normal standards. Some unfortunate

celebrants got caught up in police brutalities, such as being flogged mercilessly, being detained and brutally assaulted, even to the point of dying, and being frog-marched or given a heavy fine.

Washing of hands became the new norm, with sales of detergents, sanitizers and washing basins booming in sales. Handshakes were dispensed with, as it created some air of suspicion among close associates. The cultural aspect of greeting by hand was dispensed with and replaced by bows, Namasti, bowing from afar and clasping hands, greeting by foot-to foot greeting, and elbow-to-elbow salutations. COVID-19 impinged on people's long-established cultural norms. Those who are social animals could not have the chance to attend gatherings in order to show off their social skills. This could have led to pent-up feelings, with psychological impact of denying people of self-expression.

With lockdowns inside homes, people resorted to binge eating and drinking orgies, giving rise to concerns of obesity, coronary problems, and people feeling claustrophobic, especially children who need free range running and careering around. Home-confinement for children is harmful for the healthy development of children's psycho-motor skills, aesthetic faculty development, which is facilitated and enhanced by outdoor activities, and general mental and cognitive development. Parents had challenges caging their children at home, as the age gap became difficult to bridge.

Children became glued to Netflix and other TV channels, playing video games, watching cartoons and becoming obese through being couch potatoes. Confinement at home caused binge eating, stress, agony and uncertainty, as many had lost their jobs or were told to work from home, at some reduced income, through telecommuting or teleworking. Men suddenly grew beards, and the ladies went with their hair unattended to in tussled manner. People with creative genius took to exploring and enhancing their talent, through experimentation with musical compositions, artwork, dance moves, painting, gardening and working with pets and animals.

This helped technophiles display their ICT skills, and the technophobes to play catch-up by learning new IT skills in order to cope with work. Social media platforms such as Facebook, WhatsApp, Twitter, Instagram, Pinterest and LinkedIn experienced heavy traffic, resulting in vendors making a kill in profits. For example, profits for businesses such as Apple, Amazon, Facebook, Ali Baba, Netflix and Microsoft, Huawei, and WhatsApp soared. House orders and home deliveries became the new norm under lockdown. Many confined individuals discovered new hobbies. Ali Baba, e-Bay and Lastminute.com had their businesses soaring, while others in tourism, hospitality and personal care services

such as hairdressing, manicure and pedicure, had no chance to operate under lockdown.

Construction, personal services, and manufacturing industries were the hardest hit, as they could not operate without their workers, who were under lockdown. Under lockdown, it would be presumed that there would be many births, with plenty of COVID-19 babies being born. However, the issue of stress, trauma, and uncertainty caused fear, panic and danger of contracting the virus. It made it difficult for couples to engage in procreation as high adrenalin and cortisol levels were not germane for sexual arousal. So perhaps, there could be no baby boom. It could be a fifty-fifty matter, of either baby boom or baby slash burst.

*Technological-* We can state that electronic communication, using applications such as Whats App, WizIQ, ZOOM, Microsoft Team, Facebook, Astria Learning, Twitter, MOODLE, and LinkedIn helped people connect, so as to carry on normal business without interruption. However, in a developing country such as Zambia, where internet speed is based on 3G and 4G technologies, and also electricity supply is erratic due to frequent power outages from the power supplier, ZESCO, it was not easy to get business going, as people spent lots of money to acquire gadgets, to have alternate power supply and also to subscribe to fast internet providers.

Many government workers were left behind, as many of them were not as computer-literate as their counterparts in the private sector. This shows that, in the post-COVID-19 era, the SMART Zambia Agenda that was declared by the Zambian government in 2016 has to be accelerated and given teeth to bite, by empowering many citizens with ICT skills and ICT gadgets. COVID-19 is indeed an eye-opener to the fact that we have to jack up our act so that we are not left behind by other countries.

*Economic-* The outbreak of COVID-19 towards the end of 2019 in Wuhan, China and its subsequent spread to all parts of the world has spelt doom for the global economy, as recession and depression are forecast. The hardest hit sectors are air travel, tourism and the hospitality industries. In Africa, the highest tourist destinations are Morocco, South Africa, Kenya, Mauritius, Cape Verde, Tunisia, Tanzania, Gambia, and Botswana. These countries are therefore hardest hit from heavy losses of income.

The WTO estimates that about 21 million people are directly and indirectly employed by the tourism sector, and that the sector generates 9% of Africa's GDP (BBC Focus on Africa, 25 May 2020). Also those engaged in providing small-scale personal services such as hair salons, chauffeur services, among others are those heavily affected. These sectors will need government rescue plans, and access to soft bank loans (Zambia, 2020).

Massive unemployment is looming large, quantitative easing, crowding out effect, bulging national debt, over-taxation, inter-generational debt, overheating of the economy, and inflation are some of the economic fallout from COVID-19 pandemic.

In the aftermath of the Cold War, Capitalists won the war against the Communists, but in the post-COVID-19 era, the short-term gain of the capitalists has translated into a win for the Socialists and Welfare states, such as Sweden, China, UK, and the countries with liberal centrist systems of nationalistic discipline, patriotism, and order such as South Korea, Sweden, Germany, Russia, Japan, Canada, Iceland and all the Scandinavian countries.

Thomas Robert Malthus' Spectre chases us up to this day. Malthus had warned in his time that if humans did not check their promiscuity and fecundity or tendency to be prolific procreators, then the means of sustenance or food supply, which would be growing at a pitiable arithmetic rate, would not be able to keep up pace with the rapid geometric rate of population explosion, which would result in nature's intervention through famine, wars, natural calamities, and epidemics that would decimate the population (Hunt et al., 2009).

It was a Doomsday scenario which was painted by Malthus, known as the Malthusian spectre. During the COVID-19 pandemic outbreak, Strategic Communication by Governor Cuomo of New York State, in the USA, has been exceptional in a true leadership style. The period of the pandemic saw geopolitical issues such as Oil glut, due to the Russia-Saudi stand-off, as Saudi is seen as a surrogate state of the USA by Russia, and there is the perennial USA-China trade war, the Turkey-Syria tango, the UAE-Yemen saga, the WHO denigration and chastisement by the USA for its leadership being pro-China, prompting Ireland to quadruple its contribution to WHO, and China also pledging to give 2 billion dollars to WHO over a period. The polemic war of words was and is unending.

*Ethical-* During the COVID-19 era, we found Individual freedom clashing with centrist and political directives from the central government (Huttington, 2007). There is struggle for space among individuals, constituent states, and the central federal government, particularly exemplified in the USA unfolding drama, more so than in any other country. Individuals are protesting against the idea of using technological applications for contact tracing, and for tracking, in the fight against the spread of corona virus. On the one hand, individuals are protective of their privacy and private space, and on the other hand, the state has duty to safeguard the health and security of its citizens. So there is a clash and conflict of interests between the state and individuals, which requires new governance and administrative models to be developed, or existing liberal democratic systems to be revisited (Deutsch, 1980).

However, much depends on culture and religion of a country. In Turkey, for instance, they are largely Muslim by religion, and they are relatively liberal and scientifically exposed, so they were able to implement early contact tracing interventions to reduce the impact of the pandemic. The situation was bad in Iran, where the impact of western-imposed sanctions was brutally felt, as the biting economic hardship was telling on the COVID death toll. It cost thousands of many lives, as they could not import necessary basic supplies such as PPEs, medicines and equipment.

South Korea is largely a Christian nation, with a collectivist culture, which enabled them to submit themselves for contact tracing without much resistance. The same applied to China, where they have a commandist ideology of state rule, and collectivist culture or socialism/communism. It is clear that western countries, in contrast, have miserably failed the litmus test of statehood survival, as they place individual freedom above national safety, in emergencies like COVID-19. Western countries, notably the USA, which claims to be the standard bearer of democracy, fared badly in containing the spread of the corona virus, as national guidelines were not adhered to, and there was a lot of confusion, wrangling, and indecision between the Federal and state governments.

*Political-* The political lesson that the COVID-19 pandemic has taught the world is that no country is an island, as we live in an interdependent world of complementarity and supplementarity. This calls for a rethink of a multilateral world order in what Kissinger and others have been calling for over a long time now, as a New World Order that is apolitical, collectivist, and devoid of geopolitics (Kissenger, 2015; CFR, 2020; Chomsky, 2017). The model of independent, individualistic and selfish societies should come to an end for us to embrace the idea of community, good neighbourliness, and having a universal turn of mind rather than what some leaders have projected as ultra-nationalistic tendencies, irredentism, and insularity. We need to revisit the 1649 Westphalian concept of the nation-state. It is sad that political leadership and statesmanship have been debased by what can be termed Twitter-Leadership, instead of the more formal press conferences held to announce policy or to engage the various publics.

*Legal-* It is sad that in the 21<sup>st</sup> century, parts of the Congo, Sudan, and Nigeria suffer terror and indignities from terrorists, rebels, and religious zealots. Human rights are in jeopardy in such environments, and they cannot be sustained or enforced, as women are raped and children are abducted to become child soldiers. Some greedy adventurers and capitalists are ripping apart virgin forests and desecrating the land in search of gold, diamonds, Coltan, tantalite, and other minerals, without paying attention to the 17 UN Sustainable



Development Goals (SDGs). In these devastated areas, it is hard to extend assistance to COVID-19 victims. Some citizens are pleading their Constitutional rights of freedom of association and movement, under lockdown strictures, provoking conflict of interest between individual freedoms on the one hand, and interest and security of the state on the other hand.

*Environmental-* During the five or so months of lockdown, there was less mobility of humans, so much so that it was noticed by environmental watchers that the amount of CFC and carbon emissions reduced drastically, and some depleted parts of the ozone layer recovered (the-scientist.com). Many animals in zoos and game parks were free from the glare of millions of visitors, and they started breeding in numbers (the-scientist.com). This tells us that we need to follow the lockdown model of declaring a period of pause on some activities, for a reasonable period for the natural ecosystem to recover, so that we can sustain and maintain healthy balance between production and consumption. This will be in line with the SDGs of the UN. The lockdown reduced air travel considerably, which improved air quality and also many manufacturing activities in the worst polluting countries stopped, especially in China, India, USA, South Korea, Japan, and others in South East Asia.

### c) COVID-19 Challenges

As the model of PESTEL or STEEPLE shows above, the impact and effects of COVID-19 are wide-ranging. The most affected people are those in the insurance business because when there is economic recession and depression, people are not making enough income to be able to afford paying insurance premiums or obtaining insurance cover, unless it is mandatory in the type of business (Zambia, 2020). Ordinary insurance like life assurance suffers from low patronage in COVID times.

This means that in the post-COVID-19 era, insurance firms have to diversify their products to come up with new and innovative products in order to increase sales. The incidence of the pandemic and its adverse effects are an Act of God or Force majeure, which cannot be insured against. This therefore calls for government intervention and support for individuals and SMEs or small scale enterprises, which will need government bailout for them to sustain the tempo of their businesses. The trickiest part for business owners is that, despite low custom or turnover, they have to pay rentals, wage bills, electricity and water bills, service loans, and maintain structures, fittings and machinery. Many may declare bankruptcies in order to be let off the hook.

Those who took mortgages to build or own houses will be hard put to it paying back their mortgages, and in some cases, some of their houses will be repossessed by the mortgage firms for breach of

contract. Many tenants in rented apartments will be served eviction notices to quit for failure to honour contractual obligations. Some of these affected tenants may seek personal bank loans, which also will not be forthcoming because banks are sceptical to give personal loans, especially during this period of uncertainty, high deaths from the pandemic, and also because there are no jobs to serve as collateral for loans. Property values may fall post-COVID era so property hunters can have a buyers' market.

This also means that the most lucrative aspect of banking, lending money, will be adversely affected, and banks will make low turnover. This is the time for borrowers to renegotiate loans by asking for moratorium or long and extended periods to service loans. As there are lockdowns and less mobility, there will be greater demand for ICT gadgets like laptops, smartphones, and desktops and tablets, e-books and online trading, which requires internet connectivity from the Internet Service Providers (ISPs) such as MTN, Airtel, Zamtel, i-Connect, Huawei, and Hai, and Liquid Telecommunications. Investors can look to invest in these industries.

This is the time for NGOs and philanthropic organisations to donate ICT gadgets to schools, colleges and universities, as part of their Corporate Social Responsibility (CSR). Many youth and employees need to be given liberal credit terms to be able to own computers and other ICT accessories, which will promote their work online. Retailers of these items have to roll out sales promotion schemes to accelerate sales. COVID-19 poses many challenges but also provides many opportunities for businesses to exploit. Airlines, hotels, transporters, manufacturers, and generally, those in the tourism, travel, and hospitality industries are the hardest hit. Despite that, there are still opportunities to exploit by being innovative and using internet connectivity to create and exploit many opportunities such as promoting travel packages which are mouth-watering, and which are on liberal terms, to entice and retain customers.

Government and private sector joint partnership (Public-Private Partnerships-PPPs) initiatives have to be developed and launched to encourage consumption by borrowing a leaf from John Maynard Keynes' under-consumption and multiplier models (Begg et al., 2013). Rich people and moneybags can be enticed to save more, by offering them attractive customer value propositions, and high yields on government bonds and treasury bills. The majority poor however, have to be wooed and cajoled to consume more, so that the economy can be kick-started. The government sector has to be expanded at some considerable pace, but not too fast as to create crowding out effect for the private sector players.

Economists contend that there are too many leakages in the government sector, so capital should be put in the hands of the private sector to husband capital



resources better. However, in the initial stages of recovery, it is imperative for the government to lead the way for others to follow. Government, through the Federal Reserve/Central Bank, can use quantitative easing by expanding money supply by printing more money to issue onto the market. Government can gain from this practice through Seigniorage or the difference between the cost of printing money and the face value of the money printed, and put into circulation.

We will be wrong to assume that the negative impact of COVID-19 is heaviest on the developing countries than on the developed countries.

The developed countries could be worst hit in the short run but they have greater resilience to bounce back quicker. The effect of this pandemic will have very long term impact on the developing countries, because of weaker institutions and slow capacity to recover, caused by heavy indebtedness, poor infrastructure, low levels of productivity, weak oversight systems, high levels of illiteracy, and poor earnings from raw commodity exports, such as timber, crude oil, copper, bauxite, rubber, cocoa, coffee, tobacco and cotton.

All in all, the post-COVOD-19 era calls for a new type of entrepreneur who is smart, and who does business mainly online. Supply chain bullwhip effect is where bottlenecks in supply cause supply imbalances at one end of the supply chain, creating shortages on one end, and over-supply at the other end. There is need to decentralize supply hubs to reduce this effect.

This can be overcome by creating regional hubs, and also decentralizing most activities by using strategies such as nearest neighbour method for deliveries, in order to reduce delivery costs, ordering supplies in bulk through centralized ordering system, reducing rejects and returns by incorporating customers in the process of manufacturing, outsourcing supplies cheaply from support industries, among many other strategies (study.com, n.d.; Salvatore, 2014).

## VII. EDUCATION SECTOR

### a) Lecturers

During the Lockdown, Lecturers had many heaven-sent opportunities to catch up on research and producing quality publishable articles. Also, they had ample room to reflect on their delivery modes, and how to improve on student engagement through multi-media Blended Learning activities. The issue of how to examine students in high schools, colleges and universities has become a raging talking point. Many Higher Educational Authorities (HEAs) have inflexible rules and guidelines which will make examining students online very problematic, because some students lack exposure to online Computer-Based Examinations (CBEs) and many have suddenly developed phobias or become technophobic. Students should be encouraged to hone their typing skills and to take the Computer

Driving Licence online test of proficiency. The progression rules from the HEAs for university students who sit exams have to be made flexible to be in line with the new normal.

A few students are Geeks or technophiles, and they have excellent typing speeds to cope with online examinations. Online examination questions should be Case Studies and problem-solving centred, which will obviate the need for students to google answers or to cheat. Some universities around the world are threatening to either reduce salaries of lecturers or lay off some of them, as COVID-19 has eroded revenue base and caused many potential students to withdraw or relocate. Many lecturers with Visiting Professorship accreditation to other universities have had to suspend their Sabbatical leave, and stay at home. However, a lot of academics have taken the bull by the horns to dive deep into writing profusely, thereby increasing the volume of publications world-wide.

### b) Students

During the COVID-19 pandemic disruption, students in universities and colleges were sent home and told to access e-learning platforms for delivery of lectures, submission of assignments by uploading them on our portal, and taking exams online from any location. Students complained bitterly about not being able to connect either due to power outages or due to not being able to afford computers, as they have to pay at internet cafes to access services. Before the online exams, many students developed cold feet, and kicked against writing exams online, because they said they were slow in typing. Some threatened to boycott the exams, and they petitioned the authorities to no avail. About 96 per cent of the 3000-student number wrote the exam, and about the same percentage passed the exams, which was commendable for ZCAS University in Lusaka.

Students forget that the new normal is to work online, as ICT skills are required these days of all employees, so they have a golden opportunity to upgrade their ICT skills during this new normal period. From that experience, going forward, our University has decided to cease with face-to face engagement, as the threat of the pandemic is still there to contend with. Our university has also decided to have blended learning, by exploring many modes of delivery online, as well as random engagements of face-to-face, when the authorities declare it safe to do so.

## VIII. NATIONAL ECONOMIC CHALLENGES AND OPPORTUNITIES

The fight against the COVID-19 pandemic has squandered massive resources which should have been deployed for development purposes. Luckily, many donations were received from friendly countries in Europe, America and Asia. Economic growth has been

slowed down as during the pandemic, the economy was down to one third of its installed capacity, and during the post-pandemic recovery period, up to two thirds capacity. We hope that full capacity or back to normal growth rate can take a year or two to attain.

We expect the government to embark on massive economic recovery plans, by undertaking infrastructural development plans such as housing and road construction. However, the high levels of both domestic and external debts constrain growth. A new strategy will be to concentrate on high-yielding service industries such as ICT, whereby young people can be trained to develop software for sale to giant technology firms outside Africa. This means that government should set up technopreneur enterprise theme parks and incubation hubs, to increase output of technological solutions for export.

This can be a green field investment. Government has to use ICT to reach out to rural populations so that they can sell their surplus produce on the market. Reaching out to the rural population using ICT intervention will help reduce poverty, and to close the national technological divide between urban areas and rural areas. Young entrepreneurs and technopreneurs who set up as born global companies have to be supported by government by giving them start-up loans to accelerate development in the rural areas.

The post-COVID era is the time for government to increase funding for Research and Development (R & D) for research institutions and universities to come up with solutions to national problems, such as combating the ill-effects of global warming, and arresting the problem of youth unemployment. The post-COVID era will require government to increase its networking activities, by increasing sub-regional, regional, continental and global networks through collaborations, in order to increase national capacity in combating many threats, such as outbreak of infectious diseases, control of pests such as army worms and locusts, among others. Such increased collaborations with the AU, EU, and UN can and will enhance and build local capacity for combating the ravages of global warming.

## IX. FORECASTS

### a) *Kondratief Cycle*

Kondratief was a Russian economist who put forward his economic theory of long cycles lasting about 50 years. In economics, normal cycles are short periods of about 7 years. We last had a serious global pandemic in 1919 (National geographic.com, n.d.) and we have had one in 2020. In 2121, which is about hundred years from now, we may have a major recurrence of an epidemic, since we see a pattern of repeating numbers, 1919, 2020, and then 2121.

### b) *American Civil War II 2031*

It is believed that wars make countries tick, so a particular party in America stokes war when it is in power. America has been engaged in wars, on average, every 85 years since 1776. In 1776, there was the War of Independence between the Federalist states and Britain which ended in defeat for Britain, as America had support from many European sympathisers, notably France.

In 1861, America was engaged in the Civil War between the Northern States rooting for abolition of slavery, and the Southerners who were against it. America again was involved in the Second World War in 1942, after Japan bombed Pearl Harbour in Hawaii. We can see from these accounts that almost every 85 years or so, America is at war either internally or externally. We cannot say which one the one to come soon in 2031 will be, but it is most likely going to be either an internal war of secession, or an external war with an emerging great world power. We hope we are not sounding like Nostradamus, that 16<sup>th</sup> Century seer in Italy, who gave many predictions in his Quatrain treatise, concerning our times up to the year 3297, when he predicts the end of the world will come (holybooks.com)

### c) *Great Depression II 2030*

The Great Depression occurred at the beginning of 1929 and ended around 1933 (history.com; Wikipedia.com). It started ten years after the great 1919 Influenza pandemic. If history repeats itself, then we are in for a second dose of the Great Depression 2 in 2030, because it will coincide with the time of the American war around 2031. After COVID-19, the world will never be the same again. Short term palliative measures will be put in place but these cannot solve a problem of a great magnitude. It is most likely that the solutions put in place post-COVID, will collapse ten years down the line, unless world leaders show great foresight, commitment, sacrifice and political goodwill to succeed, as a global body collective. The European Union have shown the way with their great 750 trillion euros recovery plan.

It is most likely that most short term palliative measures taken by countries in isolation will buckle after a few years, and cave in again ten years down the line. The capitalist system as we know it now, will also collapse and a new world system will be needed to replace it, which will be more humanistic and driven by no country in particular (cf. Piketty, 2014; Huttington; Fukuyama, Chomsky, Toffler).

This will see the end of capitalism as predicted by Fukuyama and others, and the end of the dollar as the currency of international trade. Western Civilization as we know it now will be replaced by a pan-global civilization, led by countries in the Far East, where the global axis of power will shift to. This is because increase in internet connectivity will make Africa become a centre of a new trading bloc, astride the west and

east, and many students from the west, north and east will troop to Africa to attend universities and pursue new adventures

#### d) COVID-19 recurrence 2121

We last had a serious global pandemic in 1919 and we have had one in 2020. In 2121, which is about hundred years from now, we may have a major recurrence of an epidemic, since we see a pattern of repeating numbers, 1919, 2020, and then 2121. Are these cosmic magic numbers? Well, science meets superstition and it is difficult to determine which holds sway.

## X. CONCLUSION

### Recommendations

- Disaster preparedness and management: Countries and multilateral institutions should increase funding for capacity-building in rising to the challenges of natural disasters such as outbreak of pandemics, tsunamis, wild fires, floods, drought, earthquakes, and storms, among others
- Reform of UN: The reform of the archaic, moribund, and bureaucratic structures of the UN needs to be attended to as a matter of urgency in order for it to be in line with 21<sup>st</sup> century needs and demands
- Strengthening of WHO pandemic response: The WHO and other Disaster Response Agencies such as MSF, UNICEF, CARITAS, and WFP should restructure their pandemic alert systems as currently the structures in place are not robust and flexible enough as seen in the dilly-dallying before declaring COVID-19 a pandemic. These institutions need massive donor funding for them to operate efficiently and effectively
- Global Pandemic Alert Group: An independent global watchdog of scientists should be set up with links to all countries of the world to advise governments and multilateral institutions on pandemics. This could be made up of scientists and medical personnel from different countries
- Global Eminent Persons Group: To augment global political leadership, we should have in place in each continent and regions a group of seasoned and retired leaders who can be called upon for advice in case of emergencies like COVID-19

### Global Emergencies Response Relief Groups:

- One per cent of all food stocks should be reserved for emergencies in all countries by keeping food reserves in food banks
- Seed Banks should be set up in each country and region of the world

- Every country should set aside 1 per cent of its GDP for disaster preparedness and emergency relief operations
- Enforcement of ban on all game meat in all countries
- Relook at political leadership in Africa and parts of the world by ensuring that elections are free and fair to elect credible leaders
- Time for Reform of Global Institutions such as the UN and its agencies
- Time to resolve global pandemic of Youth Unemployment by deploying many youth throughout the world to work on disaster mitigation and disaster preparedness programmes in all countries. This is an avenue for creating massive jobs
- Great Depression 2 to occur in 2030, ten years after COVID-19, so there should be global disaster management inspectorate teams in each region of the world to inspect country-preparedness of all countries who sign on the programme
- Improvement of hospital infrastructure worldwide by providing adequate PPEs, equipment and training medical and paramedical staff in emergency procedures and protocols.

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# Business Competitiveness: Building and Applying the 3Cs and the Strategic Change Matrix across COVID-19

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**Keywords:** *business competitiveness, strategic change matrix; 3cs model; sustainable performance; collective intelligence, competitive intelligence; competence; capabilities; value deliverance system; knowledge creation.*

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BUSINESSCOMPETITIVENESSBUILDINGANDAPPLYINGTHE3CSANDTHESTRATEGICCHANGEMATRIXACROSSCOVID19

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# Business Competitiveness: Building and Applying the 3Cs and the Strategic Change Matrix across COVID-19

John R. Hamilton <sup>α</sup>, Rohit Ramanujam <sup>σ</sup>, Singwhat Tee <sup>ρ</sup> & Michael Underdown <sup>ω</sup>

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## I. INTRODUCTION

Across the 2019-2020 COVID-19 global pandemic times, it is increasingly important for firms to continually map their pathways towards competitiveness (Eaves et al. 2020; Ollagnier et al. 2020; Sheppard et al. 2020). This India-wide study captures Survey Monkey online respondent data from 313 management consultant firm members of the 'Institute of Management Consultants of India.' It investigates how management consultancy firms (MCFs) across India help each of their contracting client firm (CFs) to build, and enhance, their unique competitiveness.

### a) Client Firms

The long-term impacts of the COVID-19 global pandemic continue creating disruptions. This brings both a threat, and an opportunity to the firm. In these uncertain times, astute firms can adopt an offensive position - building on their strengths, and seeking at pace, to close their competitiveness gap. This likely requires quality and performance mixes of innovation, technology and people (Eaves et al. 2020).

The risk of catching the COVID-19 virus has also driven consumers towards online purchases and

home delivery services. Hence, as firms move towards a different and post COVID-19 pandemic global business environment, new digital opportunities can offer further firm capabilities and deliverables and possibly greater firm scale-up possibilities (Ollagnier et al. 2020).

Sheppard et al. (2020) suggest firms should repair their existing business, rethinking the firm's future focus and reconfiguring the firm's overall strategic model. Thus, the astute firm can restart post COVID-19, by offering a transformed suite of digitally improved business capabilities that may in-turn change or enhance its competitiveness possibilities.

Accenture in Europe see business competitiveness resulting from a multi-dimensional approach. They suggest bold leadership can develop innovative approaches towards new customer value and towards creating a strategy for both long-term business competitiveness and business growth. This likely requires investment to shore up core deliverables, to pursue renewed growth through both incremental and game-changing innovation, and to improve the firm's competitive positioning within its business ecosystem (Ollagnier et al. 2020).

Such consumer-related changes are forcing astute firms to incorporate latest rapid-response digital servicing systems into their capabilities suites. Such firms also seek to develop their competencies, to grow their digital and data-driven capabilities and to produce smart deliverable systems that ultimately help change their business competitiveness (Eaves et al. 2020). Digitally aligned inclusions can further enable the firm's capabilities and advance pathways towards competitive cost advantage and new competitive intelligences. These can likely add to a firm's sustainable performance positioning (Ollagnier et al. 2020). Hence to outmaneuver competitors, and/or to guard against an unknown future, a CF today can contract the assistance of a MCF.

### b) Management Consulting Firms

MCFs are professional services entities with a strong team of business researchers and problem solvers. These entities typically professionally assist firms and/or governments to: investigate problems, identify key solutions, and advance ongoing firm performance and business outcomes (Brandon-Jones

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et al. 2016). CFs see MCFs as assisting in their change management processes (Burke, 2017), and/or as building MCF suggestions into: their future business strategies, modifying their IT systems, and changing their operational designs and structures, but retaining an applied behavioral science and psychology approach (Burke, 2017).

This MCF management consulting process is normally a contracted arrangement between a MCF and a CF. It is generally strategically framed to ultimately deliver changes and benefits to the contracting CF. For example, some of MCF's knowledge creation competencies may be useful CF additions that then help it grow revenue and profitability (Li et al. 2002; Palvia et al. 2010), whilst other MCF competencies components (like new innovations) can sometimes indirectly or directly assist in delivering further CF financial capabilities (Becerra et al. 2008; Cheung et al. 2011).

Management consulting can sometimes present in complex formats. Rio Tinto's 'mine-of-the future' receives multiple external knowledge-related firm inputs from firms including: Google (GPS), SAP, Microsoft (HoloLens3, democratizing IT), Apple (3D interactive gaming engines), plus: systems automation, robotics, mechanics, digital intelligence and R&D from multiple sources. These products coalesce as suites of new competencies to help build Rio Tinto's entrepreneurial intellectual capital, its new knowledge creation, its new innovations, and its existing and developing capacities. This approach is in-effect multiple MCFs consulting and assisting aspects of the CF (Rio Tinto) to enhance its technological capabilities and build its strategic drive for greater business competitiveness.

This multiple MCFs-to-CF relationship is now strategically mapped into delivering Rio Tinto's world first 'intelligent' mine - with all its capabilities/assets digitally driven, and returning smart networked decisions 'in a microsecond.' (Rio Tinto, 2020). Again, as per the MCF-to-CF relationships discussed above, the Rio Tinto model provides the same 3Cs phases of (1) competencies - which further enable (2) capabilities, and capabilities' deliverables - which further enhance (3) business competitiveness (Hamilton, 2020).

MCFs typically employ intellectually-astute individuals as their management consultants. In specific cases, MCFs can collectively enhance the CF's performance capabilities (Woolley et al. 2010). They can bring selected unique capabilities like: proficiency, ideation, information, intelligence, and reaction (Grewal et al. 2020; Harvey et al. 2019) into the CF. MCFs can help motivate a CF workforce towards change, and towards enhancing existing qualities and servicing capabilities (Johnson and Ashforth, 2008; Yee et al. 2008). They can also assist in building additional CF revenue streams by combining the MCF's and the CF's

latest business practices (Bergh and Gibbons, 2011; Hughes et al. 2011).

Research studies support that MCFs typically do add capabilities expertise across services, qualities, performance, and profit/loss reengineering (De Boeck et al. 2019; Loureiro et al. 2020; McGivern et al. 2018). Some research studies add that MCFs can bring behavioral (competitive) perspectives that then help with the CF's motivation, cognition, and emotion progression (Cho and Linderman, 2019; Johnsen et al. 2019; Levine et al. 2017; Pluut et al. 2018). Thus, MCFs can both enhance and/or add to an existing CF's business capabilities, and these can then contribute towards enhancing a CF's competitiveness.

### c) Study Motivation

Consultancy.com.au suggests globally, management consulting has compounded 4.1% pa from \$205 billion in 2011 to \$251 billion in 2016. Management consulting is a form of relational strategic management between the MCF and the contracting CF and targeting the building of business competitiveness (Dyer & Singh, 1998). Management consulting incorporates further strategic management views including: (1) the external view of the firm - with superior returns targeted (Duschek, 2004; Ormanidhi & Stringa, 2008; Porter, 1980), (2) the resource-based view - offering superior internal returns (Barney, 1991; Duschek, 2004; Rumelt, 1991), (3) the competence-based view - efficiently using resources (Freiling, 2004), and (4) the knowledge-based view - with knowledge as a productive resource (Grant, 2002). Hence, the MCF is well resourced to offer a CF various-pathways towards strategic change within the dynamism prevalent across the globally-competitive industrial domain (Teece et al. 1997).

The MCF-CF relationship resides within the strategic management paradigm. Clegg, Kornberger and Rhodes (2004) propose a likely strategic management relationship between organizational theory and organizational practice can create a unique, targeted, business-competitive positioning for a contracting CF. This management consulting process builds through creating concepts (competencies), delivering proposed capabilities (or actions), improving economic worth, and creating new CF business competitiveness possibilities. Rodenhauser (2018) proposes a recent MCF shift from its former 'MCF brainy-body-shop' (that tells its CF what to do), to its current MCF-CF unique-product-development deliverables (where diversified digital competencies articulate into changing CF business capabilities) (Bogdanich & Forsythe, 2018). MCFs and CFs both continue to migrate their current business models and deliverables towards consumer-demanded solutions (Clun, 2017) and towards new CF competitiveness

positions (Cavaleri & Shabana, 2018; Dyllick & Muff, 2016; Jednak & Kragulj, 2015; Stefanikova et al. 2015).

However, like the above literature, most MCF-CF research is non-empirical, or supplied by the industry itself. Hence, this study notes an opportunity to research, and to further clarify the workings of MCF CF strategic management relationship. It asks the research question:

*In COVID-19 times can MCF competencies, and developing MCF-CF relational capabilities, model into enhancing a CF competitiveness position?*

#### d) Research Setting

Today, CFs contractually-engage MCFs worldwide (Deloitte, 2020; Ernst & Young, 2020; L.E.K. Consulting, 2020; Vault.com Inc., 2020). To add research continuity, this MCF study enlists the Indian management consulting industry as follows:

1. This one nation study offers ongoing constants – national uniformity, business governance uniformity, language/culture uniformity, and it enlists highly-informed respondents from the peak management consulting body throughout India.
2. The 'Institute of Management Consultants of India' emailed each of its members with this study's on-line Survey Monkey requests and its five follow-up email reminders.
3. Local and global MCF members of the Institute of Management Consultants of India have scant MCF competencies literature linking Indian MCF competencies constructs into advancing CF capabilities systems, or into changing CF business competitiveness.

Against this research setting, this study seeks answers to the above research question.

## II. LITERATURE REVIEW

### a) Background

MCFs release their internal management consultants to investigate their collective competencies as available strategic knowledge networks that can be initiated to provide 'expert' advice and assistance that can help deliver agreed or contracted changes into a CF's capabilities (Pratap & Saha, 2018; Whittington, 2006). MCF's also target progressing each CF towards a changed level of business competitiveness (Srinivasan, 2014; Whittington, 2006). These changes in business competitiveness are often indirectly gauged against the CF sustainable performance as it meets ongoing, and emerging, global business challenges (Jensen et al. 2010; McMakin & Fletcher, 2018; Noe et al. 2017; Srinivasan, 2014). In summary, MCFs work to ultimately build the business competitiveness of a contracting CF. The MCF is also contractually accountable to the CF (Fincham, 2002). Thus, the MCF

and the CF form a relationship that requires strategic and bi-directional cooperation.

The MCF-CF strategic relationship encompasses situational and behavioral integration, and this can aid in the deliverance of CF business competitiveness (Kisfalvi et al. 2016; von Briel et al. 2019). Thus, the MCF-CF relationship exhibits: respect, positivity, agility, responsiveness, and flexibility, and it incorporates asymmetric relational exchanges of knowledge and information (Leiby, 2018). The MCF-CF strategic relationship can also introduce new CF capabilities (and even new CF competency aspects) (Greenwood & Suddaby, 2006).

This MCF relational behavior varies with each contracting CF. Each CF has different: deliverance expertise, formal project responsibilities, personal and skills, and current consultancy progression capabilities (Sturdy & Wright, 2011). However, the MCF-CF relationship can be beneficial – saving time and co-creating changes to CF capabilities and their deliverables processes (Breidbach & Maglio, 2016).

### b) Management Consulting Theoretical Background

Scant definitive management consulting theory permeates the literature, and it remains inconsistent. This is in-part, because management consulting can encompass a diversity of activities.

Management consulting, from a theoretical perspective is a strategic management process that encompasses the 'resource-based view' of the firm (Barney, 1991), with theoretical extensions into encompassing business expert systems, knowledge development/utilization capabilities, and delivering sustainable and competitive-business advantage (Wenerfelt, 1984; Lado & Zhang, 1998; Haseeb et al. 2019).

Management consulting also brings strategies (Tallman, 1991), competencies (Lado et al. 1992), business innovation (Sundbo, 1996), economic worth (Navon, 1995), product development (Verona, 1999), and research implications (Schulze, 1992) into the resource-based view's theoretical framework. Management consulting also fits within institutional theory - as talent-resourced MCF institutions enlist their management consultants to support the social engagement structure that arises between the MCF and its contracted CF. Here, both parties relationally pursue a business solution within the surrounding competitive environment (DiMaggio & Powell, 1983), and the MCF and CF combine their valuable, rare, inimitable and firm resources towards enriching CF capabilities (Tan et al. 2015), and towards enhancing CF business competitiveness (Cardeal & António, 2012).

Management consulting also captures the theory of planned behavior (Ajzen, 1991), motivation theories (Garske & Arkes, 1981), consumption theory (Sheth et al. 1991a), and users-gratification theory (Katz



et al. 1973). These behavioral theories help the MCF-CF relationship to strategically-focus towards the build of consumer-targeted business competitiveness solutions.

The MCF-CF relational system pursues CF capabilities and their deliverables (resources), along with the CF capabilities incorporation of ongoing competitive intelligences (Chase & Murtha, 2019; Mees-Buss & Welch, 2019) - especially when CF capabilities target improving economic performance (Clegg et al. 2004) and enhancing CF business competitiveness.

Transaction cost theory supports the MCF's worth to the contracting CF (Canbäck, 1998). Transaction cost economics theory, social capital theory, and organizational learning theory also apply to aspects of the MCF-CF relationship - as each can help to build CF business solutions within the surrounding competitive environment (DiMaggio & Powell, 1983).

Business network theory (Axelsson, 2010) presents MCF-CF interactions, along with connectivities, as causing complex changes over time. Leiby (2018) suggests a MCF justifies, recommends, and helps deliver suitable CF capabilities improvements to the CF business deliverables systems, and so brings a prospecting theoretical approach (Tversky & Kahneman, 1979). Luhmann (2005; 2007) adds that structurally-connected MCF-CF networked communication systems operate according to logics, intelligences, and connectivities systems. Thus, business network theory likely also incorporates an attributes-focused theoretical approach (Kelley & Michela, 1980).

Institutional Theory (Jepperson, 1991; Meyer & Höllerer, 2014) brings capacities, innovation and inter-firm connectivities development (or knowledge creation and entrepreneurial intellectual capital) into the MCF-CF collaborative framework (Strang & Meyer, 1993). Institutional theory also (1) draws on: coercive formal/informal competitive influences, (2) encompasses mimetic externalities (including industry memberships, consultancies, or government impediments) and (3) enhances normative competitiveness and best practices surrounding the business competitive environment (DiMaggio & Powell, 1983).

Hence this COVID-19 study models the MCF-CF resource transference relationship, which occurs relationally, sequentially, and as a network solution over-time. The relationship is also causal - where MCF competencies can help change CF capabilities which in turn can then change CF business competitiveness. Further, as a causal structure, the MCF-CF resource transference relationship can enlist literature supported construct items, and then measure them against a Likert 1-to-5 scale framework. This framework can then frame a SEM model - with causal flows both within (and between) constructs (and their item measures) or within (and between) construct blocks. Hence a relationally-mapped, causal approach to this study's research can be stepwise gauged against Hume's theory-of-causation and Aristotle's 4-step theory-of-causation (Falcon, 2011). Material-cause first bring literature constructs and items. Formal-cause then measures construct-linked, and typologically-collated, efficient-cause. Data cause sees factors reduced to 'best' construct representations. Final-cause models a statistically-relevant best business solution.

The above literature offers management consulting as collectively encompassing a broad spectrum of theories, but fitting within the strategic management relational view of the firm. Consequently, management consulting fits within the strategic management paradigm. From the theoretical approaches above a strategic MCF-CF relationship model is now offered as focusing towards adeptly-delivering dynamic, inter-firm competitive advantage (Dyer & Singh, 1998; Teece et al. 1997). This study's causal approach is appropriate to the development of a three phase MCF-CF resources transference relationship model – initiated by MCF competencies, which are adapted into changing CF capabilities and their embedded systems of business deliverables. These in-turn allow for changes in CF business competitiveness. This three-phase relational model is presented as the 3Cs model structure of Figure 1.

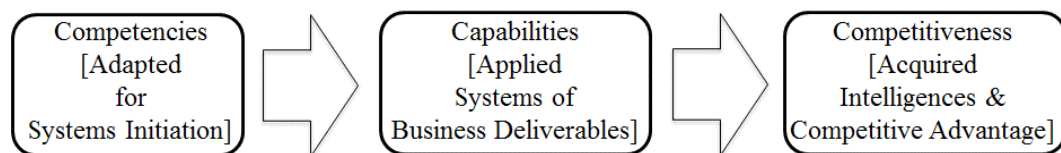


Figure 1: The 3Cs Model (adapted from Hamilton, 2020)

### c) Competencies embedded in the 3Cs Model

In this study the 3Cs model's competencies are the MCF's adapted intellectual, innovative, knowledge, and skills (capabilities) characteristics. These collectively network, and can then be selectively enlisted to efficiently-advance a CF's capabilities - and so change its business performance (Werr & Styhre, 2002; Lee &

Jung, 2018). The MCF capacities adapt to frame its embedded strategic competitive transference options and abilities into the CF. To this, the MCF adds its recent, learned knowledge creation application possibilities. The MCF also continually innovates to stay at the forefront of business developments, and so continually derives new competitive-business adaptive



horizons (Bello et al. 2016). The MCF enlists its existing competitive IP as beneficial entrepreneurial intellectual capital applied towards changing business applications (Werr & Stjernberg, 2003), and towards changing CF capabilities (Werr & Styhre, 2002).

#### i. Knowledge creation

Knowledge creation is a continual, collaborative, strategic, economic and analyzed combination of different kinds of transference information (Bronnenmayer et al. 2016; Gebhardt et al. 2019; Vallaster et al. 2019); It is entrepreneurial and performance-related and digital (Rydén & El Sawy, 2019; Wang et al. 2019). It taps external sourcing, purchase actions, inter-firm combinations, alliances and/or acquisitions (Goedhart et al. 2015), and it targets product/service affordability (Dobusch et al. 2019), and strategic management systems (Cabiddu et al. 2019; Frynas et al. 2018). Lee and Jung (2018) see MCF knowledge creation as a precursor to enhancing the utilitarian qualities of the CF's capabilities. Thus, MCF knowledge creation is part of an engaged competencies set, selectively adapted to deliver considered, entrepreneurial, strategic and qualities improvements for a contracting CF.

#### ii. Capacities

Capacities are the skills resource toolkits (materials, expertise, functions, information, prices) enabling planned changes to a contracting CF (Degener et al. 2018; Zollo et al. 2018). Capacities are planned activities to provide actionable information regarding a CF's rivals (Suddaby et al. 2020). Hence, the MCF's engaged capacities potentially support multiple outcomes (performance, planning, servicing, successes) across existing/new markets (Teo & Choo, 2001). Petroni (2000), Teo and Choo (2001) and Lee and Jung (2018) view capacities as competencies that potentially assist qualities, products/services, prices, and ROIs. This study sees MCF capacities as capturing qualities and product/servicing linkages that can be adapted to add value-for-money, leading-edge knowledge and potential market leadership settings.

#### iii. Innovation

Innovation helps generate new ideas, creative thoughts, new imaginations, new applications new attention and new emphasis and/or new effective services (Liang, Shu, & Farh, 2019; Molner et al. 2019; O'Reilly & Binns, 2019). Innovation pursues something new – including: new approaches, new technologies exploration, new servicing innovation, new visionary ideas, new ventures, and/or new attention/emphasis/measurement (Bouncken et al. 2020; Jones et al. 2020).

Innovation can enlist R&D intensity, R&D spending, sales and revenue (Xu et al. 2019). It can solve ill-founded ideas, build new acceptance, and avoid risk (Ordanini & Parasuraman, 2011), or it can run adaptive or differentiation comparisons to competitor

items and replace inferior solutions with higher qualities and servicing solutions (Bello et al. 2016).

Innovation in this study provides the CF with new ideas including: collaborative knowledge and support competences that create further CF dynamic resourcing capabilities (Ordanini & Parasuraman, 2011), and encapsulate novel ideas, new technologies exploration, R&D intensity and innovation measurement, and competitor comparisons (Bello et al. 2016, Liang et al. 2019, Xu et al. 2019).

#### iv. Entrepreneurial Intellectual Capital

Entrepreneurial intellectual capital procures big data information and enhances problem solving (Zhan et al. 2018) across collaborative, near real-time, product development and supply chain knowledge and information acquisition processes (Kache & Seuring, 2017; Lee & Jung 2018) from implicit or explicit internal and external sources. It links flexible business infrastructure competencies into assimilation, management, financial and operational targets (Liu et al. 2016).

Entrepreneurial intellectual capital socio-technical dimensions also help deliver enhanced capabilities practices – including: deep infrastructure knowledge, utilization of practical infrastructure knowhow and boosting of competencies via state-of-the-art practices (Liu et al. 2006).

This study pursues entrepreneurial intellectual capital as problem solving expertise, improving firm social capital, developing global firm performance, making firm performance world-class and resourcing to deliver firm solutions.

#### d) Capabilities embedded in the 3Cs Model

The MCF-CF capabilities exist as applied multi-networked business deliverables systems. The first system is the values deliverance system – consisting of qualities, performance and economic worth. The second system is the consumer-relations system – consisting of servicing, risk avoidance and contractual satisfaction. These two systems are business retail related as pathways towards loyalty and/or sustainability (Jones et al. 2006). The third system is the competitive intelligences system – consisting of qualities, risks, servicing and intelligences acquired. These systems fit within Kaltcheva et al.'s (2013) capabilities scope of 'path linkages that strategically apply and-gauge the fulfilment of MCF-CF capabilities deliverables - whilst keeping the firm sustainable and economically competitive.'

#### i. Qualities

The qualities subset of a firm's operational values system (McLachlin, 2000; Hamilton et al. 2014; Hamilton & Tee, 2016) can be gauged against service qualities (reliability, responsiveness, assurance, empathy, tangibles) (Zeithaml et al. 1990). In management consulting, reliability and responsiveness

are key MCF-CF values system business deliverables (McLachlin, 2000). Assurance and empathy are also important tangible contributors. Thus, in management consulting, the MCF-CF relationship pursues heightened levels of service qualities deliverables, and conjointly produces new measurable values system deliverables. In this study the MCF-CF relationship is respectful, highly-skilled, delivering improved qualities, responding to opportunities, finding points of excellence, and consistently improvements driven.

#### ii. *Performance*

The performance subset of a firm's operational values system sees MCF-CF improvement options often performance-related across the workplace (McLachlin, 2000). Performance is an induced applied change in outcomes from a start point to an end point (Cannon et al. 2010). Performance is an applied operational measure such as cost, speed, dependability, quality or flexibility against lean business operational measurement groupings such as just-in-time, automation, kaizen, total productive maintenance, or capability stream mapping (Belekoukias et al. 2014). This study enlists four often-applied performance deliverables (efficiency, effectiveness, productivity and flexibility) (de Leeuw & van den Berg, 2011; Karwan & Markland, 2006) as applied optimized business outcomes, an optimized relationship, an improved service, and a collaborative relationship. Further as part of the values system, performance also displays a path link from qualities into performance, and another path link from performance into economic worth (Cannon et al. 2010; Yrjölä et al. 2019; Zhang et al. (2019).

#### iii. *Economic-Worth*

The economic worth subset of a firm's operational values system can emanate from an external firm perspective (Spanos & Lioukas 2001) and can result in applied budgeted accomplishments (sales volume, growth-in-sales, market share, growth) (Bronnenmayer et al. 2016). Internally, economic worth can be a strategic profitability (ROA, profit, ROI, ROE, net profit) (Bronnenmayer et al. 2016; Geletkanycz & Boyd, 2011; Sobol & Klein, 2009). In this study economic worth is improved returns, worthwhile (value) investments, profit, and value for solution development. A MCF-CF economical worth measure also provides a path towards a sustainable (competitive)-business positioning (Hamilton, 2006; Hamilton & Tee, 2016; Jabłoński, 2016).

#### iv. *Servicing*

The servicing subset of a firm's consumer-relations system is an hedonic capability that a consumer is acquiring when viewed against an ongoing experience (Babin et al. 1994). It is consumer-perceived, and it is also associated with senses, pleasures, feelings, and/or emotions (Cheng, 2014). It encompasses the extent to which the deliverables of a

servicing capability arouses emotions, and creates pleasant experiences (Jahromi & Zhang, 2020). Thus, servicing is an emotive, consumer-related, hedonic capability experience. Servicing normally includes a consumer's perceived capability, relationship, services and needs connections (Rogg et al. 2001). Servicing covers awareness, problems, complaints and feedback (Sum et al. 2002). But servicing can encapsulate consumer needs, consumer goals, consumer-orientation behavior, and/or sales-behavior (Johnson & Ashforth, 2008). Servicing sometimes extends across recommendations, returns, degrees-of-service and service priorities/standards (Arenas et al. 2020). Thus, although servicing is inconsistently captured - because it varies depending on circumstances, this study follows Johnson and Ashforth's (2008) definition of 'servicing as a firm's capabilities response towards satisfying its consumers' hedonic needs in ways better than its current competition. Hence this study sees servicing as sharing expertise, providing innovative solutions, delivering cost effective solutions and completing planned services.

#### v. *Risks Avoidance*

The risks avoidance subset of a firm's consumer-relations system captures changing business environments as these often drive economic pressures in firms. Risks avoidance correlates with firm capabilities (Dotzel & Shankar, 2019), but to change a business by including a MCF-to-CF risks avoidance capabilities construct remains challenging. Some see economic downturns as risks resulting from externalities and performance paralysis – and measurable via resource utilization analysis. An intentional shift in internal resource utilization remains risky in itself, and in some cases possibly links with a firm's ongoing performance (de Oliveira et al. 2020). Other external risks arise when adding new technologies (Radanliev et al. 2019) or when changing customer servicing (such as: service-efficiencies, buying patterns and/or innovative practices) (Al Kailani & Kumar, 2011, Snihur & Wiklund, 2019). Thus, risks avoidance also likely links with firm servicing. Hence risks avoidance is included in MCF-CF capabilities suites as change(s) affecting resources utilization, timeframes for servicing, technologies incorporated into services, and consistency of requested product qualities.

#### vi. *Contractual Satisfaction*

The contractual satisfaction subset of a firm's consumer-relations system is included as it supports consumer re-consumption considerations (Brown & Chin, 2004; Porter et al. 2020; Schepker et al. 2014). Contractual satisfaction is also an external personalized MCF-CF relationship – leading towards improving (ongoing) competitive advantage (Pick & Eisend, 2014). Contractual satisfaction from a psychological perspective appraises MCF-CF activities, tasking and

accomplishments (McKinlay & Starkey, 1988). It reflects on ideas, desires, predictions and normative customer expectations (García-Canal, 1996), and is sometimes linked to perceived improved qualities or better financial performance (Dobrzykowski & McFadden, 2020; Polo & Sese, 2013). High level servicing, risk mitigation and ongoing familiarity are precursors to improving contractual satisfaction (Lai et al. 2013; Poppo & Zhou, 2014). Contractual satisfaction is also linked forwards into generating a sustainable (competitive)-business positioning (Van der Heijden et al. 2013). In this study contractual satisfaction is measured as consulting on-budget and on-time, and effectively implementing change improvements.

#### vii. *Competitive Intelligence*

Competitive intelligences are a subset of a firm's competitive intelligences system. They are part of 'a marathon, and not a sprint' process, towards improved economic growth and social welfare (Porter, 2004). This form of competitiveness offers the firm the ability to: (1) compete within a specific market, (2) increase market share, (3) enter expanding (international) markets, and (4) achieve sustainable business growth and profitability (Moghaddam et al. 2020). Sapienza et al. (2006) offer firm-growth, as business competitiveness - linked to a firm acquiring an enhanced sustainable performance positioning. Thus, firm competitive intelligences are a form of firm capabilities deliverables drawing on: (1) suitable input resource competencies (human/financial/technology, innovation, and intellectual design based resources), (2) internal operational/managerial capabilities across process systems, leadership, and astute strategies, and (3) intelligence-supported, sustainable (competitive) business outcomes measures (Cetindamar & Kilitcioglu, 2013). This study measures competitive intelligences as improving competitive advantage, new intelligences building business success, intelligent engagements, and intelligently growing business markets.

#### e) *Competitiveness embedded in the 3Cs Model*

##### i. *Competitiveness, Sustainability and Collective Intelligence*

Competitiveness remains a relative and not absolute term (Feurer & Chaharbaghi, 1994; Herciu & Ogorean, 2018). Some see competitiveness as a firm's: comparative astute usages of its resources (Tan et al. 2016) or performance efficiencies (Porter, 2007) or profitability measures (Garelli, 2006) or stakeholder value advantages (Chikan, 2008). However, competitiveness is comparative, and in the business domain, it is typically used to compare a firm against its potentially competing firms (Porter, 1985; Porter and Kramer, 2002; Jiang et al, 2016; Tan et al, 2016). Competitiveness also links with (1) competitive advantage, (2) added technologies (Denning&

Stratopoulos, 2003; Shrivastava, 1995; Tracey, Vonderembse and Lim, 1999), and to (3) values enlisted (Porter & Kramer, 2011; Marin, Rubio & Maya, 2012; Hamilton & Tee, 2016).

Firms are learning institutions that act and react, to their external and global environments (Feurer and Chaharbaghi, 1994). Some firms realize their competencies, and their resource capabilities alone, may be insufficient to produce their desired competitiveness (Wu, 2008), and so seek expert consultancy assistance (Ramanujam et al. 2019; Ramanujam, 2020). Here, additional capabilities including business pivots with external cloud data intelligences, process enhancing changes new resource inclusions can assist in enhancing competitiveness (Lin & Wu, 2014; Mihet & Philippon, 2019; Hamilton 2020). Hence when conducting business, *competitiveness* is better termed as *business competitiveness*.

Firms exist in perpetuity, and by definition, are 'sustainable entities'. However, competitiveness has an overall firm (business) outcome connotation, whilst sustainability holds a performance outcome connotation (Wagner & Schaltegger, 2003; Schaltegger & Wagner, 2017).

A firm's ongoing sustainable performance encapsulates its economic, social, corporate, and environmental perspectives within an ever-changing business and global environment. Porter (1980) describes this as competitive strategy - with a firm finding an ongoing operational position within its industry where it can sustainably perform and balance its competitive forces into exploiting the most structural good from its capabilities, whilst also creating minimal internal business harm. The firm can also exploit changes to its firm competencies, capabilities, and sustainable performance positioning typically before other rival firms recognize the occurrence of such a pivot. Thus, a firm's strategic management deliverables can contribute towards its sustainable performance positioning.

Herciu and Ogorean, (2018) also note a firm can synergistically combine 'all its resources' to achieve better (1) productivity (revenue per worker) – a qualities-performance measure, (2) profitability (return on assets) – an economic-worth measure, (3) effectiveness (total assets turnover) – an economic-worth measure, and (4) ongoing sustainability (Dow Jones sustainability performance measure). They show these four systems synergistically combine and contribute to enhancing the firm's overall business competitiveness.

Thus, when conducting business, the *sustainable performance positioning* for the firm is typically a subset of its business competitiveness (which encapsulates the entire business outcomes of the firm).

In building towards business competitiveness, risks for example, can be minimized through: (1) changed initiatives/designs (Chang et al. 2017), (2)

operational resourcing can be changed (Chang et al. 2017), (3) technologies can be changed (Häkkinen & Belloni, 2011; Heffernan, 2012), (4) enhanced capabilities and their deliverables practices can be changed (Beske et al. 2014) – such as: developing economic worth, building ongoing performance, growing digital intelligences, and/or growing market opportunities (Schaltegger & Wagner, 2017; Zhang et al. 2019 in press; Hamilton, 2020; Peng et al. 2020), and (5) including further innovations (Häkkinen & Belloni, 2011). As these firm-enhancing changes arise, the firm's sustainable performance positioning likely improves, and again its overall business competitiveness likely increases.

A firm's sustainable performance positioning can also be strategically enhanced in many ways by: (1) using less resources (Zhang et al. 2011), (2) improving energy efficiencies (Häkkinen & Belloni, 2011; Kolk & Pinkse, 2005), (3) meeting government legislative rules (Marx et al. 2015), (4) meeting consumer preferences (Schrettle et al. 2014), and/ (5) building a positive consumer image of the firm (Chang & Rhee, 2011), and again such enhancements can build towards a firm's business competitiveness.

Further, in COVID-19 times business competitiveness is increasingly digital. Online purchasing is now a major revenue stream strength of the firm. Such new technologies inclusions and new innovations when linked to new market opportunities and ongoing business competitiveness (Haanes & Fjeldstad, 2000; Mellahi & Johnson, 2000; Veliyath & Fitzgerald, 2000) then help create new collective intelligences (Parida, Sjödin & Reim, 2019). Here, 'first-mover' or 'early adopter' digital collective intelligence advantages can likely help re-position or pivot the firm into a changed business competitiveness position.

Thus, business competitiveness can be derived as two constructs: (1) a sustainable performance positioning component, supported by (2) a collective intelligences component.

## ii. Sustainable Performance

Sustainable performance positioning practices deliver a more efficient process, a higher productivity, and enhanced global market opportunities (Zhang et al. 2011), and this represents a major contribution towards business competitiveness (Chang et al. 2017). Investments into first changing: latest technologies deployed, into solving uncertainties, and/or into rectifying new operation risks, add to the firm's collective intelligences and these can help support both an enhanced sustainable performance positioning and enhanced business competitiveness (Van der Borgh & Schepers, 2018).

Hence, in a changing business world, the MCF and its contracted CF seek to retain their ongoing, individual, sustainable performance positioning. This

requires a capacity to positively engage across their resources (including: workforce, financials, processes, systems, technologies, innovations, connectivities), and to seek ongoing, externally-competitive, and beneficial firm pathways - designed to meet current, and aspiration needs (Auh et al. 2019; Hilken et al. 2017). Thus, a firm's sustainable performance positioning involves a system of ongoing, directed, monitored, and change-related management controls.

Dyllick and Muff (2016) conclude truly sustainable firms seek competitive business solutions that increase their sustainable performance impact, ease their financial conflicts, ease societal needs, innovate their processes, and their strategic reach. In their view collaborative partnerships (such as MCF-CF relationships) can increase the strategic impact of their sustainable performance positioning. Positive business relationships such as in MCF and contracting CF trust domains can deliver reduced transactional costs and can develop inter-firm connectivities (Srinivasan, 2014; Zhang et al. 2011).

Multiple strategic competitive and capabilities management control systems interactively, and diagnostically link into the deliverance of a sustainable performance positioning (Bruining et al. 2004; Gond et al. 2012). Arjaliès and Mundy (2013) studied business management control systems in France's largest listed companies. They found: innovation, communication, reporting, plus assessing threats and opportunities contributes towards a sustainable performance positioning. MCF-CF relational processes likely show similar behavior.

Cavaleri and Shabana (2018) use competitive cost leadership, competitive differentiation, levels of innovation, and levels of imitation/innovation to conceptually-frame a firm's management control systems towards a sustainable performance (financially-rewarding) positioning. Bronnenmayer et al. (2016) also measure budget/scheduling deliverance, targets achieved, profitability, expansion-to-existing, and as extension-to-existing schemes as delivering sustainable performance positioning. Such studies suggest the CF sustainable performance positioning remains a desirable and measurable relationship outcome.

This study follows the Gond et al. (2012) and Arjaliès and Mundy (2013) relationship-view that a MCF-CF deployed, integrated-suite of management control systems can deliver CF sustainable performance positioning - provided the approach is collectively and intelligently integrated (Burgelman, 1991; Simons, 1994). Hence, this study captures the sustainable performance positioning as where the MCF adds/delivers all their CF contracted services, the highest capability-for-money CF solutions, improved CF qualities/performances, and also helps promote competitive/accelerated CF business growth.



### iii. *Collective Intelligences*

Collective intelligences constitute a grouped, shared, physical and virtual intelligence system that arises from a firm's collaboration, its collective decision making efforts, and its strategic positioning against its workplace and marketspace competition ([https://en.wikipedia.org/wiki/Collective\\_intelligence](https://en.wikipedia.org/wiki/Collective_intelligence)). Collective intelligences are an integral part of the firm's strategic and competitive management system. They coordinate, channel, and search engine data-mine direct ideas, solutions and proposals. They overcome deficiencies in connectivities and in knowledge transfer. They formulate mechanisms to innovatively solve new situational encounters. They evolve with their successes, misunderstandings, problems and solutions. They also acquire new learning and skills that assist in future evaluations to restructure and overcome face-to face complex and uncertain situations (Figueroa & Perez, 2018).

These intelligences accumulate across the firm's competencies and its capabilities systems. Collective intelligences blend traditional competencies, high-tech knowhow and firm capabilities (Rubio, Gragera & Fernández, 2018). In particular the values deliverance system and the competitive intelligences capabilities system are major contributors in delivering enhanced collective intelligences. Here information driven collective intelligences emerge from the connection and interaction of multiple, distributed, independent agents that collectively produce and process information, and eventually turn it into useful competitive business knowledge that can be conceptually represented (Fontana, Formato & Pareschi, 2010). This study captures collective intelligences as: adding latest specifically-targeted ideas, enabling latest innovation knowledge solutions, incorporating new transforming digital solution insights and delivering competitive market share pricing solutions.

### f) *The 3Cs Model Further Pathways Theoretical Support*

Business Network Theory (Axelsson, 2010) characterizes interactions with connectivities that cause complex changes over time between relationally connected firms. Institutional Theory (Jepperson, 1991; Meyer & Höllerer, 2014) brings capacities, innovation and inter-firm connectivities development into this collaborative framework (Strang & Meyer, 1993). In this study the MCF and its contracting CF also fit relational resource base theory (Barney, 1991) - with links enhancing a sustainable performance and competitive advantage (Wenerfelt, 1984; Haseeb et al. 2019). Resources include firm competencies systems - such as knowledge, assets, innovations and information along with firm capabilities such as systems controls,

implementations, effectiveness and efficiency (Daft, 1983; Barney, 1991), and all become part of the firm's net high-values sustainable performance system (Popovic et al. 2018).

Thus, the MCF-CF relationship brings a dynamic strategic perspective with multiple constructs driving firm value creation and firm value capture. Here the MCF-CF relational consultancy facilitates access to complementary resources, and provides competitiveness benefits over time (Tan et al. 2015; Dyer et al. 2018). Here, valuable, rare, hard-to-imitate firm resources, such as special qualities, high performance and economic worth, can be 'exploited' towards maximizing economic potential (Dyer et al. 2018), whilst providing pathways (such as transforming or pivoting the business model and by guarding against rival substitution and imitation products) towards enhancing firm (CF) business competitiveness, and sustainable performance strategies (Cavallo et al. 2020). Thus, the MCF-CF consultancy relationship is a multi-pathways and a competitive pathways model structure.

### g) *The 3Cs model*

Sections 2.2 to 2.6 summarize the theory and constructs embedded into the Figure 1 3Cs model. Figure 1 is now expanded and re-presented as Figure 2. The four competencies constructs work as a combined system. The three central capabilities systems represent the intermediate constructs and the two right side constructs in combination represent the overall business competitiveness position.

Proposition 1 (P1) captures the relationship between competencies and capabilities, and proposition 2 (P2) embodies the capabilities to competitiveness relationship. These pathways are multi-faceted and require complex explanation beyond the scope of this study. Detailed summaries of such construct path linkages can be found within a series of recent publications including Ramanujam, (2020), Hamilton, (2020), Ramanujam, Hamilton and Ciccotosto, (2019), Ramanujam et al. (2019).



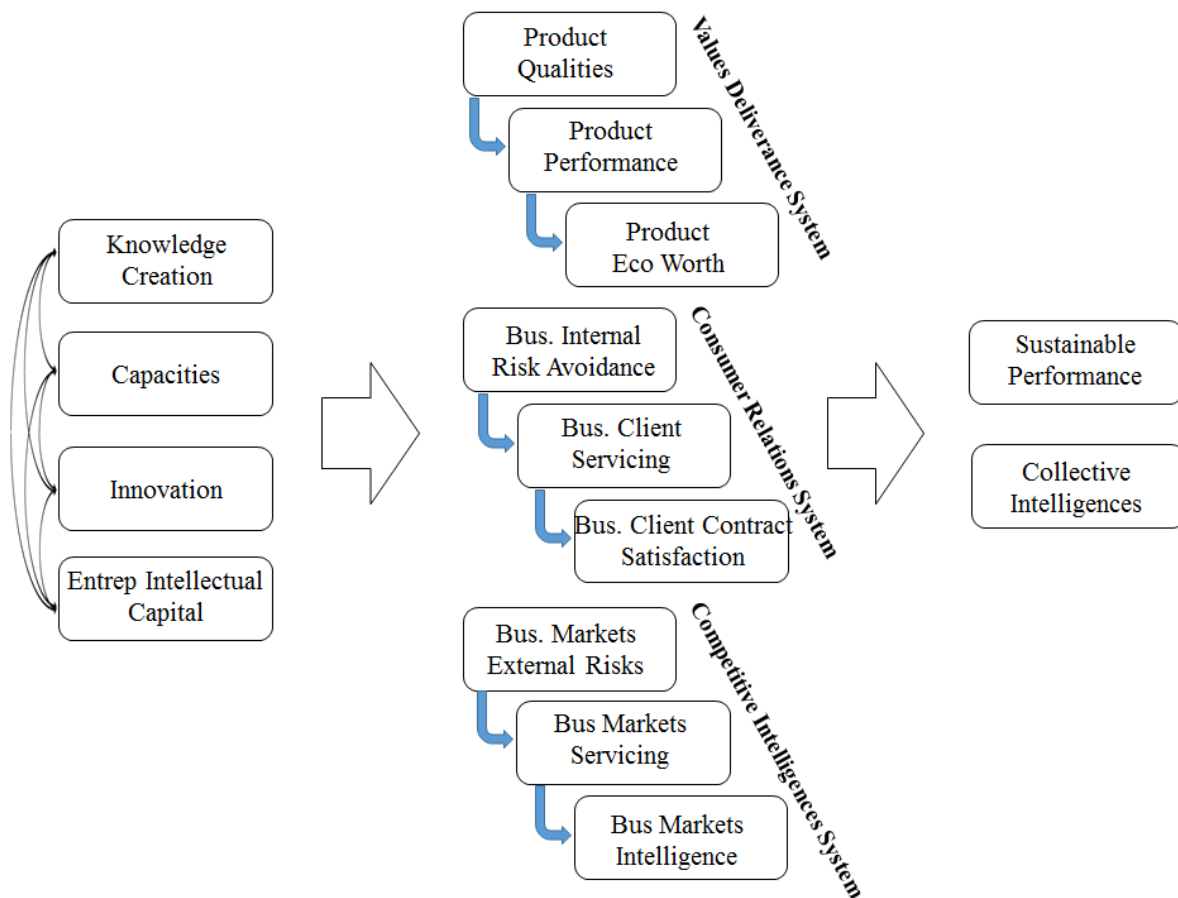


Figure 2: Constructs arrangement within the 3Cs model

### III. METHODOLOGY

#### a) Data Preparation

##### i. Data Collection

This Likert scale 5-point (strongly disagree = 1 to strongly agree = 5) study, engages the popular online survey instrument Survey Monkey, and follow's Dillman's (2015) non-incentives on-line survey approach. The study works through the 'Institute of Management Consultants of India.' This peak and international management consulting regional body operates throughout India. This peak body six times emailed each of its members with this study's on-line Survey Monkey requests and/or with its follow-up reminders. Survey completion attempts from the Institute of Management Consultants of India 2020 membership of 550-600 members, totaled 313. Over this 12-week data collection time frame occasional member respondent surveys were incomplete – suggesting fatigue. Some surveys left gaps in the demographics, or the qualitative answers or left illogical Likert questionnaire gaps. Another 16 surveys came from the same IP address – suggesting possible multiple entries by firm respondent – these were also removed. Hence, 234 valid unique member respondent surveys representing 41% of the Institute of Management

Consultants of India 2020 membership were retained for analysis.

##### ii. Data Preparation

Access to a previous study's questionnaire (Ramanujam et al. (2019) allowed this study to make questionnaire refinements – thereby minimizing respondent measurement item interpretive issues. The previous study's targeted nine constructs and 37 measurement items were adapted and improved – delivering 13 constructs and 58 measurement items, and better capturing a model to explain business competitiveness.

Data cleaning (to no-missing values) removed two more respondent cases with around 10% of their Likert items being left blank. Frequency distributions showed no questionnaire items required initial elimination, and means and standard deviations showed only small skewing or kurtosis.

##### iii. Confirmatory Factor Analysis

Factor reduction (maximum likelihood, oblim, 200 rotations, residuals < 0.05) (Cunningham, 2009) delivered 13 strong constructs as shown in Table 1 - with three to six indicator/measurement items per construct. Item loads lay between 0.58 and 0.90 with only nine of 58 item loads being below 0.70 (Hair et al.

2014). As this study investigates relational pathways, and path strengths, a single indicator latent variable approach is adopted (Munck, 1979; Cunningham, 2008; Grace & Bollen, 2008). This approach minimizes any interaction effects between construct measures, and it best exposes the relative significance of the beta pathways within the model (Cunningham, 2008; Grace & Bollen, 2008).

Construct means and standard deviations indicate near normality (Table 1). Hence maximum likelihood remains the appropriate approach to factor reduction. The Cronbach alpha measures range from 0.82 to 0.92 indicating strong constructs in all cases (Hair, et al, 2014).

The average single indicator load and error measures are derived from Munck's (1979) equations. Here, each net-load resides between 0.63 and 0.75, and so represents a strong load per construct. The error terms are all small, and lie between 0.04 and 0.10. Hence these loads and errors are likely acceptable for SEM modelling (Munck, 1979; Cunningham, 2009). The average variance extracted (AVE) captures the amount of variance due to measurement error in the construct. All AVE's range between 0.50-0.72 and are thus acceptable (Hair et al. 2014).

Table 1: Combined Measurement/Indicator Item Data

Item Code	Construct and Measurement Indicator Items (232 respondent cases into MCF data set)	Item Load	AVE	Mean	Std Dev (σ)	Cronbach Alpha (α)	Load [α(√α)]	Error [σ <sup>2</sup> (1-α)]
<b>KNOWLEDGE CREATION</b>			<b>0.61</b>	<b>3.964</b>	<b>0.753</b>	<b>0.856</b>	<b>0.70</b>	<b>0.08</b>
1	adds MCF expert knowledge to CF infrastructure/practices	0.850						
2	adds MCF experiential knowledge to CF infrastructure/practices	0.835						
3	delivers knowledge-based CF infrastructure/practices	0.758						
4	provides further knowledge capabilities for the CF	0.656						
<b>CAPACITIES</b>			<b>0.52</b>	<b>4.061</b>	<b>0.685</b>	<b>0.840</b>	<b>0.63</b>	<b>0.07</b>
5	offers high quality to CF products	0.825						
6	offers clear CF product focusing	0.753						
7	delivers authentic & enduring CF orgal leadership approaches	0.687						
8	offers clear CF value for money	0.683						
9	offers support to change the CF's business	0.641						
<b>INNOVATION</b>			<b>0.60</b>	<b>3.926</b>	<b>0.815</b>	<b>0.849</b>	<b>0.75</b>	<b>0.10</b>
10	uses innovation to solve CF requests	0.870						
11	provides solutions to tomorrow's unknown problems	0.774						
12	encourages MCFs to innovate while solving CF problems	0.772						
13	delivers unique benefits to the CF results	0.665						
<b>ENTREPRENEURIAL INTELLECTUAL CAPITAL</b>			<b>0.58</b>	<b>4.065</b>	<b>0.713</b>	<b>0.872</b>	<b>0.67</b>	<b>0.07</b>
14	uses MCF intellectual capital to make CF performance world-class	0.885						
15	uses MCF collaborations to make CF performance world-class	0.768						
16	uses MCF intellectual capital to improve CF's social capital	0.739						
17	provides intellectual problem solving consulting expertise	0.712						
18	uses MCF intellectual resources to complete CF assignment	0.689						
<b>QUALITIES</b>			<b>0.62</b>	<b>4.077</b>	<b>0.679</b>	<b>0.891</b>	<b>0.64</b>	<b>0.05</b>
19	consulting changes seen as improving qualities of CF opportunities	0.842						
20	consulting processes highlighting where CF can best excel	0.822						
21	advice that consistently improves qualities across CF business	0.791						
22	consulting actions consistently look 'skilled' to CF shareholders	0.752						
23	MCFs are consistently respectful in assisting them	0.731						
<b>PERFORMANCE</b>			<b>0.64</b>	<b>4.126</b>	<b>0.706</b>	<b>0.874</b>	<b>0.66</b>	<b>0.06</b>
24	collaborative MCF-CF relationships	0.851						
25	optimal MCF-CF relationships	0.850						
26	high levels of optimized CF business outcomes	0.840						
27	MCF improves all the CF's contracted services	0.651						
<b>ECONOMIC WORTH</b>			<b>0.65</b>	<b>4.054</b>	<b>0.739</b>	<b>0.882</b>	<b>0.69</b>	<b>0.06</b>
28	worthwhile CF outcomes for worthwhile investments	0.875						
29	improve CF rewards for money invested	0.818						
30	optimized CF financial performances per MCF-CF solutions engaged	0.801						
31	profitable consumer services from the CF monies invested	0.730						
<b>RISKS AVOIDANCE</b>			<b>0.56</b>	<b>4.026</b>	<b>0.722</b>	<b>0.832</b>	<b>0.66</b>	<b>0.09</b>
32	MCF change(s) that influence CF's use-of-resources	0.850						
33	MCFs that consistently deliver ongoing results quality to a CF request	0.720						
34	risk-assessed solutions that include latest technologies inclusions	0.718						
35	MCF services the CF requirements within agreed timelines	0.706						
<b>SERVICING</b>			<b>0.63</b>	<b>4.105</b>	<b>0.705</b>	<b>0.872</b>	<b>0.66</b>	<b>0.06</b>
36	providing cutting-edge MCF-CF innovative solutions	0.819						
37	delivering MCF-CF efficient cost effective solutions	0.815						
38	completing all MCF-CF services as planned	0.774						
39	always sharing MCF-CF expertise	0.770						
<b>40</b>			<b>0.50</b>	<b>4.030</b>	<b>0.726</b>	<b>0.822</b>	<b>0.66</b>	<b>0.09</b>
40	MCF meet agreed recommendations	0.755						
41	MCF effective implementations for CF	0.752						
42	MCF change(s) that improve CF business capabilities	0.749						
43	MCF consulting on time	0.692						
44	MCF consulting on budget	0.580						
<b>COMPETITIVE INTELLIGENCE</b>			<b>0.72</b>	<b>4.125</b>	<b>0.724</b>	<b>0.910</b>	<b>0.69</b>	<b>0.05</b>
45	engages the MCF intelligences to assist the CF	0.902						
46	builds MCF-CF competitive intelligences for the CF	0.866						
47	applies new MCF intelligences to help build CF's business success	0.833						
48	improves the CF's competitive advantage	0.794						
<b>SUSTAINABLE PERFORMANCE</b>			<b>0.67</b>	<b>4.077</b>	<b>0.760</b>	<b>0.923</b>	<b>0.73</b>	<b>0.04</b>
49	MCF-CF responsibility for CF quality performance	0.843						
50	a strong positive MCF-CF partnership	0.843						
51	MCF-CF business solutions that deliver a competitive difference	0.836						
52	accelerated CF business growth	0.833						
53	MCF-CF highest value for money solutions delivered	0.784						
54	always accomplishing what MCF contracted for CF	0.774						
<b>COLLECTIVE INTELLIGENCES</b>			<b>0.60</b>	<b>4.124</b>	<b>0.735</b>	<b>0.832</b>	<b>0.67</b>	<b>0.09</b>
55	adds MCF-CF latest specifically-targeted ideas across CF	0.801						
56	enables MCF-CF latest innovation knowledge solutions across CF	0.859						
57	incorporates new transforming digital solution insights across CF	0.717						
58	delivers pricing solutions to win further competitive market share	0.725						

#### IV. RESULTS

##### a) Structural Equation Modelling with AMOS 25.0

Figures 1 and 2, Table 1, and the 232 cases data set are combined under AMOS 25.0 structural path modelling to provide a multivariate statistical analysis of the structural relationships between the 13 constructs and their measurement/indicator items (Hair et al. 2014).

The model fit data at the base of Figure 3 shows the resultant structural path modelling delivers an excellent model fit across all the key Goodness-of-Fit

measures for small (200-400 case) data sets. All beta weight path measures are significant at  $p < 0.05$  or better. The Chi Square –Degrees of Freedom ratio of 1.89 lies between 1 and 3 – indicating excellent fit, the  $p$  value is recorded, but less than that desired., hence the 200 times bootstrapped Bollen Stine  $p$  is applied - delivering an acceptable value of 0.393 (i.e.  $< 0.05$ ) (Hair et al, 2014). Thus, across all key investigative measures, Figure 3's MCF-CF 3Cs model is an excellent fit path model.

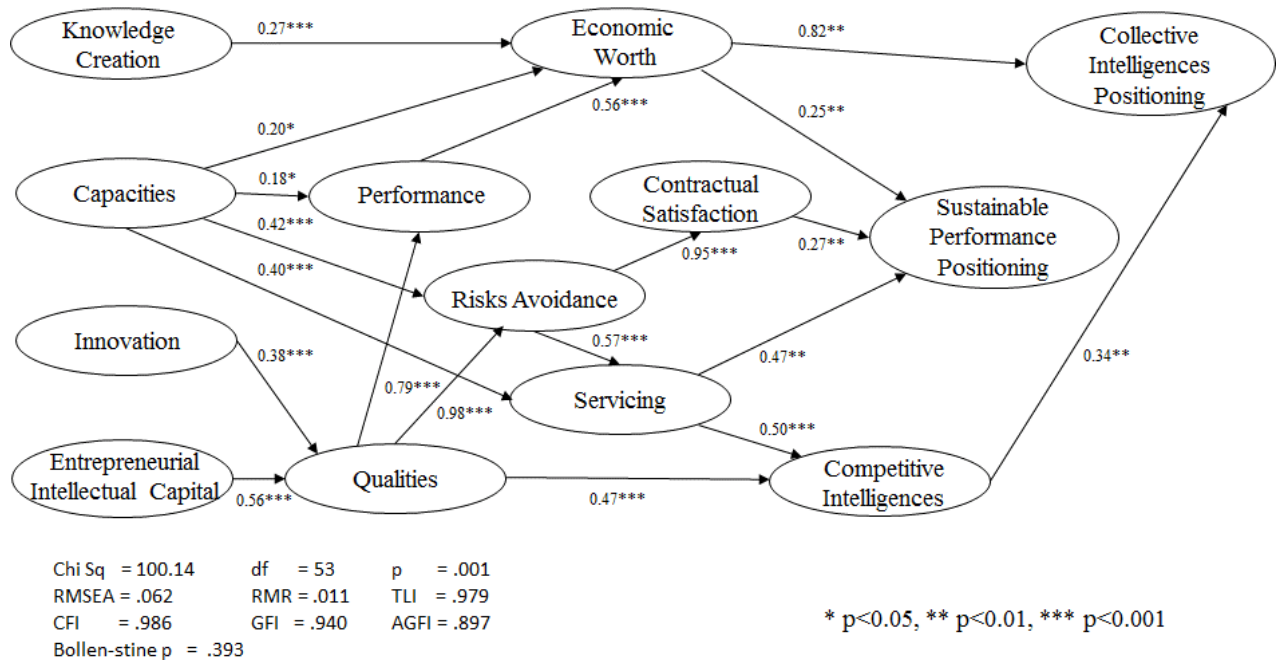


Figure 3: The MCF-CF 3Cs model

Considering the capabilities systems, the MCF-CF values deliverance system draws on all competencies to frame the qualities-to-performance-to-economic worth capabilities pathway, and each capability is causally, sequentially, and additively enacted. Indeed, a CF's qualities appear to be its key starting capability. Neither the consumer relations system (CRM) nor the competitive intelligences system requires knowledge creation. The maximizing of CF sustainable performance positioning and CF collective intelligences draws upon all four MCF competencies and all six MCF-CF capabilities.

Thus, the role of the MCF and the contracting CF remains complex, engaging, theoretically-framed, and relationally intensive. Further, the MCF must also consider risk mitigation (Glückler & Armbrüster, 2003; Starr et al. 2003), new technologies and innovation assessments, competitive analysis, along with the actual MCF-CF stepwise capabilities systems deliverance modelling approach.

##### b) Construct Correlations

As all Table 2 construct correlations significantly, and strongly correlate (Cunningham, 2009; Hair et al. 2014), the validity of the path model is further established. All causal precursor constructs strongly correlate with the business competitiveness constructs. Hence, the factor reduction construct process holds discriminant validity - with each construct being shown as suitable for AMOS 25.0 structural equation modelling. In line with Figures 1 and 2, this Figure 3 structural path model shows unidirectional causal information flows across the 3Cs model from independent (competencies) to intermediate (capabilities), to dependent (competitiveness). This and the multiple model pathways suggests the model behaves as an overall system of interconnecting systems, strategically sequenced to assist in producing enhanced competitiveness over time.

Table 2: MCF-CF 3Cs Model Correlations

	Entrep Intel Capital	Knowledge	Capacities	Innovation	Qualities	Risks Avoidance	Servicing	Performance	Satisfaction	Eco Worth	Competitive Intel	Collective Intel	Sustainable Perf
Intel Capital	1												
Knowledge	0.87	1											
Capacities	0.86	0.86	1										
Innovation	0.81	0.80	0.87	1									
Qualities	0.86	0.78	0.81	0.83	1								
Risks Avoidance	0.87	0.83	0.90	0.86	0.93	1							
Servicing	0.84	0.81	0.91	0.83	0.85	0.93	1						
Performance	0.84	0.78	0.82	0.82	0.94	0.90	0.84	1					
Satisfaction	0.83	0.78	0.85	0.81	0.88	0.95	0.88	0.85	1				
Eco Worth	0.90	0.90	0.91	0.87	0.92	0.93	0.89	0.95	0.88	1			
Competitive Intel	0.83	0.78	0.84	0.81	0.90	0.90	0.90	0.86	0.86	0.88	1		
Collective Intel	0.76	0.75	0.78	0.74	0.80	0.81	0.79	0.81	0.77	0.84	0.81	1	
Sustainable Perf	0.84	0.82	0.89	0.83	0.87	0.93	0.93	0.87	0.91	0.91	0.88	0.79	1

## V. DISCUSSION

MCFs and CFs continually migrate their current business models and applications towards future consumer-demand solutions (Clun, 2017). Across today's changing global business environments MCF's strategize, and use their acquired entrepreneurial intellectual capital, to knowledge-survey new market opportunities (Irwin et al. 2018). They use these uniquely-acquired competencies as consultancy enablers that can combine and competitively assist towards firm improvements (Rangan & Dhanapal, 2016). In India for example, MCFs enlist external and internal big data sources in mapping their complex, competitive strategies; their innovation; and their knowledge creation (Srinivasan, 2014). In contrast, many Australian firms pursue incremental (rather than transformative and/or innovative) business improvements (Innovation and Science Australia, 2016). Thus, in different countries, MCFs may differ in their consulting CF approaches (Australian Information Industry Association, 2017).

Across the COVID-19 pandemic times, astute firms are re-adjusting and often pursuing digital transformation benefits occurring across global markets (Schilirò, 2020). Some are firms pursuing digital leadership (Prince, 2019). Other firms are seeking new approaches - often involving pivots (Hamilton, 2020). Some are transforming their operations towards an integrated, digital, intelligent, uniquely-competitive entity (The Australian Chamber of Commerce and Industry, 2017). Such developments can reduce transactional costs and improve market access (Hamilton, 2020). Results show such digitally creative business areas bring added competitiveness and typically perform, and

grow, above the general business deliverables of the economy as a whole (Clun, 2017).

Across such COVID-19 pandemic times MCFs can offer astute firms even further assistance -such as applying their 3Cs approaches as a relational assistance mechanism designed to advance changes in each firm's business competitiveness. MCF-CF capabilities deliverance approaches do vary depending on the CF, and its capabilities, and its contractual requirements. For example, the MCF-CF approach may be (1) a CRM system building higher-order meta-cognitive competitive intelligence solutions (Srinivasan, 2014), or (2) value deliverance systems capturing qualities, performance and economic utilitarian capabilities (Jones et al. 2006; Seetharaman, 2020). These and other MCF-CF deliverables modes offer new, scalable, CF business competitiveness solutions.

### a) Study Implications

Table 3 introduces the 3Cs model standardized total effects. All competencies and capabilities exert a significant change in CF sustainable performance positioning and collective intelligences positioning – with knowledge creation and innovation being weaker causal contributors.



Table 3: MCF-CF 3Cs Model Standardized Total Effects

	Entrep Intel	Capital	Knowledge	Creation	Capacities	Innovation	Qualities	Risks	Avoidance	Servicing	Performance	Satisfaction	Eco Worth	Competitive	Intel	Average	Effects per	Construct
Qualities	0.56					0.38												
Risks Avoidance	0.33				0.42	0.23	0.59											
Servicing	0.19				0.64	0.13	0.34	0.57										
Performance	0.44				0.18	0.30	0.80											
Satisfaction	0.31				0.40	0.21	0.56	0.95										
Eco Worth	0.24	0.30	0.31	0.17	0.44						0.55							
Competitive Intel	0.36				0.32	0.24	0.64	0.29	0.50									
Collective Intel	0.25	0.16	0.28	0.17	0.45	0.10	0.17	0.30					0.54	0.34			0.28	
Sustainable Perf	0.23	0.08	0.49	0.16	0.42	0.52	0.47	0.14	0.27	0.25							0.31	
<b>Average Effects per Construct</b>	<b>0.33</b>	<b>0.18</b>	<b>0.38</b>	<b>0.22</b>	<b>0.53</b>	<b>0.48</b>	<b>0.38</b>	<b>0.33</b>	<b>0.27</b>	<b>0.40</b>	<b>0.34</b>							

i. Assessing the MCF-CF 3Cs Model Standardized Total Effects

As the average effects per construct for collective intelligences (0.28) and sustainable performance (0.31) are near equal we may assume that business competitiveness is equally delivered via these two constructs. This suggests the most important areas to maximize are the MCF's capabilities and entrepreneurial intellectual capital followed by the CF's qualities, risks avoidance, servicing, and economic worth.

Further, to boost CF's collective intelligences, the CF should specifically contract a MCF with competencies that offer strong existing (digital) entrepreneurial intellectual capital along with a strong set of relevant strategic capacities. Table 3 indicates innovation is a weaker competencies contributor to collective intelligences. Thus, it remains a likely business improvement target area for the CF, and one that the MCF can focus on when enhancing its future competencies.

To promote collective intelligences the key cross-system capabilities constructs of qualities, risks avoidance servicing, competitive intelligences likely need optimization, along with the constructs supporting economic worth. Thus, a complexity of CF approaches is available to the MCF when seeking progress towards optimizing CF collective intelligences. A similar consideration is used to optimize CF sustainable performance.

Still further optimizations are possible across the three capabilities systems of Figure 2. These systems can be structurally equation modelled, and their optimization can be mathematically gauged. This aspect is reserved for a subsequent article, but it is generally described below (section 5.2) in conjunction with this

study's Table 4 adaptation of the strategic change matrix.

ii. Table 3 and Research Question

Figure 3 and Table 3 clearly, and positively answers the research question 'in COVID-19 times can MCF competencies, and developing MCF-CF relational capabilities, model into enhancing a CF business competitiveness position?' Here the CF's business competitiveness position is captured conjointly by the CF's sustainable performance positioning, and by the CF's collective intelligences positioning.

Further, all constructs used in this study exert positive causally-directed effects. This indicates all constructs may help to improve a firm's competitiveness. Thus, the CF should strategically investigate the deliverables of each construct for possible modification, enhancement, change, or even as possible drivers of a potential pivot change.

When seeking a strategic, beneficial, or optimal repositioning, the CF should carefully consider the individual contributions of each relative measurement item and construct effect within each system, along with the relative optimizing contributions across the entire 3Cs model system. Once such optimization contributions are mapped, then the CF can formulate, and implement as desired, its immediate and ongoing competitiveness strategies.

b) The Strategic Change Matrix

The Figure 4 strategic change matrix offers pathways towards advancing past research. It offers pathways to move from a low-level current Z axis matrix box capturing operational, risks and intelligence capabilities systems to a new Z axis positions shown as '1.' The Z axis also implies that operations sets the base, which is refined by risks avoidance incorporation, and which is further refined by competitive business and

markets systems inclusions. The other axes can be similarly considered. This visual interpretive approach

offers competitiveness pathways towards future-proofing a modern agile firm (Hamilton, 2020).

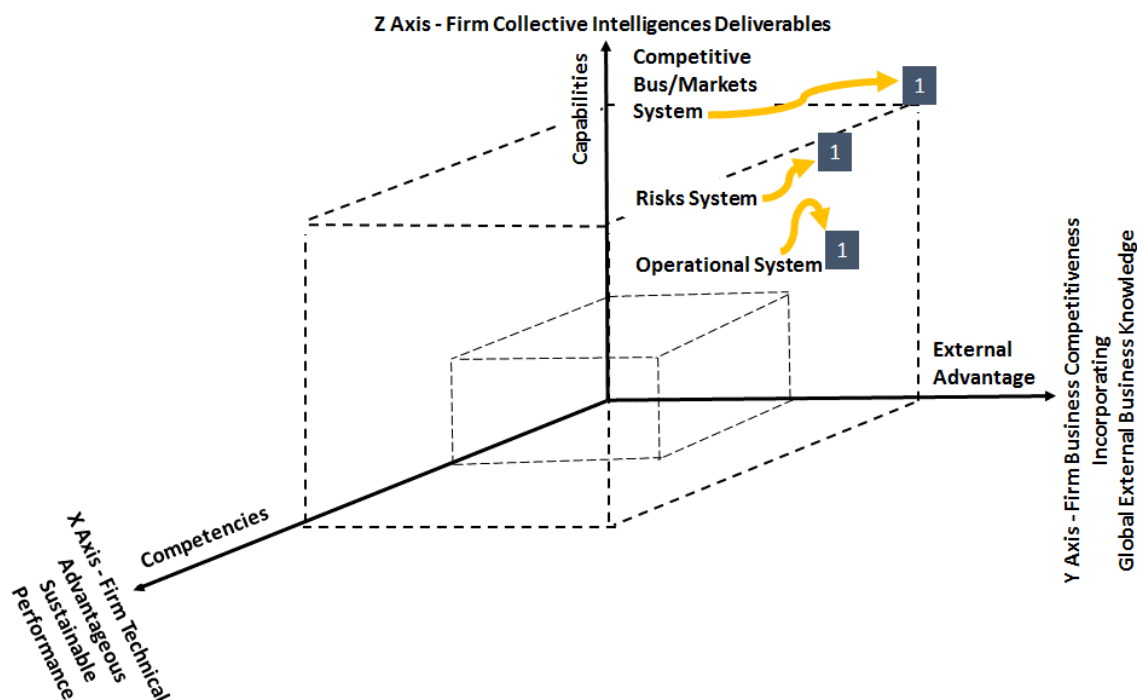


Figure 4: Strategic Change Matrix (adapted from Hamilton, 2020)

Across today's COVID-19 pandemic times, agile firms are repositioning in response to their dramatically-changed business circumstances. CF's seeking to reposition often contract a MCF to assist them in maintaining and/or strategically re-mixing their existing business networks. Today the MCF-CF relationship typically seeks to digitally integrate CF business systems further into an optimizable state of dynamic but flexible equilibrium. Here, the CF is

positioned towards strategically executing chosen, circumstances-altering, business model changes - ones that incorporate its firm business systems. However, these business systems such as those shown in Table 4 likely network in some form across the three capabilities systems analyzed in this study. Thus, as per Figure 3 and Figure 4, a visual understanding of these overlaps can develop as presented below in section 5.3.

Table 4: MCF-CF 3Cs Standardized Total Effects Systems Contributors

Firm Business Systems (Hamilton, 2020)	Values Deliverance Systems	Consumer Relationship Management Systems	Competitive Intelligences Systems
Glocal competitiveness systems	x	x	x
Digital business knowledge systems	x	x	x
Innovation and technologies systems	x	x	x
Capabilities systems	x	x	
Optimizations and feedback systems	x	x	
Economic systems	x		
Intelligences and services systems		x	x
Internal/external leadership & overviews systems	x	x	x

### c) The MCF-CF Relationship

Table 3 can incorporate into Figure 4 as follows. First the standardized total effects scores for just the values deliverance system can be averaged to an x axis

score of  $(0.24+0.30+0.31+0.17)/4 = 0.25$ , a y axis score of  $(0.54+0.25)/2 = 0.40$  and a z axis score of  $(0.44+0.55)/2 = 0.49$ . Second the standardized total effects scores for just the CRM (& risks avoidance)

system can be averaged to an x axis score of  $(0.33+0.42+0.23+0.59)/4 = 0.39$ , a y axis score of  $(0.57+0.95)/2 = 0.76$  and a z axis score of  $(0.0.17+0.47+0.27)/3 = 0.30$ . Third, the standardized total effects values for just the competitive intelligences system can be averaged to an x axis score of

$(0.36+0.32+0.24)/3 = 0.31$ , a y axis score of  $(0.64+0.29+0.50)/3 = 0.48$  and a z axis score of  $(0.34)/1 = 0.34$ . This result is visually shown as Figure 5, and it represents the average change MCF respondents expect to deliver to their contracting CFs.

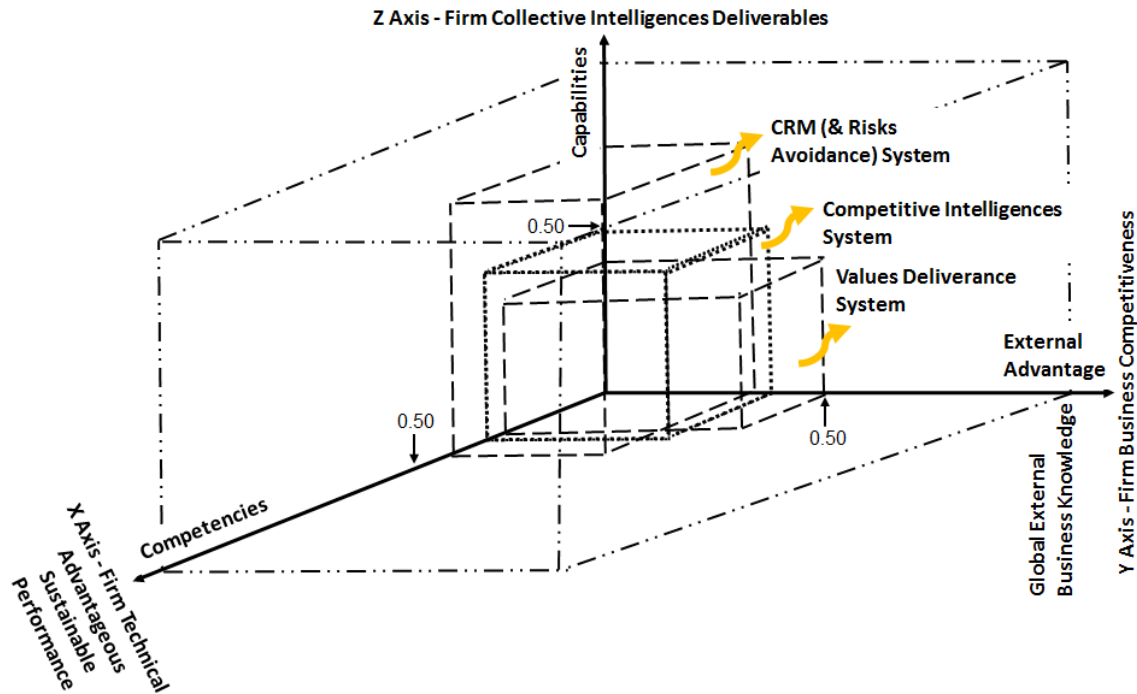


Figure 5: Strategic Change Matrix showing typical MCF-CF capabilities systems

These values suggest the MCF-CF relationship likely delivers a different solution for the developed CF capabilities systems of each contracting CF. The values system has a stronger competitiveness focus. The risks avoidance system has a stronger collective intelligences and competencies focus, whilst the competitive intelligences system positions intermediate or between the other two systems.

Further, an overall strategic change matrix position can be established by computing a net score for the three axes (x axis = 0.32, y axis = 0.54, z axis = 0.38). This indicates the management consultant respondents in India recognize they relationally contribute to the CF's strategic improvement across all three dimensions. They believe they typically advance: (1) CF competitiveness by around 54%, (2) CF collective intelligences by around 38%, and (3) CF competencies by around 32%. Thus, the MCF, on average, provides significant, advantageous, but still only partial business competitiveness solutions to each contracting CF.

d) *The Strategic Change Matrix: a Firm's Values Deliverance Pathway to Competitiveness*

Table 4 depicts that each firm can have a unique strategic change matrix position box (which may

or may not be rectangular) with three overlaying strategic y axis systems. The first y axis system is the strategic operational systems box. Here the firm executes its operations as a values deliverance system.

The firm exists because its qualities, performance and economic worth deliverables are suitably aligned to, and appeal to, its global/local consumer markets. The firm normally strategizes and targets towards its most efficient, effective, viable capabilities deliverables. Hence, it attains a strategic target conversion value of between zero (0%) and 1 (100%). Here, the standardized total effects of Table 3 can gauge a relative, average-weighted score. For example, a firm can follow the Figure 3 3Cs model and establish its own construct beta path weight standardized total effects across its values deliverance system. The firm can then apply these focal points, and test various optimization contributions towards improving its economic worth. Similar estimates can be established for the risks avoidance and competitive intelligences systems. Again, strategic change matrix boxes or an overall strategic change matrix box can be established for the firm. This sets the firm's base-line from which it can competitively gauge and then direct its

strategic, unique, future repositioning. Thus, any CF can use this study's approach and work from a more informed values deliverance position aimed at to strategically improving its competitiveness.

#### e) *The COVID-19 Pathway to Future Business Competitiveness*

In searching for a competitiveness position beyond COVID-19, the CFs sustainable performance can be advanced with additional measures incorporating latest knowledge additions, further useful innovation inclusions, broadened/heightened capabilities, and/or additional (relevant) entrepreneurial intellectual capital. In special circumstances where a firm requires a change of direction then a pivot solution may be considered around the global external business knowledge area of the y axis.

Where the firm has a current strategic change matrix position determined, it can pursue an advantageous new strategic matrix box positioning. For example, the firm may choose to target a 20% stronger collective intelligences system designed to digitally enhance its value deliverance system, whilst mitigating certain risks. This potentially strengthened business competitiveness positioning also involves competitiveness externalities such as: greater buyer demands, positive supplier changes, less competition, fewer substitutes, and/or fewer copy-cat entrants. Alternatively, if a firm selected a 10% improvement to its existing sustainability performance position from its chosen budget allocation – then from this study's approach this may arise by just smart innovative inclusions to the 3Cs model approach.

Any firm can apply the 3Cs model and strategic change matrix approach. A firm's strategic change matrix box positioning offers a rapid visual from which a firm repositioning or a competitor analysis can be visually assessed for key points of competitive difference against the firm's external environment. The firm can also select where, when and how they can reposition the business. A future, firm-pursued, strategic change matrix box need not be a geometrically regular box shape. It may be specifically expanded towards one focal point, or even towards multiple combinations of competitiveness points. Thus, there are many unique ways for a firm to improve its own post COVID-19 pandemic business competitiveness. Alternatively, a CF can engage a MCF and drawn on its competencies and capabilities to rapidly develop its chosen 3Cs improvements into a recognizable strategic change matrix position.

#### f) *Management Consulting Theory and Competitiveness*

There is little definitive management consulting theory in the literature and it remains inconsistent. This is in part because management consulting can encompass a diversity of activities. However,

management consulting remains a strategic management relational resource process that usually arises between a MCF and a contracting CF.

Thus, this study proposes that:

*'management consulting theory embodies a 3Cs management consulting process - where the management consulting firm competencies (as networks of potential business enhancers) relationally mix with the contracting client firm by fusing their competencies and improving the client firm's capabilities systems. Together these improved networks of shared deliverables systems then contribute towards changing the client firm's business competitiveness positioning.'*

Here, the client firm's business competitiveness positioning embodies the 'global/local' business systems outcomes embedded throughout its sustainable performance positioning and its collective intelligences positioning.'

## VI. CONCLUSIONS

This India-wide, empirical, point-in-time, global literature-supported, quantitative study involves 232 leading management consulting firm (MCF) consultants and contracting client firm (CF) perspectives. It positively answers the research question showing that today in COVID-19 times, MCF competencies, and MCF-CF relationally developed CF capabilities can network model towards a solution that can change a CF's business competitiveness position.

This study shows that by applying firm-specific refinements to Hamilton's (2020) Figure 3 MCF-CF 3Cs model, and by next incorporating a Table 3 MCF-CF 3Cs Model Standardized Total Effects approach, then a Figure 4 and/or Figure 5 visual, three-dimensional, geometrical, and relational- strategic change matrix position can be mapped for the CF. When next pursuing a more-optimal, strategic (and unique), future CF business competitiveness position, this existing CF strategic change matrix position can be re-gauged, and/or further interpreted, in a similar manner to Figure 5.

Across this 2019-2020 COVID-19 global pandemic time period this study supports the need to strengthen, and refine, the sparse and shallow attempts at building 'Management Consulting Theory.' This study believes 'Management Consulting Theory' should strategically embody management consulting processes - specifically linking MCF competencies (as networks of potential business enhancers) into the MCF-CF relationally-developed CF competencies, and into improved CF capabilities systems deliverables. Together these improved, and networked, multiple CF deliverables systems can then contribute towards changing CF business competitiveness over time.

Today's sudden COVID-19 forced changes on the business world means the firm may need to:



consolidate, or diversify, or pivot, or reinvent, or digitally re-tool, or experiment/transition/exploit a new option. Here, the firm may need to collect and wisely consider each embedded component of its intelligences. This should be conducted in conjunction with it assessing the relevance, and the priority, of each of its sustainable performance components. Such forced change situations likely draw on the firm's competencies, and particularly its weakest engaged competencies of knowledge creation and innovation. Enhancing these two competencies can give the firm a substantive business re-positioning advantage. When implementing such changes, the firm may carefully choose what items it can best uniquely-network across its 'global/local' competencies, and then how to target-map these into reframing its business model. Here, its latest innovative/digital/knowledge approaches can incorporate into its capabilities by additions across its values deliverance system, its CRM system, and competitive intelligences system.

Finally, to cross beyond the COVID-19 pandemic, the firm's business competitiveness choices of what, when, where, and how to focus/retain its uniqueness across its 3Cs constructs can all deploy into its re-modelling and re-optimizing processes. Over time, these two enhancing processes should focus on increasing the firm's business competitiveness components, and they can do so by focusing almost equally on both its sustainable performance positioning and also its collective intelligences positioning!

#### Recommendations and Limitations

This India-wide, point-in-time study offers new research, a new 3Cs constructs model, and a strategic change matrix application tool as a new approach to the MCF-CF relationship and business competitiveness. It is validated by bootstrapping (Cunningham, 2009), but for wide global acceptance it can be further validated by additional research studies conducted across developed countries and/or possibly sub-sectioned across major global cultures. Validation can even occur via specific industry studies. Such future research studies should also seek to contribute towards management consulting theory.

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## Temperature Data in 3d Structure Reveal the Internal COD Involvement in Molecular Form

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**Abstract-** Addition of small molecule into force is going to be the task of another rule based activation for any meaningful application in biology of animalia kingdom of existence. Otherwise it is mandatory to fulfill the norms for adequacy principle arising out of carbon value in force here in protein or other where carbon alone dominates the due course of action and all. Accordingly we have developed an internal one proposal for any meaningful application in carbon based study of intervening elements of interaction arising from carbon value. Additional to existing calculations in modeling, it is going to be the one only force will dominate the scenario of molecular alteration for many salvations in living organisms. According to rule of law coming from carbon profile, the hydrogen atom also to be the main part of the value calculation and all. According to new force of carbon calculation, it is here calculated to be the internal one of carbon profile found in 3D structure where another part of intervening elements taken into account.

**Keywords:** ICOD, temperature factor, carbon value, protein, DNA/RNA, CARd3D, cohesive force, rule of law.

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# Temperature Data in 3d Structure Reveal the Internal COD Involvement in Molecular Form

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**Abstract-** Addition of small molecule into force is going to be the task of another rule based activation for any meaningful application in biology of animalia kingdom of existence. Otherwise it is mandatory to fulfill the norms for adequacy principle arising out of carbon value in force here in protein or other where carbon alone dominates the due course of action and all. Accordingly we have developed an internal one proposal for any meaningful application in carbon based study of intervening elements of interaction arising from carbon value. Additional to existing calculations in modeling, it is going to be the one only force will dominate the scenario of molecular alteration for many salvations in living organisms. According to rule of law coming from carbon profile, the hydrogen atom also to be the main part of the value calculation and all. According to new force of carbon calculation, it is here calculated to be the internal one of carbon profile found in 3D structure where another part of intervening elements taken into account. As part of this work the internal carbon values are compared to temperature factor value of crystal valuation. Accordingly the tested molecule of SOD obeys this internal one and all other parameters needed to incorporate therein. Interestingly the internal values dominate the scenario of uncertainty arising here in temperature factor for protein as well as in RNA or DNA. Very well documented internal values are crucial for any meaningful application where other modifications arising for alteration at the vicinity of active role played by proteins and so on. One can trust these developments for any meaningful applications arising for disease solving or control and also for proteome of future applications. Over and above this evolving newly developed one going to be the task of newly existence of successful run for the future one.

**Keywords:** ICOD, temperature factor, carbon value, protein, DNA/RNA, CARd3D, cohesive force, rule of law.

## I. INTRODUCTION

Atomic coordinates of all protein level seems to be clear from the pdb of RCSB. However other parameter that are in play are not yet taken into account here in pdb where only occupancy and temperature factor is listed there against each atom. Additionally other atomic level coordination coming from carbon alone is missing in part. Of course it needed to be worked out for certain application and all. All that happens under universal law of force may represent here in pdb of protein structures. However the uncertainty arising out of carbon value hence forth

incorporated in due course of action coming along side of developmental technology of new generation [1-20]. All that needed to be incorporated are how small portion of protein molecule might interact with neighboring one to compensate the needed internal COD (ICOD) formation that and all part of the newly evolving proteomics of allied science yet to be realized.

All that happen in due course of interaction within or external one may be put forth for meaningful application here in biology or in material science where another type of atoms to be in study of interaction with changing parameters of ICOD values. Whereas it is necessary to monitor or alter these changes along the newly evolving proteome values. Under this circumstance it is very clear that atomic coordinates may represent all that uncertainty related issue of individual atoms. Fact is that ICOD values determine to be part of this new force of interaction which govern in all temperature value or B-factor of individual atoms. When atoms are uncertain according to rule of thermodynamic principle, very essential to take into account of this ICOD activity of individual atoms involved in protein structure or action of other one internally in the structure. Fact being that ICOD values dictate to be in order or disorder which temperature value reveal it. Many such interaction forces arising from carbon force of interaction might be uncertain in individual force of atom altogether in the protein of interest. However very many fact of domains revealed in nature of proteome of pdb one is revealing the all available forces according to rule of law governed by force arising out of carbon fact of adjoining elements arising from neighboring residues of unknown value which again in due course of interaction with other set of amino acids or so. Additionally alteration might be in force with other elements available locally in the vicinity of protein molecule is concerned.

Additional force arising out of carbon value may be computed from COD of all atoms out of CARd program written in PERL. All these happening out of additional force may be intriguing as for as protein structure or available interaction with other of forceful interaction. In the vicinity of interaction it may be noticed to involvement of neighboring one in response to other force of interactive elements. Addition might be intriguing in this in order to improve the additional internal COD at that point of interaction. According to nature of interaction

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intriguing in the vicinity of elemental adjustment arising here internally may be captured via our ICOD value available from CARd3D one additional to other all atom force available via other packages of modeling stuff. Over and above it is only the carbon value of interaction determined to be interactive elements in the course of structure formation or interaction with other elements of adjoining force of interaction. However it is limited to protein 3D structure availability. All other parameters may be generated for ICOD of available proteins. At the same time additional force might be interested to make any addition or omission of amino acids that and all involved in ICOD formation at the sight of vicinity or long. All that matter to incorporate in due course of action in science of everything where these alone are major player of the game of intervening elements and all. One can go along the way simulating it in terms of carbon force of interaction. However limited to narrow one available for certain applications. All that matter to incorporate in the calculations may not work accordingly in the vicinity of additional force incoming in terms of carbon value. All along the calculations however may refer to additional structural value available from pdb alone help in improving it. Otherwise going to be exhaustive in terms of carbon force calculation for any meaningful applications. Adjoining one is crucial for any addition to take part which is part of available protein structure already in the database. Already available one of course be crucial for any application of mutational study or so. All that available one workout to be part of addition or not. Addition or deletion may be accepted or not in force may be computed based on the available structure one for that event of situation in addition to other force coming from adjoining elements counted from amino acids of interest. Here we prove that addition of small molecule in the vicinity of active stretch in protein of interest may be captured from carbon value alone but comparable to temperature value of additional information available in the crystal structure at pdb via RCSB. According to new table, ICOD can be captured via temperature factor value available via X-ray structure. All the happenings to individual atoms are adequately captured in the value provided for temperature value additional to occupancy which is differently dealing the same concept of uncertainty. According to new line of uncertainty, additional force of interaction is due to carbon value which again in terms of available structure. Additionally other force that may influence another molecule accordingly in the crystal are needless to incorporate in this value of uncertainty where carbon value arising from internal alone is deterministic in uncertain is concerned. Otherwise temperature factor may or may not influence of

another molecule deposited over the other during crystallization. All that happening because additional force arising from internal COD and all that arising out of other may be neglected during consideration of uncertainty in the event that addition or drifting of course be part of carbon value alone where other may be excluded for consideration accordingly. Otherwise going to be significant in terms of carbon of force arising out of additional work counted via ICOD value. For the present the additional forces are calculated to be in accordance to available temperature factor which are demonstrated here in this study. Over and above it is true to be considered as it is and no further arguments needed to be included for any point of consideration. All that happenings in the vicinity or structural one are due to this carbon force of interaction. Accepting it in terms of ICOD preferably be useful. Non adherence of ICOD may be deviation from intervening elements of interest in terms of available sources for and above the application is concerned. One should go ahead with this newly evolving practice of carbon value for any purposeful deviation in addition to other values coming for object oriented application. Over and above it is to be the true of all that happening in protein science and macromolecule of biologically important. Very well documented elsewhere in the universal problem of doi to be incorporated. Fortunately we have some applications leading to disease solving and all. Incorporation of these newly evolving proteome going to be the part of main source for application where new creature yet to be realized and all. Additional to this force of interaction for several diseases solving, adherence of alternative elements of interaction may be crucial for evolving genome over the current disease oriented omics under influence.

## II. METHODOLOGY

Of course the data for the analysis are always be the pdb under RCSB. According to the rule of law governing from carbon fact of adequacy principle the CARd program does take care of everything from sequence read to analysis and report. Overall performances are already reported elsewhere []. Better combination of analysis and alteration are adjusted to meet the carbon value to be evaluated according to rule of law. Over and above it is significant to involve this analysis for alteration and all. CARd performs operation at outer length of 62, 78, 109, 125, 140, 155, 171, 202, 218, 233, 249, 264, 342 and 700 atoms and average for analysis report. According to carbon rule of law, it is expected to have value of 0.3144 for an ICOD to be achieved or else alternative carbon high or carbon reduction state. According to the principle observed from carbon value, it is noticed that carbon high portions

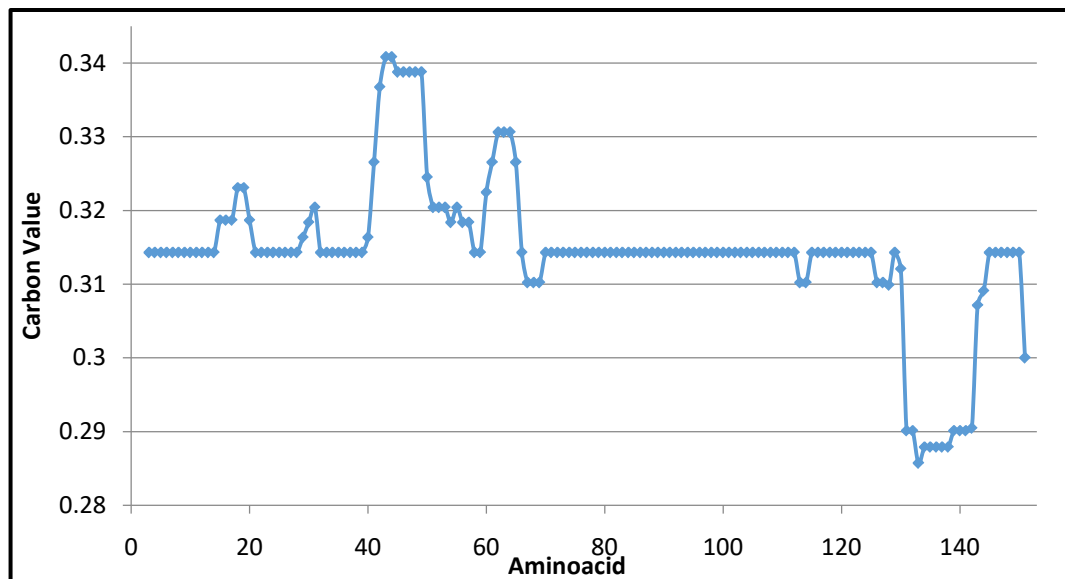
are not accommodated fully at lower dias and is met at higher dias which in turn meet the temperature factor values. Well here we analyzed the temperature factor values which are direct evidence of our ICOD calculations observed elsewhere in the other applications side. Of course it is mandatory to follow the ICOD principle even if the atoms are not arranged accordingly. Otherwise the amino acids are arranged to represent this task. Whereas mandated in it to achieve the proposed structure or selective function. Well this phenomenon is captured in this CARd value reported in the figure 1. It is a plot of carbon value averaged over the above out length and amino acids. Of course arranged amino acids are according to needs of the protein of interest; here it is super oxide dismutase (SOD). The pdb code of all is 2XJK. Over and above it turns out to be radical change in the overall ICOD formation and alteration occurs only at active region and accordingly the other parameter coming from X-ray values.

The other analysis reported earlier to capture the carbon phenomena is the carbon in 3D structure that reveal again ICOD, hydrophobic or hydrophilic regions that are amenable from COD formation. Work has been considerably improved over a period of time to test several phenomena that take place in biology and all. Accordingly the CARd3D program is altered to capture the essence of unattended phenomena that are ICOD relevant. Accordingly we have developed to ICOD parameter in different dias from as low as 4 and high as possible, but here it was 7 to 77 which cover all necessary values. Well said earlier that carbon role of honor is in adequacy to if any protein to be active. Accordingly the amino acids are embedded into it. As per adequacy principle the alternative biology of upcoming events are arising from carbon alone. Otherwise call it as adequacy of alternative realm adjoining the amino acid of interest. Arranged amino acids are altered according to the carbon value to accommodate in the structure. Otherwise action takes place from carbon alone and none other than this. According to rule of law, adequacy is met, provide it meets the requirement of 31.44% of carbon value provided with circular arrangements. Accordingly the arrangements are met to satisfy this parameter. Otherwise there is going to be altered structure according to dia of different value. Well it is said that the parameter at dia 16Å adequate the principle for lower dias otherwise all other dias are adjoining one to play around. According to new realm the principle has to be met out to accommodate carbon value. Otherwise other molecule of interest might satisfy them to rule the carbon value. Well all these are well captured in the program and averaged for plot as shown in figure 2. Also the accordance are limited to carbon role and adhere to the norm of carbon value accordingly. Very well documented alterations are applied here to

compare with temperature factor of all elements. Otherwise going to be overall performance rather than local parameters which are taken into account of other activity that take place in biology.

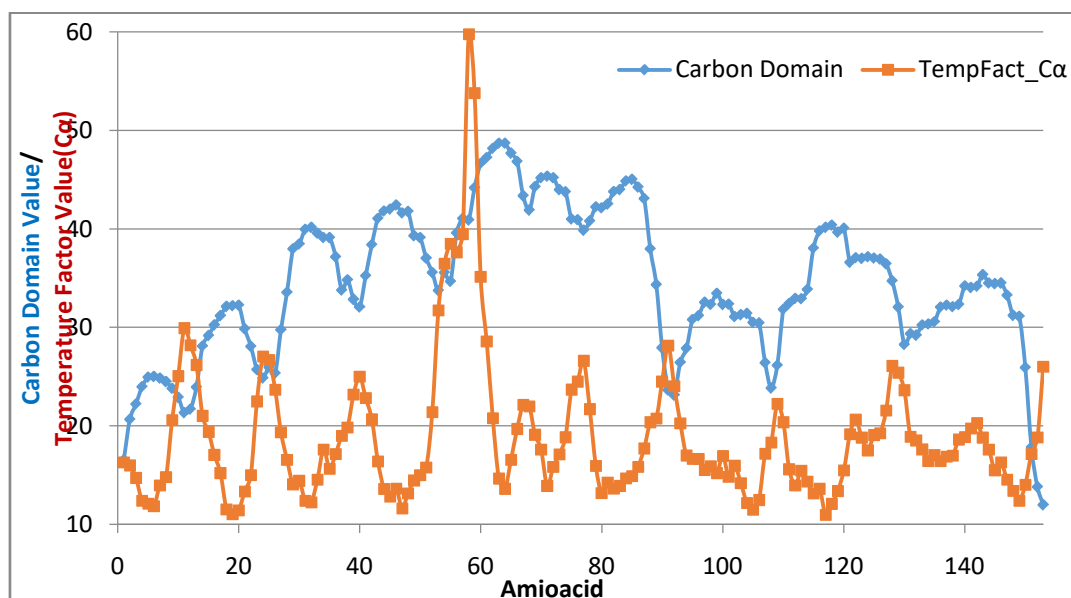
As said above the adequacy parameters are alternatively captured from temperature factor value which takes into account of all dias of adequacy value rather than dia at 16Å alone. Alpha carbon values are arranged according to amino acids as shown in figure 2 and framed according to ICOD value obtained from average of all dias and so on. According to rule of law one might be expecting the value to be in par with X-ray crystal data alleviate to modernize our ICOD value of all ICOD obtained from lower dia to maximum possible dia. Accordingly the values are extracted to map the parameter with ICOD value obtained from CARd3D program of alternative one to solve different dias. Well one would expect ICOD to be according to nature of interaction coming from carbon role. Accordingly the values are arranged and plotted against to amino acids. Ofcourse the values may be from average of all atoms of individual amino acids to take into account. Interestingly it works well. Otherwise the alpha carbon alone represents this phenomenon of ICOD at all level. Accordingly the arrangements are carried out perform the operation of ICOD and temperature factor value comparison. As shown in figure 2, the arrangements are neat and alternative to ICOD value. According to rule of law, the ICOD regions are stable over the hydrophobic elements and hydrophilic might be able follow or not. As said in the principle the ICOD portions are expectedly lower temperature factor value and stable over the other disordered unstable portion. Accordingly the results are interpreted. Otherwise ICODs are alternative to temperature factor of all atoms vice versa. Arrangements are to meet the required threshold to say order or disorder and so on. Well said earlier that the hydrophobic portions are less stable over the ICOD regions. But in this case the hydrophobic regions are covered with larger ICOD parameters coming from adjoining elements of interest. Accordingly the temperature factor parameters are valued. Arranged are the average ICOD values and alpha carbon temperature factor value. Otherwise going to yield overall performance of the protein system and may not be the individual role played by intervening elements which are spelt out by ICOD here. Well ICOD may perform better over the conventional value obtainable from X-ray in terms of order or disorder is concern. Otherwise X-ray are arranged values and ICOD are computed value which again superior over one another. Very well that ICODs are comparable to temperature factor value which again alleviate the next level of operation and all.

## III. RESULTS AND DISCUSSION



**Figure 1:** Graph showing ICOD calculated from sequence information. Note that the line on carbon value of 0.3144 is ICOD portion of the protein. Otherwise the non ICOD having higher carbon value is carbon rich and carbon reduced portion is hydrophilic in nature

The average GAD values for SOD is given in figure 1. As can be seen there the GAD portions are having carbon value of 31.4% at 1-12, 21-27, 32-38, 70-124, and 15-19. SOD possesses active site at about 51-62 or hydrophobic part at 15-20, 28-31, 40-56, 59-65 or hydrophilic part at 130-145. As part of the ICOD expectations the carbon rich hydrophobic parts are in disarray or unstable over GAD regions. Accordingly occupy higher temperature factor values as part of the sedimentation of crystal of one another. Otherwise the GAD regions are highly stable over the other regions, compact and array forming over the rest of the portion. Believe it or not the hydrophobic portions are in disarray and accordingly higher values of temperature factor. Provided the large scale proteins can accommodate these carbon rich portions of ICOD at higher end. Naturally the higher carbon content active regions are accommodated accordingly by neighborhood. Whether or not the active roles are protected by neighboring GAD regions, accordingly safeguarded during inactive time of intercourse. Over and above the portions which are hydrophilic may take part in domain formation. Otherwise it requires more carbon for ICOD formation. Accordingly one can test with mutational study over the issue. Proof that ICOD of all amino acids exception to carbon high nonICOD forming regions are stable over the one with high carbon values.



**Figure 2:** ICOD computed along the protein in different dias are averaged for total carbon domain value which are in comparable to temperature factor of atom C $\alpha$ . ICOD are agreeable to temperature factor according to the nature of atom involved with ICOD or carbon-rich or carbon reduced portions

Accordingly the ICOD of all amino acids are computed using our homemade CARD3D program written in PERL. As seen in figure 2, the ICODs are plotted against amino acids which are in accordance to ICOD of GAD regions that are shown in figure 1. Also in the plot are temperature factor of alpha carbon of each amino acids taken from crystallographic data (pdb structure). All are in agreement with ICOD value with hoping that higher ICODs are highly stable over the non ICOD regions. Interestingly, the ICODs are invariably matching with temperature values all along the amino acids of domain or nondomain regions. Otherwise hydrophilic stretches may be deviating with negligence for purposeful arrangements to form ICOD. Otherwise all are accordance to ICOD and only the ICOD determine to stability over the other forces of interaction revealed from various other sources. Well it is clear that carbon alone do match with temperature factor of all atoms and nothing of coming from van der Waals or from electrostatic one. Deliberately it is devised to have ICOD forming elements in the control of cohesive force arising from carbon alone. Nonetheless it is advised to form coherent intervening force to make it an ICOD and all. Otherwise ICOD will be in a position to take over the issue of ICOD formation by mutation or alteration for meaningful applications. Advised to form a nonICOD stretches for any interactive species to have eventuality of intervening elements in accordance to arrangements already in the available data of pdb structures. Anything arising out of this eventually be useful for non-intervening elements of accordance to follow for futureful applications. Otherwise going to be in the market for damage control and all. Many eventualities are coming forward to makeup the disease control and

all. Otherwise going to be useful for meaningful application of disease prohibition or stopping of catching of disease formula under the cloud of carbon one. Over and above this may be useful for futuristic application over development in accordance to developmental biology for future creature. Well otherwise going long way of travel with many different eventuality as per demand over space and time. Nurture these phenomena of intervening elements to pursue new kind of research over the development of new creature with adequate knowledge and support. Well known fact that dreaming high is big enough to pursue upcoming one to continue with dedications and test, rather than merely occupying position and above. Over the period of time this has consumed enormous amount of time and effort to come to this stage of knowledge based movement to recruit other elements that can survive in due course of time management. Whereas it is time now to think of this newly evolved force of interaction in the years to come. Whereas it is alpha beta of elemental course of interactions in the year ahead. Well it may be taking part in the event of eventual analysis of intervening elements to construct a robo like platform for other space of interactive elements intervening. Over and above this might be interesting to note the survival of this newly evolved one to take over the existing one during meaningful application as otherwise limited by a factor adjoining force which may not work fine everywhere in the system of approach. Rather it may be better performer over the existing phenomena of interactive elements in dealing situation to situation accordance to fruitful discussion on eventful applications. Otherwise going to be the wonderful meaning of event that controlled by other passes by



newly developed wondering of other of plan work force adjoining the existing one which may fail at one point of time. Accordance to new force of interaction it is a matter time to take over the new plan of action to deliver new variety of actionable applications. Eventually it is matter for moving body to accomplish the task of driven force or less over the conventional one already existing. During this new variety of application it is recommended that popularly known ones are driven away first during due course of interaction. Eventually that occupy the new form of action during initiation and all. Well it will be marketable for many to accomplish the task during failure of the existing condition and above. Overwhelmingly it might solve several such problems during this kind of operation in the universe of meaningful applications. Well in advance one can plan or die hard to establish this newly evolving event to the point that it might be interesting to makeup. Over and above it is a fantastic development over the conventional one during the production stage of interaction. Wellbeing is the key to success of this new force of action taking part in the additional action of force forming from carbon alone. Over a period of time of course all other issue can also be brought up to the meaningful application in the eventuality that may fail to accomplish task oriented problem. Very well done in this case of alteration eventually need of this hour for accordance to the nature of elemental analysis during the process of action. Otherwise going to be big hit in the event that may fail to accomplish the task may be brought forward the reality of working. Well it is a matter of time to come and accomplish this task.

In most of the applications it is going to be the task of calculation the ICOD value at dia of  $16\text{\AA}$ . Whereas it is counted as the whole lot of dias for the temperature factor is concerned. Accordingly over a larger spectrum accomplishment it may be higher ICOD values for carbon rich regions which is expected for satisfaction. One might even think that the smaller dia ICOD can be compared for larger dia value adjusted in temperature factor of atoms. Otherwise accomplishments are adjusted for higher carbon value while the ICOD patterns are left out at the higher performance of intervening elements coming from longer neighbors. Eventually it is for the eventual elements to accomplish the task of fulfillment of ICOD formation and all. Otherwise all other are satisfied with lower dias eventually end up with lower ICOD value. Meaningful say that accomplishments are attained at smaller dias and adequacy met at that level, further may not be required to proceed with neighboring value. Over and above it is a matter of time to achieve this task of fulfillment the eventuality of needless carbon out there. Otherwise going to be healing of the carbon rich pattern in the event of hydrophilic pattern that are adjacent to hydrophobic part.

Non ICOD patterns are filled with atoms of ICOD forming elements. Whereas it is mostly the recovery of this force of interaction the poison that adapt to the biology of living matter. Well one need to spend time on it to win this task of inadequacy. Many are inadequate to meet out the task of other platform in joining force. Only the lower phenomenon of adequacy is important for functional units to work in nature. Many such viral ones are behaving this platform needless adequacy problem. Well one might want to meet out this task of achievement of disease free zone of alteration. Mutational studies may be part this task for meaning application of viral one to achieve the force of action.

Well we have reported that cohesive force alters that bond lengths of atoms involved in ICOD. Accordingly the system response but not on the basis of long range interaction as reported for temperature factor. Other evidence of intervening elements are accomplished by superposition of one with or without alteration at active sites. It is clearly explaining the adjoining elements in dealing with ICOD of nonICOD elements in active one. Over and above it is a matter of time to eliminate the task of non-obedience of internal atoms in the ICOD formation.

Temperature factor is one of the main part of the structural proteins to achieve the structure intact of ICOD one. Otherwise nothing can be achieved out of other forces of interactions. On order to match the computed ICOD value with temperature factor we have tested for derivative test which are on accomplishment of ICOD one and all. Derivatives 5-1, 6-2, 7-3 etc seems to be good in the sense that it is matching with ICOD aligned. Over and above the temperature factor of alpha carbon is taken here for implementation of adequacy principle as it alone neutral to the residue of interest. Overwhelmingly it reproduces the result of matching scale, better than any other atoms at the ICOD comparison. Otherwise all atom involvement can be part of it, which again matching it. But there are side chain portions which may deviate from the regular task of ICOD formation and in particular the lysine which has long tail and electrophilic elements at the last of it. All of this shows disorder from temperature factor value. Removal of this lysine from regular task is expected to have better performance over the conventional one. This is phenomenon of deviation is also observed in temperature factor values of individual atoms and also in ICOD values. Well we may conclude that ICODs are the driving force of attraction in all these intervening elements. With this we derive principle of intervening elements existing from available database of pdb.

According to the nature of interactive elements it seems to a pattern of events that take part accordingly as observed from ups and don of ICOD and its temperature factor values. Well we have work towards these intervening elements in achieving the task of mutational study and all. It appears to be occurs at

intervening length of 15 or so. According to principle of carbon principle of adequacy it meets at 16Å which contain about atoms that are coming from neighbor of 15 alone and none are accordance to them. Very well said that the atoms are arranged to meet the philosophy of carbon role. Accordingly arranged are the amino acids. Otherwise call it as adequate amino acids that perform well with carbon profile of attraction. Otherwise going to be other circle of alteration coming from long range interactive elements which may provide adequacy principle as in the case of temperature factor observed for it. Over and above it maintain the law of carbon value adequately and all. One might scale this phenomenon from carbon value of adequacy principle.

One of the interesting phenomena of active site formation due to disulphide bond is unexplained from previous work of other forces. Whereas it is clearly visible from ICOD and comparable to temperature factor value. Carbon phenomenon explains it thoroughly over the active site formation due to cystein-cystein disulphide bond. In fact the neighboring role in fulfilling this demand made out of disulfide bond is felt at the adjoining amino acids instead of that happens at Cys itself. Over and above it is clear evidence of neighbor role in formation of ICOD while in other force is in due.

On analyzing the nucleic acid structures (2M6V and 1YFG) for ICOD formation and comparable to temperature factor values reported therein, it is clear evidence that ICOD alone dominate the scenario of temperature factor and all. It explains atom by atom interaction within the neighborhood. In fact the stacking interaction followed by quadruplex formation by DNA, GGGTTGGGTTTGGGTGGG is due to COD. There are unstable and stable elements along the sequence and structure. Accordingly the ICOD and temperature factor varies. It is a clear evidence of ICOD involvement in biomolecular systems that may be the future of study in due course action. Over and above it is evident that the cross check of this value with temperature factor is going to be the use of monumental development of newly proposing developmental creature of application. Of course project on stalking and pairing interactions or exceptions can be planned adequately to meet out the requirements. Stability factor can be adequately met out from this carbon role of interactive elements and species. None other forces can explain this phenomena of intervening elements and all.

#### IV. CONCLUSION

According to the rule of law governed from carbon value, the proposed arrangements are altered because of adequacy principle. Otherwise it is evident from ICOD value comparable to temperature factor value observed from X-ray crystallography structure. It is

clear that the internal COD coming from carbon role interior to protein or other macromolecule of biological nature are made out of macroscopic scale which again meets out the temperature factor value. Original value of crystallography can be better exploited for purposeful identification and application of ICOD parameter for and above application in living system of interest. Over the period of time it is a matter for every one think in this direction of long livable one arising from carbon value here in this research. Periodic checking and analysis of all such intervening elements of interaction are going to be the pillar of the new developmental creature to come in due course. Over and above it is a matter of time to expose and advance the science of everything coming out from carbon course of interaction. Well in advance one can think of alternative elements to be imparted for smooth transformation of elemental incorporation. Over and above one might even leave out the old one to cherish the new beginning of advanced technological improvement over the conventional one arising as undesirable. Of course one might even want of alternative events to be incorporated at all level for futureful happening while old one to go away. Of course one would go on searching for real application of alternative elements at the adjoining course. Purposeful applications are yet to be chartered out to meet out requirements of elements. Overall it is going to be alternative source of interaction in the course of failure or so. Meaningful of this devised application are to be part of the new developmental application in the years to go or vary again in principle. Overall it may hit the supersonic radio wave parameter to meet the people interest in the course of interaction. One would even go ahead with new line work which provides hell lot of achievable task of magnificent research, alternative to the existing one and all. Alternative in the sense that accommodate the newly evolved one go along the evolving radio frequency attractive to one another. All that happen at one time, of course during the evolutionary time development. One may opt for a prolonged application during this devised application of carbon value. Over and above it is new developmental task to reach out to every needy to take part and all. Overall performance can be monitored to meet out the task oriented problem of interest. One can opt out to change the parameter for betterment in the campaign of engaged life platform. One may think twice to meet the loyal one to risk out the old of anarchy. Of course time will tell all about this task oriented activity related to development and all. One should risk this development in due course of action every now and then. Performance can be altered according to the need or the development for purposeful application.

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# New Numerals and Alphabets-Contribution towards New Knowledge, Cryptology, Encryption, Learner Support, and Afrocentric Studies

By Kwesi Atta Sakyi

*ZCAS University*

**Abstract-** Human communication has developed over thousands of years with contributions to the development of written alphabets and numerals coming from the ancient Phoenicians, Sumerians, Egyptians, Chinese, Greeks, Romans, Indians and Arabs. Our objective in this paper is to introduce new forms of alphabets and numerals which have been developed by us as our personal contribution to the subject of human communication. We developed these characters about ten years ago and now we feel it is time to publish it in a short communication. In this paper, we review some of the literature pertaining to the development of writing and then we introduce the new forms of writing developed by us by stating forward how these new forms of writing can be applied in the real world of human communication. We hope that the new numerals and alphabets will be useful in the fields of encryption, cryptology, and education.

**Keywords:** alphabets, characters, communication, cryptology, encryption, linguistics, numerals, phonology, syllables, calligraphy, palaeontology.

**GJSFR-I Classification:** FOR Code: 330199p



NEWNUMERALSANDALPHABETSCONTRIBUTIONTOWARDSNEWKNOWLEDGECRYPTOLOGYENCRIPTIONLEARNERSUPPORTANDAFROCENTRICSTUDIES

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## 1. INTRODUCTION

We are social scientists with training and academic background in Educational Pedagogy and Psychology, Economics, Geography, Business Management, Public Administration, and we have a passion for the English Language as poets and authors. We aim in this article to introduce new and innovative numerals and alphabet characters which we hope will have many applications in Linguistic Studies, Phonology, Cryptology, Programming Language, Computer Science, Machine Learning, Encryption, Communication Science, Information Technology, and Early Childhood Education.

In this article, we introduce new numerals and alphabets with a view to adding a new and fresh angle to the study of human communication. The article is a short communication that addresses our desire to show creativity by adding to the corpus of existing knowledge as part of our contribution to African scholarship. Information is any data that is organised into meaningful form so as to be useful in addressing human problems and, which can be communicated strategically and

meaningfully to elicit appropriate responses (Turban *et al.*, 2015).

Since the last two decades from the year 2000, there have been tremendous advancements in technological development in the Information Communication Technology arena, so much so that, there is need to pause and take stock of our gains and losses. We are now in the era of Artificial Intelligence (AI) and Machine Learning (ML), which offer many vistas and new opportunities for breakthroughs, and at the same time, they pose as threats to human peaceful co-existence, as some discoveries such as AI and ML may be used for diabolical and destructive ends, such as creation of intelligent weaponry systems and unmanned weapons launched from outer space.

We are likely to see vistas of Smart Cities with extraordinary seamless and integrated transportation systems, all made possible by AI and ML, using Big Data Analytics in Data Science. Also, we are likely to see further, the merging and integration of world trade, commerce, e-learning, e-money or crypto-currency, and convergent sociological systems in an integrated and boundary-less global community, tending towards what many see as one World New Order (Turban *et al.*, 2015; Kissinger). Convergence itself can offer many cost-saving opportunities, yet it can also lead to intrusion into people's privacy, as governments take control of databases like the case is in China, Russia and many of the centrist-command nations of the world, where databases are at the disposal of the authorities.

Also, we see a lot of kickback around the world against the installation of secret cameras in public places to spy on people, especially to help detect crime and apprehend traffic offenders. We find that many people worldwide are sceptical about the use of facial recognition technologies. All these events and actions have moral, ethical, and technical implications in the fields of information and communication technology, and they have capability to impact positively or negatively on the future lifestyles of human beings.

We take note that Convergence of data systems, through the use of the internet, can create problems of cyber-security for individuals and nations,

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as it was the case of William Assange and the saga of the Wikileaks (Wikipedia).

The poor people who live in areas which lack internet connectivity may further be impoverished and marginalised, leading to the widening of the gap between the haves and have-nots, and also the widening of the internet divide between the rich North and the poor South. We perceive that the migration of businesses and educational systems online, into cyber space post-COVID-19, will cause many disruptions to the way businesses have been run, and also it will cascade into a quantum leap in unemployment in the first phase of this second wave of the great depression. Thereafter, we estimate that about 20-30 years from now, governments and the private sector will find ways to introduce new forms of market interventions, through deskilling and retraining employees to adapt to the new normal, and also through restructuring and reform of the current moribund economic system of free markets and selfish capitalist principles.

## II. BACKGROUND

We observe that, from time immemorial, human beings have been thrilled by the desire to use devious means to communicate their ideas to their neighbours, and also to future generations, by the use of symbols, designs, letters, characters, engravings, inscriptions, etchings, incisions, graphics, recorded sounds and videos, sculpture, artefacts, and paintings (Powell, 2009; Schmandt-Besserat, 2007; Schmandt-Besserat, 1996; Nissene & Heine, 2009; webspace.ship.edu).

Our modern alphabets have evolved from many sources, through the contributions of the ancient Egyptians (Hieroglyphics or picture writing), Sumerians (Cuneiform or wedge-shaped writing), Syrians, Greeks, Phoenicians (Aleph Beta), Arabs, Israelites, Persians, Chinese, and Hindus (Sanskrit), among others (Chrisomalis, n.d.; Coe & Stone, 2005; Moos, 1997; Bagley, 2004; Baines, 2007; Black, 2008; Bernal, 2007; Chrisomalis, n.d.). In Africa however, we note that the Amharic Language of Ethiopia, and the Fon Language of Dahomey (now Benin Republic in West Africa), are the only African languages which developed their own alphabets or their own unique forms of writing (Boahen, 1968; Mazrui, 1987). As recently as 1989, two brothers in Guinea, West Africa, also developed the Fula alphabet which is called ADLAM, for the Fulani language, a language that was threatened with extinction (Wikipedia, n.d.).

Ethiopia Airways proudly displays the Amharic characters on their aeroplanes. It reveals the long history of Ethiopia and gives them a sense of pride and unique national identity. Writing is the only form of human communication which captures sounds, ideas, emotions, legends, and records of human transactions. Writing has the capability of transmitting messages

accurately across countries and across generations, whether electronically or manually (History.com; Powell, 2009; Rogers, 2009). About ten years ago, we sat down and thought of developing new forms of alphabet and numerals which we hope will be innovative to communicators, scientists and those interested in evolution of new ideas.

When we recall history through the works of Johann Guttenberg, William Caxton, Wycliffe and the host of writing and printing pioneers, we are struck with awe at their relentless efforts to bestow to us the art of writing and publishing, which at a point in the distant past, were activities reserved for priests in performing their sacred rites (Sass, 2005; Nice, 2010). Writing, at a point in time, was an exclusive preserve of the few initiates of esoteric and arcane society; a select few in the ancient world. The written word was not easily accessible to everyone, especially the heathen or those considered vulgar, unlettered, and *sans culottes* or those of low pedigree in society (Racoma, 2018; History.com, 2018).

## III. LITERATURE REVIEW

### a) Afrocentric Viewpoint

According to the United Nations Educational Scientific and Cultural Organization (UNESCO), Arabic, Bengali, English, French, German, Hindi, Japanese, Mandarin Chinese, Portuguese, Russian and Spanish, each has at least 100 million speakers worldwide (UNESCO, n.d.). These languages account for 51% of the population of the world. The remaining 49% speak any of the remaining 6000+ languages, with most sharing a mother tongue with only a tiny percentage of the world's population (UNESCO, n.d.). It is believed that many minority languages throughout the world will soon vanish or become extinct, including the Effutu language (part of the Guan Languages in Ghana) of the people of Winneba, to which we belong.

Most of the world's languages (33% or 2197) are found in Asia, followed closely by 30% coming from Africa (2058). The people of the Pacific and the Americas combined, use 34% (2324) languages, while Europe, with its 230 languages, accounts for only 3% of the total number of languages used across the globe, yet the European languages paradoxically are predominant and are widely spoken around the world, as they are used as official languages and languages of educational instruction, commerce, government business, and general purpose of daily communication (UNESCO, n.d.).

It was the colonial legacy which bequeathed these European languages to their former colonies. The ignominious Trans-Atlantic Slave Trade which was started around 1480 through the recommendation of a Spanish Catholic priest, Las Casas, did serve as a stumbling block to the development of indigenous

African languages(Boahen, 1968; Fage, 1983; Agbodeka, 1967; Ansah, 2018).

In a mixed feeling context, the arrival of foreign religions to Africa such as Islam and Christianity did havoc to the development of indigenous African authentic cultural forms and other art forms on the one hand, and on the other hand, they created educational and commercial opportunities which benefitted both coloniser and colonised. However, we cannot lose sight of the tremendous work which many Christian Missionaries in Africa did to provide an authentic orthography of the indigenous African languages (Ansah, 2018; Ajayi, 1972; Okpewho, 1981; Fanon, 1967; Rodney, 1973; Boahen, *et al.*, 1986).

In Ghana, former Gold Coast, the works of the Scottish, Basel, Wesleyan/Methodist, and Presbyterian churches stand out clearly in the area of studying the local dialects and helping to codify them, and to give them written format (Ansah, 2018; Davidson, 1995; Webster, *et al.*, 1967).

We can recall and recount names such as Rattray, Christaller, Andres Riis, Balmer, Phillip Quarcoc, Thomas Thompson, Dunwell, J. A. Annobil, C.F.C. Grant, Ato Ahuma, C. A. Akrofi and Ajayi Crowther, among many other missionaries in the Gold Coast who contributed in a humungous way to the study of indigenous languages (Ansah, 2018; Boahen *et al.*, 1987; Claridge, 1915).

The desire to promote indigenous languages and African art forms was given a boost after Ghana attained independence in 1957, and the first founding father President, Osagyefo Dr Kwame Nkrumah, set up the Institute of African Studies and the Department of Drama and Dance at the University of Ghana in 1963 to promote the study of African art forms (Ansah, 2018; Obeng, 1997:127-139). This gave impetus for the study and preservation of African folkloric knowledge, and to project the image of the black person as being capable of attaining the highest levels of excellence in intellectual achievement and scholarship (Ansah, 2018).

Nkrumah assembled the best brains around the world to help drive his vision, and he brought eminent scholars to Accra, including Dr W.E.B. Du Bois, the first African American to graduate with a doctorate from Harvard University (Obeng, 1997: 87-88). There was also the famous West Indian Economist, Sir Arthur Lewis, to advise on economic planning. Lewis brought to Accra other expatriateeconomists such as Neustadt, Arthur Nurske, and Rosenstein Rodan who worked alongside Ghanaian pioneer economists such as J.H. Mensah, K.Y. Amoako, Robert Gardner, R.A. Arkhurst and E.N. Omaboe, among others. Nkrumah relied much on the prodigious knowledge of indigenous scholars like Professors KwabenaNketsia, J.H. Nketia, Ephraim Amu, John De Graft, and Efua Sutherland, among others to push through his development agenda in Ghana and Africa (Ansah, 2018; Obeng, 1997).

The early missionaries brought to Africa the religion of Christianity with the Book (Bible) and accompanying education. The Moslem scholars from Persia and Saudi Arabia who went to teach at Sankore University in Timbuctu (c.800-1500 AD) such as IbnBatuta, IbnKhaldun, and Al Bekri also came with Islamic lore and education (Ajayi, 1972; Boahen *et al.*, 1987; Webster *et al.*, 1967). It was a mixed blessing in the sense that while it exposed the Africans to the then new Knowledge, it also displaced their own indigenous traditional forms of art and knowledge.

Even though the imposition of foreign religions on Africans brought them new forms of enlightenment in the form of education and religion, yet this act did them a disservice by depriving them the opportunity of developing their own indigenous artistic forms of expression which foreigners derided as inferior. Therefore, Colonialism, the Slave Trade, and the imposition of foreign Religious beliefs were the trio nemesis of the development of indigenous African civilizations (Boahen, 1986; Davidson, 1995).

It will be preposterous to presume that Africans did not have scholarship in the form of written alphabet or symbols before the advent of colonialism. The famous Cave paintings in Namibia, of the Okhavango and Khoi-khoisan people, and the famous Adinkra Symbols and gold weight measurement symbols of the Ashanti people of Ghana, do attest to the high forms of artistic attainment and expression, and scholarship prior to the arrival of Europeans in Africa, towards the end of the 15<sup>th</sup> century (Opoku, 1978). The same can be said about the famous Benin Face masks of the people of the Niger Delta area in Nigeria, and the Bakongo in Congo. The architectural monuments in Mwanamwatapa in Bulawayo in Zimbabwe also show evidence of high sense of critical thinking, engineering proficiency and prowess (Opoku, 1978; Smit, Posnansky & Danzig, 1974; Mazrui, 1987; Fage, 2001; Davidson, 1985; Ajayi, 1972; Afigbo, 1986; Armah, 1995; Armah, 2002).

In Africa, language is written large in art forms such as the rich Kente Tapestries of the Ashanti, and the richly-coloured and intricately designed Ashoke textiles of the Yoruba. In- deed, in Africa, language is written large and bold in artistic expressions and forms, such as carvings, sculptors, paintings, intricate and well-choreographed dance forms, traditional drumming, and oral traditional folklore such as the Ananse Stories of the Akan people of Ghana, and the Kalulu stories of Zambia, among others (Opoku, 1978; Armah, 2002).

#### b) Early Forms of Writing

Wonderopolis.com (n.d) informs us that early forms of writing were principally developed in three parts of the ancient world in China, the Near East, and Mesoamerica. Writing in China dates back more than 3000 years ago, while writing in Mesoamerica dates

back more than 2500 years ago; and writing in the Near East is more than 5000 years ago. According to Schmandt-Besserat (2007), forms of writing developed independently of one another in these three regions of the world. In Central America, in Mexico, the Olmecs (600-500 BC) developed a form of writing which resurfaced again around 250-900 AD, among the Maya people (Schmandt-Besserat, 2005; Sass, 2005; Nissen & Heine, 2009; Coe & Stone, 2005; Marcus, 1998).

In China, writing was invented during the Shang Dynasty (1400-1200 BC). The early forms of writing were used mainly for Accounting and commercial record keeping. In other places of the ancient world, writing was used during religious ceremonies and also used on tombstones. Early writing was held sacred as a few select among the priesthood class held the secrets to deciphering the strange-looking symbols or characters of the alphabet, especially in ancient Egypt (Schmandt-Besserat, 2007; Xigui, 2000).

It is conjectured that the Arabic numeral system of number digits, which we use today, came out of the Indian Sanskrit language, which itself came out of the Chinese (LINFO, 2004; webspace.ship.edu, n.d.; Boyer, 1944; Heath, 1921; Ifrah, 1998).

It is known that before Rome was founded in 756 BC by the twin brothers Remus and Romulus on the River Tiber, there was a black race called the Etruscans living in the area (Bonfante & Bonfante, 2007). It was they who gave the Romans their seven letter alphabet in the year 700 BC. The Roman alphabet had no lower case letters, as all seven characters were upper case (LINFO, 2004; Fowler, 1999; Bernal, 2007).

In later years, writing was deployed for artistic and literary engagement, for entertainment, and for preserving human records of achievement. According to Schmandt-Besserat (2007; 2005), writing is the main technology for gathering, processing, storing and retrieving, communicating, and disseminating information. Early writing appeared in three different forms as Alphabet or Character Set, Syllabaries, and Ideographs or Logographs or Pictographs (LINFO, 2004; Salomon, 2012; Bernal, 2007). Alphabet is made up of a set of letters or characters such as the English/Latin alphabet, where each letter represents a sound.

Syllabaries are letters that stand for syllables or vowel sounds, and this applies to languages such as Korean, Japanese and Chinese languages, which have many syllables in their languages. Pictographs or logographs are characters which are ideas or pictures such as ancient Egyptian Hieroglyphics (LINFO, 2004). The earliest writing from which the English alphabet has evolved is that of the Phoenicians who occupied present day Lebanon and Syria. The Phoenicians themselves, being great seafarers and traders, are thought to have learnt the art of writing from a Semitic group that was

found to the north-east of Egypt (Factsanddetails.com; History.com, 2018).

The Phoenicians were the first to develop the first alphabet with 22 characters, around 1200 BC but they were not the first to invent writing, because the Sumerians and the Akhadians were the first writers, but they did not have alphabets; only wedge-shaped writing for keeping accounting records (Black, 2008; Chrisomalis, n.d.; Melissa, 2013; Gow, 1883)(see Appendix A, Appendix B, and Appendix C).

Chrisomalis (n. d.) contends that through trade, the Greeks learnt of the art of writing from the Egyptians. In ancient Mesopotamia, wedge-shaped writing or Cuneiform was used by the traders to keep records of their business transactions. The Phoenician letter N was the letter for fish called NUN, which is similar to our Effutu language in Ghana in which fish is called INU. The Phoenician symbol or letter for O was that of a picture of the eye called AYIN, which again in Akan language of Ghana, is ENYI for the eye.

A fence in Phoenician is called HE, which in Akan language of Ghana is called HE or border or boundary. A spear in Phoenician is called GIMMEL, which in Akan language of Ghana is called KAMMA, with a slight resemblance in sound to the Phoenician, GIMMEL. Oral tradition in Ghana states that some tribes in Ghana came from far off places such as Egypt, Iran, Yemen, Israel, and Sudan (Armah, 2002; Armah, 1995; Opoku, 1978).

#### c) *Evolution of language and alphabet*

The Harvard website for Chaucer stated that the art of reading ancient hand-written manuscripts is called Palaeontology. In the Middle Ages (500-1500 AD), before printing was invented, books were rare as they were meticulously written by hand by monastic copyists who were monks. The writings or calligraphy was ornate, embellished and garnished so much so that it is difficult to distinguish the alphabets in them. There was a time in England, when the letters J, U, W and I were missing in the alphabet (Melissa, 2013; Racoma, 2018; Parpola, 1994; Southgate, 1929; 1956).

The arrival of immigrants to England such as William the Conqueror in 1066 AD, brought with it different inputs and changes to the culture, and the way the indigenous English language was spoken and written (Underwood, 1946; Southgate, 1929; 1956). So many years ago, the letter W was missing from the English alphabet, until someone thought of adding two Vs together to have a double V (W) (Racoma, 2018; Melissa, 2013).

Even on the computer typeface, we find an array of fonts such as Calibri, Bookman Old School, Times New Roman, Valdana, and Arial, among many other font types. Our current 26 letters of the English alphabet have undergone many translations, rotations and reform to come to the standard we find them today

(Salomon, 2012). The alphabet during the time of Geoffrey Chaucer in Medieval England was different from those in Shakespeare's time in the 16<sup>th</sup> century, and also different during the times of Ben Johnson and the Victorian era of the scholar and writer, Oscar Wilde.

#### d) *Non-English Alphabet Countries*

There are many countries in the world today which do not use the English alphabet of 26 letters. Russia, Iran, India, Armenia, China, Turkey, Korea, Japan, Thailand, Israel, Greece, Saudi Arabia, Ethiopia, Egypt, and Vietnam, among many others, use their own forms of alphabet. The Russian alphabet has Greek and Bulgarian origins (Wikipedia). It is called Cyrillic script. History records that in 893 AD, the Bulgarian Tsar, Simeon I the Great, commissioned a new alphabet to replace the old Galgolithic alphabet which was used during the time of his father, Boris I (Wikipedia). Later, the script spread to Iran, Russia, and many parts of Eastern Europe, where Cyrillic or Russian alphabet is in use (Wikipedia). Other similar scripts are the Coptic and Armenian scripts (Wikipedia).

Other scripts which are non-English or Latin are Urdu, Arabic, Chinese, Japanese, Thai, Korean, Hebrew, Amharic, and the Fula/Fulfulde of the Fulani people of West Africa. Wikipedia (n.d.) stated that in 1989, two brothers, Abdoulaye Barry and Ibrahima from Guinea, developed a new alphabet system called ADLAM for the Fulani, Fula or Fulfulde language, which was about to get extinct (Wikipedia). This is a commendable effort worth noting. To date, this is the latest addition to the body of alphabets in use around the world. The Fula alphabet is supported by Android and Google Chrome (Wikipedia, n.d.).

#### e) *Letters, Numerals, and Computers*

According to LINFO (2004), characters are the building blocks of a language. The written form of a language consists of letters, punctuation marks, numerals, and other symbols for things such as punctuation marks, money symbols for the dollar, pound, cedi, yen, yuan, and peso, ampersand, and other symbols in mathematics, sciences and computing (LINFO, 2004).

Language evolves over time as some of the characters and symbols change, with some becoming defunct, and new ones come to replace them, through cultural diffusion, colonization, and acculturation. According to Nice (2010), the English alphabet has not always been 26 letters, as there was a time it had only 24 characters, with the letters J and U missing. Through cultural diffusion, we have the current form of 26 letters in the English alphabet. The English language has greatly been influenced by cultures around the world, notably those from Indian, Arabic, Creole, and Afrikaan influences.

The Chinese language is said to have between 40,000 and 60,000 characters in its alphabet system, although not all characters are in active use, as a highly educated Chinese is expected to know about 5000 characters (LINFO, 2004). Those pursuing basic education are expected to master, at least, about 500 Chinese characters (LINFO, 2004).

On the computer, characters are used as input devices from the keyboard to process and print out data or for storage and also as input, by using scanners to present data on the screen and also to print out information (LINFO, 2004; Turban, 2015).

Optical devices such as Optical Character Recognition (OCR) can be used to scan data for analysis, for marking school work, and for creating Artificial Intelligence systems for processing huge amounts of data, using Machine Learning principles in a SMART environment such as in a Smart City.

LINFO (2004) stated that characters are used in programming language by using commands and logic, to structure situations for critical thinking decisions. Programming language include C++ and Java. Such programming languages help to systematize and economically process and store data in user-friendly formats, for later use. Characters or letters are converted into computer electronic and digitized signals for the purposes of storage, processing, transmission and enabling data exchange between and among computer network systems, through what is called Electronic Data Interface (EDI).

Cloud computing enables flexible storage of vast amounts of data, which can be accessed anywhere any time by the users on any device or gadget. Numeric and alphabet letters are electronically converted into binary electrical impulses of zeros and ones, or alternating electrical impulses of positive and negative charges for easy storage and processing. The mathematics involved is called Boolean algebra (Turban, 2015; Tesla, Shannon).

LINFO (2004) also stated that when dealing with internationalization, computing becomes complex as many alphabet systems and languages have to be dealt with, because there are different alphabet sets to deal with, which require different keyboards, soft-wares and hardware systems.

We saw it fit to introduce new forms of numerals and alphabet as a way of having a new normal international alphabet system that will be neutral, not claimed by any country or region. We shall classify and term it as a Logogram or Locograph or Locobet, as they have some system of order, where by a letter evolves and is dependent on the shape and form of its predecessor. We shall call it the Kasian Alphabet System (KAS).

(See attached pdf file of photos of new alphabet and numerals, which we developed, with their equivalent English alphabet letters written above each one).



According to LINFO (2004), Unicode version 2.0 was released in 1996 with 38,885 known human alphabet characters. In 2000, version 3.0 was released with 49,194 characters, and again in 2003, it was upgraded to 96,382 characters (LINFO, 2004). The American Standard Code for Information Interchange (ASCII) was set up as the only encoding soft-ware which is used by computers and communication equipment, to represent text in any format. It uses eight bits or one byte to represent one character or letter. ASCII is based on the English alphabet, and it uses 128 characters, with an advanced version that uses 256 characters (LINFO, 2004).

f) *Pioneers of Information Communication Technology (ICT)*

When we come to discuss advances which have been made in ICT over the last 100 years or so, great names come to mind. We shall not reference so much in this section as the information on these great names are everywhere on Wikipedia and other sites online. Guiglermo Marconi from Italy was the first person to send a wireless message across the Atlantic many years ago, and it marked a watershed and breakthrough in communication (Wikipedia).

Had his technology been available in 1912, perhaps many souls who perished in the Titanic could have been saved. In America, Samuel Morse came up with his Morse code which became the basis of telegrams or telegraphy, which consisted of signals of dots electronically transmitted as codes, and at the receiving end, the encoded message of signals of dots is decoded as telegraph message (Wikipedia). Charles Babbage from the UK in 1948 worked on a crude system of what we know today as computing (Wikipedia).

His system was based on the ancient Abacus, which was used by the Romans to do arithmetic. During the Second War, which began in 1939 and ended in 1945, Allan Turing from Cambridge University led a team of scientists to develop cipher systems of messaging and decoding enemy messages, through advanced systems known as encryption and cryptology (Wikipedia). Again in America, Thomas Edison patented more than a thousand inventions, including the electric bulb (Wikipedia, n.d.). Alexander Graham Bell, a Scottish American engineer and scientist, invented the telephone for voice communication over long distances (Wikipedia, n.d.).

He was the one who set up the American Telephone and Telegraph (AT&T) in 1885. In the 1950s, John Baird from Scotland invented the Television set using the Rutherford tube technique to transmit sound and pictures over a distance. Television (TV) came to replace Radio Broadcasts as the preferred public address system, as it brought live communication of news broadcasts, entertainment, and advertisement

messages live into the bedrooms and sitting parlours of millions of viewers, worldwide (Wikipedia).

In the 70s and 80s, Sir Tim Berners Lee worked at the European Science and Research Centre (CERN) in Switzerland, with other collaborators from MIT in America, to develop the information Super Highway or what we now call the World Wide Web (www) or the Internet (Wikipedia, n.d.). The internet took off tremendously in the year 2000 due to the innovation and works of people like Bill Gates of Microsoft Corporation, Steve Job of Apple, Mark Zuckerberg of Facebook, Jack Ma of Ali Baba, Jeff Bezos of Amazon, and Elon Musk of SpaceX. We cannot here leave out the great work done in universities around the world and at NASA to develop newer technologies to improve communication and information management (Wikipedia, n.d.).

g) *Origin of Computer Communication-Work of Claude Shannon (1916-2001)*

A famous American mathematician, electrical engineer, inventor, visionary, and computer scientist, Claude Shannon who graduated from MIT is said to have calculated accurately that in 103 pairs of moves of Black and White marbles of a Chess game, there would be  $10^{120}$  unique games of chess (itsoc.org, n.d.). In his 1937 thesis at MIT, he stated that,

*If we could someday invent a computing machine, the way to make it*

*think would be to use binary code, by stringing together switches and*

*applying Boole's logic system to the result.* (itsoc.org, n.d.).

Shannon's MIT thesis is thought to be the most remarkable thesis of the twentieth century (Wikipedia; itsoc.org). It is believed that Shannon's famous paper which was written in 1948 created what is now known as information theory. His paper in 1948 was entitled, 'A Mathematical Theory of Communication'. In that paper, he put forward the seminal idea of converting any kind of data, such as sound, photos, and text characters into a series of electronic signals of zeroes and ones which could be transmitted without errors. In actual fact, Shannon invented digital communication as it is now used by computers around the world, and also by telecommunication equipment in binary format (scientificamerican.com; Wikipedia, n.d.).

h) *Work of Nikola Tesla (1856-1943)*

Tesla was a Serbian-American who was an electrical and mechanical engineer, an inventor and a futurist who was credited with numerous inventions such as the radio, radar, AC current, TV, and Hydro-electricity, among a legion of other inventions (theoatmeal.com; Wikipedia.com; history.com; biography.com; Britannica.com). Modern Information Communication Telecommunication (ICT) cannot be discussed without

mentioning and relating it to the work of Tesla, because it was he who has made it possible for us to have electricity to power all internet and telecommunication activities.

Tesla lived ahead of his time as he predicted many of our modern devices such as electric-powered cars, among others. In the tradition of Tesla, we believe that one day, humans should be able to talk back to nature and understand the speech of birds and animals, by being on the same frequency with them. Every morning, some woodpeckers, weaver birds, sparrows, swallows, and other birds come to our window sill to talk to us all day long in uninterrupted clatter of chatter, and they seem so excited. We guess they are telling us a lot of things which we fail to comprehend. However, we are with them in spirit, knowing that they mean well for us, and humankind in general. In our own estimation, birds are the first creatures on earth which are very close to God, as they know more about our health, doings, character, and lifestyles and they come to share news with us, but we fail to comprehend and reciprocate their good gesture. Bird-speak will one day become intelligible and decipherable through technological breakthrough.

Also, we foresee a day when we shall have plastic newspapers and books to save our trees. If we use plastics to make books and newspapers, we can save many trees and help preserve nature. Plastic books can last longer than cellulose-based books. Hardcopy-books are indispensable to children; as they are not to be exposed too much to radiation on laptops and computers, which are harmful to them. We also foresee a future state whereby in future, we shall have robots (AI) studying our lifestyles and summarizing and presenting news to us in readable formats on screens and panels on our walls at home, on our car dashboards, and on our computers, laptops and wrist watches. We can foresee AI and ML helping us to write books and stories, musical compositions and artwork, all being done through AI and ML, using neuroscience-technology so that thought becomes reality.

#### i) *Contributions to ICT by Africans*

Philip Emeagwali, a Nigerian Computer scientist who was studying at the University of Michigan in the USA, was said to have done the fastest mathematical computation in the world, by interconnecting computers. His feat led to great improvement in internet speed, and also it contributed immensely to recovery of petroleum from underground seams (Wikipedia, n.d.).

Another Nigerian, Chinedu Echeruo, who studied at MIT, developed a smart city navigation app called HopStop.com that helps city dwellers find their way back home if they get lost. He was said to have sold the app to Apple for one billion dollars (Wikipedia; guardian.ng.news).

Victor Lawrence, a Ghanaian American, is Professor of Intelligent Networked systems and he has contributed to increasing the speed of the internet and high speed connectivity at the Stevens Institute of Technology. He has 400 patents to his name (face2faceafrica.com). He is a Fellow of IEEE.

Prof Nii Quaynor, another Ghanaian, is said to be the first African to have a Phd in Computer Science from SUNY (researchictafrica.net) and the first person to set up an ISP in West Africa in 1993. He was awarded for promoting the internet in Africa (researchictafrica.net).

The name Dr Thomas O. Mensah is known to a lot of people around the world. Thomas Mensah is another Ghanaian American who pioneered fibre optics, and he is a leading expert of fibre optics in the world (Wikipedia, n.d.). His work led to the ability of fibre optic to carry greater and more volumes of data, using fibre optic rather than by using copper cables. He is a Chemical Engineer and a nanotechnologist. His inventions have revolutionized the way we communicate using the internet. Fibre optic cables have been laid under the sea to connect all the continents for speedy communication, and it is complemented by satellite communication from outer space (Wikipedia, n.d.).

Elon Musk of SpaceX and others hope to cover every part of the world with satellite coverage, to make internet a free and accessible resource for all humanity. Currently, in parts of Africa such as Zambia, internet connectivity is very slow, poor, unreliable and above all, very expensive. This noble gesture by Elon Musk and others will help to break the stranglehold of the ISP monopolies which are fleecing African residents for their use of the internet. The problems of internet connectivity affect productivity of researchers like us and others in Third World countries.

At NASA, there is Ave Klutse who is a Ghanaian Rocket Scientist in charge of space shuttle flights at the control room. He deals with complex systems of communication and remote control (cnn.com; Wikipedia/ghana's rocket man).

Another Ghanaian scientist at NASA is Trebi-Ollennu Ashitey, who is a Robotic Engineer who designs robotic arms for collecting samples. His area of expertise requires high levels of innovation and computer science. All these people from Africa are helping to advance the frontiers of knowledge in computing, information management, and communication science (Wikipedia).

Dr Isaiah Blankson, like the ones earlier mentioned above, is a rare gem Ghanaian American who leads the US Air Force in researching jet propulsion systems and advanced materials for military aircrafts. He is said to be a mathematical genius. He is an alumnus of MIT/1967. (Wikipedia, n.d.).

Lastly, we have the late Prof Francis Allotey, who developed the Allotey Formalism system that is able to prove the presence of matter in space (Wikipedia). The late Ghanaian professor was instrumental in introducing computer science as a field of study in Ghana, and also in Africa as he held positions in many international research organisations. He was an alumnus of Princeton University and Imperial College in the UK (Wikipedia, n.d.).

It was necessary here to have highlighted the contribution of Africans to the emerging field of information and communication science, because Africa is the last frontier to develop fully into an industrialized region. There is therefore great potential in Africa for the growth of ICT.

#### IV. METHODOLOGY

Since this article communicates a novel idea, we the authors, thought of a method of proceeding in this article by engaging in desk research to review some literature on writing in general, hence the approach being qualitative, historical, and narrative. It could also be said that the methodological approach we adopted was based on secondary research, even though the findings are original contribution to knowledge.

#### V. FINDINGS AND RESULTS

##### a) New Numerals

The numerals presented herein show new images which evolve from progressive developments (See attached pdf file for the numerals and characters of the new alphabet).

0

The new numeral (0) zero is drawn with a cross inside it to differentiate it from what we know as zero on the number line, and which in Cartesian Coordinates, represents the origin of the number line which stretches to infinity on either side of it, and in Cartesian Coordinates, both positive and negative axes of Y and X originate from zero, hence the cross describing zero as the central focus of mathematics. Therefore, zero should not be drawn empty as it is the demarcation point of Cartesian planes, and infinite imaginary plains in space or topology.

1

Figure 1 is drawn with one stroke downwards, which is fixed at its base as a pillar, marking reality and counting numbers.

2

Figure 2 progresses from the downward stroke of 1 with a horizontal perpendicular stroke on the top of 1, to the left to indicate a second reinforcement.

3

Figure 3 is drawn with another stroke on top of 1, this time to the right, showing three strokes, one to the left, another to the right, and yet another downwards.

4

Figure 4 is derived from the figure for 2, and adding its mirror reflection on top of Figure 2 to form a cross, thus Figure 4 is twice Figure 2.

5

Figure 5 is derived by pulling off the top L shaped part of Figure 4.

6

Figure 6 is obtained by pulling off the lower part of Figure 4

7

Figure 7 is a mirror reflection of Figure 6 with a cross across its middle part to differentiate it from Figure 2.

8

Figure 8 is obtained by rotating Figure 7 through 180 degrees from the page towards yourself to form an L, facing the wrong way.

9

Figure 9 is made up by completing the conjugate of Figure 8 to form a rectangle.

##### b) Comments

We can see from the shapes of the new numerals that Figures 1 and 3 have close resemblance as 1 is a T turned upside down. Figures 2, 4, 5, 6, 7, 8, and 9 are all rotations, reflections and combinations of the Letter L. In fact, except Zero, all the new numerals are derived from the letter L, which shows Zero to be unique from the others. Therefore the new numerals could be called L numerals or Letter numerals, based on Logic.

##### c) Large numbers

As new earths, planets, and new interstellar travel is evolving from technological and scientific advances, there will be a great need in future to have cryptic and shorthand form of representing astronomical figures hence this author thought of developing Hieroglyphic-like representation of astronomical numerals, showing human forms. The notation of Light years sometimes becomes unimaginable and unfetchable, and abstract to many, forgetting that a light year is simply figuring out how many seconds make 1 year, multiplied by the speed of light in one second, which is approximately 300,000 kilometres per second, multiplied by 60 seconds by 60 minutes by 24 hours by 365 1/4 days, which is 9.461 Quadrillion.

100

Hundred is represented by the Greek letter Pi with elongated legs.

1000

Thousand is represented by Pi with a dot on top of it.

1,000,000

One million is represented by Pi with two dots on top, and a billion by Pi with fore hands down and three dots on top, a trillion by all the dots connected into

- $1,000 = 10^3$  Thousand
- $1,000,000 = 10^6$  Million
- $1,000,000,000 = 10^9$  Billion
- $1,000,000,000,000 = 10^{12}$  Trillion
- $1,000,000,000,000,000 = 10^{15}$  Quadrillion
- $1,000,000,000,000,000,000 = 10^{18}$  Quintillion
- $1,000,000,000,000,000,000,000 = 10^{21}$  Setillion
- $1,000,000,000,000,000,000,000,000 = 10^{24}$  Septillion
- $1,000,000,000,000,000,000,000,000,000 = 10^{27}$  Octillion
- $1,000,000,000,000,000,000,000,000,000,000 = 10^{30}$  Nonillion

(Source: <https://www.thoughtco.com/zeros-in-million-billion-trillion-2312346>).

## VI. DISCUSSION

### a) New Alphabetical Letters and Possible Applications

The Latin alphabet consists of 26 letters but the one we invented has added 6 six more single characters or letters to represent sounds such as E in the English word BET, CHI sound in the English word CHICKEN, ING sound in the last letter of the word KING, O sound in the sound in the word HOT, long O sound in the word HALT, and SH sound in the word SHIRT.

The alphabetical letters which we invented have a logical structure at the beginning for easy remembering while as we proceed, we find some of them depart from this logical structure, which makes it the more interesting. These new alphabetical letters can be used in psychological testing as memory tests, intelligence quotient tests, and also as aptitude tests. The new alphabetical letters which we have derived are artistic in nature as they are mainly strokes, circles, dots, and geometrical patterns, some of which resemble typical Ashanti Adinkra symbols in Ghana.

We believe the new alphabet system can be used in coded messages, cryptology, encryption, computer programming, and also as a form of technological breakthrough for designing new computer keyboards for communication.

Early Childhood educators can have fun with young children in their art classes in drawing out the characters and letters in fun writing of these letters as they have capacity to help children develop skills in recognition of shapes and in writing strokes, straight lines, curves, circles, rectangles, triangles, and other geometrical shapes (see Appendix).

a crescent moon, Quadrillion by upraised fore arms and a triangle on top, Quintillion with a circle on top, Sextillion with a cross in the circle, and Septillion with the palms of the man outstretched. and feet stretched out as well.

### b) Vistas for the future of ICT

We can see that before the year 2000, the growth of ICT was linear of the form

$$Y = a + bx$$

Before 2000, technological growth had only one variable, namely Time represented by X in the above equation.

After 2000, the growth turned exponential to the form of

$$Y = A e^{rt}$$

After 2000, the variables became r and t where t refers to time and r refers to rate of growth of technology. R is a function of education, innovation, entrepreneurship, capital, and the PESTEL factors in the macro environment. T is time as time is an exogenous factor.

In the third phase of the ICT revolution and growth, we may conjecture having a Sigmoid Curve or a Gompertz Curve (Logistic Curve) of an S shape, showing that growth will increase rapidly in the first phase of this long run curve, then it will slacken to a plateau due to what Malthus referred to as the Doom factors of famine, wars, epidemics, catastrophes and cataclysms, among many negative factors such as the imminent threat of the wrong use of Artificial Intelligence and Machine Learning. Thereafter, there will be a new spurt in growth of an exponential form to complete the long run cycle. This curve can also be related to the innovation diffusion curve for information-communication technology by Rogers (Wikipedia, n.d.).

Finally, the new numerals and alphabet which we suggested in this paper can be used in the field of encryption and cryptology, whereby companies such as Apple, Microsoft, and SpaceX can set up their secret



language by starting from anywhere in the new alphabet as their origin or beginning, so that they can send and receive encrypted messages which should have a cipher or key somewhere to decode the message.

## VII. CONCLUSION

In this short paper review, we have endeavoured to share with you new forms of numerals and alphabet letters which we developed, based on our imagination. This work has been on the cards for six years and upwards, waiting to be unveiled, and we are happy that, at long last, we are able to share it with you. We hope that academics, educators, scientists and various communicators will find these new forms of numerals and alphabetical letters useful for their work. We hope also that our work will inspire many Africans to be innovative in diverse fields of endeavour.

Knowledge knows no racial, geographical, gender, and time boundaries. It transcends all of us, and we should all together embrace true and valid knowledge in order to extend its frontiers for the greater good of humans and our world. The new numerals and alphabet which we introduce here can be used in cryptology, encryption and educational instruction. We can develop a multiple keyboard whereby the English alphabets and our alphabets and numerals could be juxtaposed so that we can switch communication between the two forms.

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## APPENDIX

### Appendix A



Source: Hays, A.J.

Example of ancient Phoenician alphabet

### Appendix B



Clay tablet of Cuneiform writing

Appendix C

ʔa	b	g	ḥ (x)	d	h
w	z	ḥ (ħ)	ṭ	y	k
š	l	m	ḍ (ð)	n	ẓ (θ)
s	f	p	ṣ	q	r
ṭ (θ)	g̣ (γ)	t	ʔi	ʔu	s₂

Example of Cuneiform or wedge-shaped writing
























Appendix D

het h courtyard	waw w hook	haw h hurrah	d ?	digg d fish	gaml g throwstick	bet b house	'alp ' ox
'en ' eye	šamk š ?	naḥš n snake	mem m water	lamd l goad	kap k hand	yad y arm	ḥa ḥ yarn
taw t owner's	šimš š sun	ṭann ś/t bow	ra's r head	qup q monkey	ṣad ṣ plant	pi't p corner (?)	ḡa ḡ ?
mark							

Example of Hieroglyphics or picture writing of ancient Egypt

Appendix E

PROTO-CANAANITE	EARLY LETTER NAMES AND MEANINGS
	alp oxhead
	bet house
	gaml throwstick
	digg fish
	hâ(?) man calling
	wô (waw) mace
	zê(n) ?
	hê(t) fence?
	ê(t) spindle?
	yad arm
	kapp palm
	lamd ox-goad
	mêm water
	nahš snake
	cên eye
	pi't corner?
	sa(d) plant
	qu(p) ?
	ra's head of man
	tann composite bow
	id (taw) owner's mark

Example of Logography or ideograms or pictography

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# Time's Up on Empty Zero-Tolerance Slogans: A National Survey Concerning Sexual Harassment

By Bassel H. Al Wattar, Ferha Saeed, Rashna Chenoy & Khalid S. Khan

*Warwick University*

**Abstract- Purpose:** The purpose of this paper was to examine the employers' role in the prevention of sexual harassment within the healthcare workforce. We surveyed all the UK medical schools to inquire about their policies, procedures, complaint numbers and outcomes under the freedom of information law.

**Design/methodology/approach:** We submitted freedom of information requests to all 36 medical schools in the UK seeking information on all submitted sexual harassment complaints between January 2008 and January 2018. This included each school disciplinary policies in general and those concerning sexual harassment in specific, the number of formal complaints, and the final outcome of all investigations.

**GJSFR-I Classification:** FOR Code: 111799



*Strictly as per the compliance and regulations of:*





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Bassel H. Al Wattar <sup>α</sup>, Ferha Saeed <sup>σ</sup>, Rashna Chenoy <sup>ρ</sup> & Khalid S. Khan <sup>ω</sup>

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**Findings:** We received interpretable responses from 30/36 contacted medical schools (83%). All 30 schools confirmed having generic code of conduct policies (100%), however, only 12/36 schools (40%) had specific policies and procedures to deal with sexual harassment concerning staff, students or both. None offered any formal training to dealing with sexual harassment. Only three schools confirmed having >5 sexual harassment complaints (3/30, 10%), thirteen had <5 complaints (13/30, 43%) and eleven had no complaints at all (11/30, 37%).

**Research limitations/implications:** Policies, structures and processes alone are not sufficient for addressing sexual harassment. Knowing the policies and procedures alone will not prevent misconduct, keeping to the rules and regulations will. Medical Schools should rise to the challenge through concrete boundaries-related educational interventions, not empty slogans of zero tolerance.

**Originality/value:** This paper highlights the employers' obligation to engage staff in training to ensure compliance with specific rules and regulations for preventing sexual harassment in the healthcare workplace.

## I. INTRODUCTION

The recent wide coverage of #Me Too has put the persistent problem of sexual harassment and assault in the spotlight (Stockdale et al. 2019). Like all professional disciplines, medicine is bound by ethical and behavioral conduct codes (Doukas, McCullough,

and Wear 2012; Irby and Hamstra 2016; Women-Church Convergence 1995). The boundaries set within these codes continue to evolve in a constantly changing social paradigm. As doctors, like Hollywood actresses, have contributed to burning the #MeToo flame, sexual harassment has lifted its head above the parapet within the healthcare workplace (Choo et al. 2019; Jenner et al. 2019; Soklaridis et al. 2018; Stone, Phillips, and Douglas 2019). By law, medical institutions are required to commit to equality, diversity, and inclusion. Inequity associated with gender disparities (Jena, Olenski, and Blumenthal 2016) breeds an environment conducive for harassment to take place. The #MeToo disclosures have raised the need for vigilance about the existence of the right structures and processes in healthcare organizations to respond specifically to sexual misconduct allegations (Soklaridis et al. 2018; Williams 2018). Medical employers have promised a zero-tolerance culture (Bates et al. 2018).

Worldwide the healthcare provision is one of the largest employers. Compliance with the gender-based equality legislation should be its key objective as staff safety and productivity in healthcare go hand in hand (Parks and Redberg 2017). The above background prompted us to survey the readiness of the UK medical schools to meet the professional boundary-related challenges in the work place by inquiring about their sexual harassment policies, procedures, complaint numbers and outcomes under the freedom of information law. With these data we wanted to gain insight into factors that will need attention when going forward with bringing about improvements in the medical workplace.

## II. METHODS AND RESULTS

We submitted freedom of information requests to all 36 medical schools in the UK to seek information about their codes of conducts in August 2018 and awaited responses till December 2018. All requests were sent to the nominated freedom of information officer at each medical school using a standard template that was compliant with the freedom of information requesting process as governed by the UK freedom of information act 2000. All requests were submitted and moderated by the two of the authors (FS and BHA).

We specified the information request within a set time period between January 2008 and January 2018 to capture changes within the last 10 years from

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the date of our submission. We requested the following information: all versions of school disciplinary policies within the set time period; any specific policies in this time period concerning sexual harassment; the number of formal sexual harassment complaints in this time period; for each complaint the demographics for the complainants, the accused and the investigators as well as the final outcome of the investigation if applicable. If the release of any information was prohibited on the grounds of breach of confidence, we asked officers to supply us with copies of the confidentiality agreement as information should not be treated as confidential if such an agreement was not signed. When a request was denied in whole or in part, we asked officers to justify all deletions by reference to specific exemptions of the act and planned to appeal decisions to withhold any information or to charge excessive fees (though we did not use the appeal option). We expected all requests to be answered within 20 working days from the date of submission in compliance with the law and sent two reminders to the information officers in case of no response. We obtained all information electronically and

collected data using a custom-designed Excel sheet that was piloted for face validity through discussion among authors. We analysed data and reported using simple frequencies and natural percentages. All data were analysed using Microsoft Excel 2013.

In total, we received interpretable responses from 30 out of the 36 contacted medical schools (83%) (Figure 1). Five of the remaining schools acknowledged receiving our request but did not reply until the date of this publication even after two reminders and one university did not acknowledge receiving our request. All 30 schools confirmed having generic code of conduct policies (100%), however, only 12/36 schools (40%) confirmed having put in place specific disciplinary policies and procedures to deal with sexual harassment concerning staff, students or both. None offered any formal training to deal with sexual harassment. Only three schools confirmed having >5 sexual harassment filed between 2008 and 2018 (3/30, 10%). Thirteen schools had <5 complaints (13/30, 43%), and eleven had no complaints at all (11/30, 37%).

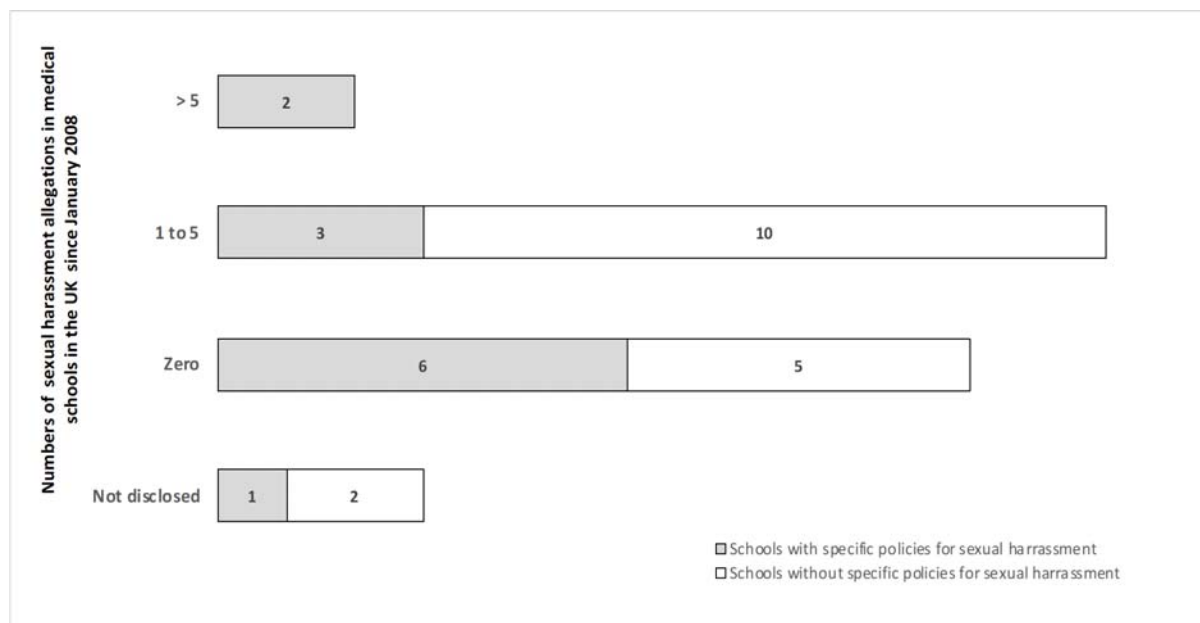


Figure 1: Sexual harassment policies and allegations in UK medical school

### III. DISCUSSION

In this survey, conducted using freedom of information requests, it was possible to map the readiness of the UK medical schools to prevent and manage sexual harassment complaints. To our surprise, the majority of surveyed educational institutions did not have adequate policies to govern the conduct of its staff and students. None offered any formal boundaries training to prevent sexual harassment, a particularly disturbing feature since medical provision occurs in a

professional boundary framework, and sexual harassment involves trespassing of the boundary.

Healthcare staff practice professionally in close proximity with each other. Their employers have the responsibility to nurture an environment that promotes maintenance of boundaries to avoid the potential for misconduct. There is often a hierarchy in the workplace to facilitate healthcare decision-making. Awareness with respect to professional role and role-related power can help staff observe invisible borders and remain within civility lines. Remaining within the boundary, i.e. inside

the safe perimeter in which colleagues interact provides for achievement of caring tasks, is what stops harassment from happening. It should, therefore be considered best practice for healthcare employers to put training in place in addition to policies and procedures. Just setting out how staff can raise complaints and what actions the employer will take to investigate them is not sufficient for protection from harassment. True equality in work place should be embedded in addressing the issue of harassment through meeting both legal obligations and training needs in the workplace. Professional regulators emphasize insight through training in this regard, especially because healthcare workers can even be at risk from exposure to advances from their patients(Nielsen et al. 2017).Sexual harassment is a complex, multifaceted phenomenon. The pathophysiology of sexual (mis) conduct can be modelled for development of continuing education courses to improve and maintain bounded behavior. Training updates can encourage staff to operate with respect, offer support to colleagues, seek help with confidence when risk of harassment surfaces, and declare what behavior is unwelcome in the workplace.

We have become concerned that campaigning and signposting are not sufficient. As a regulated profession, the concept of boundary should come naturally to healthcare professionals. Yet it has been reported that fear of allegations arising may undermine academic development as men hesitate to participate in mentoring relationships with women(Soklaridis et al. 2018).The problem has become magnified as many complaints are known to be unfounded(Henriques 2016). The work environment needs a cultural change and this cannot be met just by policy reviews and legal training of the responsible administrators and investigators for their roles, though this is a well-recognized gap too. Policy reviews cannot go much beyond revisions of documents, processes and punishments(Smith and López 2018). How can we change the workplace so both men and women can productively undertake their duties without fear? In medicine inability to change what is described as a "locker room" culture is blamed on many things, but the need to focus on professional boundary training is rarely recognized as a potential solution(Bates et al. 2018).Knowing the policies and procedures alone will not prevent misconduct, keeping to the rules and regulations will. It does not take rocket science to readily see that if staff are overworked and at the same time lonely and needy, they are vulnerable. Training in identification and prevention of risk will be an effortful endeavor as maintaining a professional environment will require taking account of the local situation through bespoke programs to address the level vulnerability in the workplace.

Risk factors for boundary crossing and violation are identifiable and can be targeted for prevention. Fundamentally, healthcare workers tend to be focused on meeting the needs of their patients, not their own needs. This situation can stress them out and may make boundary incidents more likely. Recognizing and managing stress doesn't just happen by accident. Self-care in this regard requires a focus on reducing stress by engaging in meaningful activities and keeping connected to family and friends. Psychological exhaustion resulting from overwork and lack of recognition can lead to burnout, which affects agility in boundary recognition increasing vulnerability to lapses in professionalism. The employer has a duty to support those at high risk including staff who are multi-tasking, who have family problems, who are generally dissatisfied with work, etc. Training can be used to encourage staff to take care of themselves and build healthy relationships at work. The need to promote self-care within the workplace is not just an optional extra, it is a necessary requirement for underpinning provision of good healthcare. An appropriate organizational culture with clear rules is best established when everyone is trained to follow these guidelines. This allows for a collaborative effort to help ensure a safe work environment. Training is essential for ensuring that all staff have a mutual understanding of the boundaries, the rules, and their professional responsibilities. The employer has to actively play a role in discouraging a culture of dependency and socialized relationships at the workplace.

When engaging with colleagues, healthcare staff may indulge in excessive self-disclosure, offer and accept special favors and gifts, encouraging or tolerate flirting or inappropriate joking, not seek assistance, fail to negotiate and set limits, etc. Training can help them develop positive interactions while avoiding misunderstandings concerning differences between boundary crossing versus violation(Glass 2003; Manfrin-Ledet, Porche, and Eymard 2015) Boundary crossing is common and may even be beneficial to the work environment, e.g. trainers and trainees enjoying drinks together after normal work timetable may unintentionally engage in conversations about stress, perhaps because they feel inadequately supported. This interaction, strictly not a professional or educational engagement, may contribute positively to the development of mutual trust through appropriate self-disclosure. However, if one prioritizes his or her own needs taking advantage of the other in this interaction boundary crossing spills over into violation. Looking at it this way, sexual function, which medicine readily recognizes as a physiological and neutral phenomenon, can be targeted as a boundary challenge. Going to work meets various needs of healthcare workers, but the need for intimacy need not be met at work and this is an important boundary. The grey zone between boundary crossing and violation

can be monitored to avail opportunities for returning within boundary. Tools with good measurement properties exist to screen attitudes, thoughts, and behaviors for identification of risk for boundary violations in this area (Swiggart et al. 2008). Self-awareness training, nipping this issue in the bud through monitoring of self-disclosure and social media etc., (Manfrin-Ledet et al. 2015) will help keep people professionally bound at all times in the workplace.

We submit that having specific codes of conduct reinforced through training should form part of behavior management strategies to minimize and eliminate the risk factors for boundary violation and harassment. The medical profession should rise to the challenge through concrete educational interventions, not just empty slogans of zero tolerance.

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# The Effect of Housing on Health and Challenges of Demographic Changes

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**Abstract-** There is overwhelming evidence on the robust relationship between housing and health, and the effect of poor housing conditions on health risks and outcomes. Although adequate housing is a fundamental human right and an essential social determinant of health, global prevalence of poor housing conditions is a key public health issue. Identification of the factors of housing associated with health and wellbeing, and investigation of health risks and outcomes attributed to housing conditions are essential preventive measures to ensure enhancement of both housing conditions and overall health. On the other hand, demographic changes and current trends of population growth indicate increased pressure on housing and health sectors globally. Current demographic trends suggest rapid growth of ageing population and increased urbanisation as the major challenges.

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# The Effect of Housing on Health and Challenges of Demographic Changes

Kritika Rana <sup>α</sup>, Vikram Shrestha <sup>σ</sup> & Ritesh Chimoriya <sup>ρ</sup>

**Abstract-** There is overwhelming evidence on the robust relationship between housing and health, and the effect of poor housing conditions on health risks and outcomes. Although adequate housing is a fundamental human right and an essential social determinant of health, global prevalence of poor housing conditions is a key public health issue. Identification of the factors of housing associated with health and wellbeing, and investigation of health risks and outcomes attributed to housing conditions are essential preventive measures to ensure enhancement of both housing conditions and overall health. On the other hand, demographic changes and current trends of population growth indicate increased pressure on housing and health sectors globally. Current demographic trends suggest rapid growth of ageing population and increased urbanisation as the major challenges. It is vital to examine if the existing housing conditions would be sufficient to cater to the future needs, and address any issues arising due to the projected demographic changes. This review aims to examine existing literature focusing on the effect of housing on health and the challenges arising due to demographic changes. The findings presented in this review may provide valuable insights on the effects of housing on health and inform housing and health sectors on the future directives to be undertaken.

**Keywords:** health outcomes, housing conditions, demographic change, ageing population.

## 1. INTRODUCTION

Globally, the robust relationship between housing and health has been a key subject of interest across diverse disciplines. The effect of built environment, especially housing, on general health and well-being has been well understood for over a century (1). In developed countries, people generally spend over 90% of their time indoors, at home or work (2, 3). Especially due to the COVID-19 pandemic, people have been spending even more time in their homes either due to lockdown or working from home as a social distancing measure (4). Similarly, vulnerable population sub-groups such as older adults, young children, and those with chronic illness or disability spend most of their time at home, and are more susceptible to the health risks associated with housing conditions (5, 6). Given the increasing amount of time spent in buildings

and the influence of the housing on health, adequate housing conditions are vital.

The World Health Organization (WHO) defines healthy housing as a shelter that supports a state of complete physical, mental, and social well-being (7). It integrates- the feeling of 'home' related to the sense of security and belonging; the physical structure of the residence associated with physical health; the immediate housing environment in relation to the access to essential services and protection from diverse factors; and social characteristics of the local community that facilitate health and well-being. Adequate housing is a fundamental human right and an important social determinant of health (8, 9). Nonetheless, there is a wide prevalence of poor housing conditions, globally. In the United States, the prevalence of inadequate housing was 5.2%, with moderate or severe physical defects in heating or plumbing (10). Similarly, 19% of the total homes in England did not meet the decent homes standard, which was defined as a home in a reasonable state of repair, with reasonable modern facilities and services, and providing a reasonable degree of thermal comfort (11). Moreover, 20% and 13% of the European population reported that their residence did not protect against excessive heat in summer, and was not comfortably warm during winter, respectively (12).

Considering the numerous health risks associated with poor housing and the resulting health burden due to health conditions attributed to housing, substandard housing is a major public health issue (7, 13). The commonly associated health conditions with poor housing conditions include injuries, respiratory illness, asthma, cardiovascular disease, obesity, and mental health among others (13-15). Household air pollution due to solid cooking fuels caused 3.8 million global deaths in 2016 (16). Exposure to damp housing and gas stove emissions was associated with 7.9% and 12.3% of the total asthma burden in Australian children, respectively (17). In New Zealand, about 10% of hospital admissions occur every year due to household crowding (18). Although each individual is equally exposed to the health risks attributed to poor housing, vulnerable and ethnic minority population subgroups and those with lower income are more likely to reside in substandard housing or experience homelessness, resulting in enormous health inequalities (19, 20).

On the other hand, analysing the current trends and demographic changes, adequate housing is

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expected to become increasingly vital (7). Globally, it is estimated that people aged 60 years and above will double by 2050 (21), and this population sub-group spend a significant proportion of their time at home, and may require improved housing conditions. The global demographic trends by 2050 also suggest increased urbanisation which could increase housing demand in major urban centres, thus having an impact on housing affordability (22). It is therefore essential to investigate is the current housing conditions will cater to the future needs with regards to demographic projections and changes. The purpose of this review is to examine existing literature focusing on the effect of housing on health and the challenges arising due to demographic changes. Given the limited number of current articles addressing the aforementioned issues, the need to investigate the interrelation of housing, health, and demographic projections is exemplified.

## II. THE RELATIONSHIP BETWEEN HOUSING AND HEALTH

Because of the complex and multifactorial interrelationship between housing and health, it becomes challenging to formulate a methodology especially in the housing environment to ensure precise measurement of health benefits and associated cost savings of the proposed interventions (23). However, it is essential to identify the factors of housing associated with overall health, and to investigate the health risks and outcomes arising due to poor housing conditions, such that effective interventions and preventive measures can be carried out early on. This strategy may help ensure that the negative health outcomes are mitigated, and housing conditions are improved along with the upliftment of overall health and wellbeing.

Numerous studies have investigated and established the relationship between housing and health. Table 1 outlines the association of health risks and outcomes with cause attributed to housing conditions. A study by Evci et al. (24) identified the association of characteristics of residences of elderly with the incidence of home accidents such as falls, cuts, hits, electricity accidents, and poisoning. Higher occurrence of home accidents was observed in elderly living on third floor or higher, and dwellings with less than four rooms. Moreover, higher frequency of home accidents occurred in dwellings at poor safety level, which was calculated by evaluation of seven housing characteristics- ventilation system, grabbing bar, ground coating, indoor steps or staircases, handrails, damaged staircase, and height differences in staircases.

Gustafson et al. (25) investigated the association of skin conditions with housing conditions among 371 Latino migrant farm workers in North Carolina. Pruritus was associated with absence of air conditioning, which was reported in 36.2% of

participants living in dwellings without air conditioning. Scaling of the skin was mostly reported by participants with bedroom in thermal discomfort range. A significant association of rash with humid indoor environment as a result of damp and humid housing was observed. However, the authors did not find a significant association of housing conditions with the prevalence of other skin conditions such as blisters and ingrown nails.

In a study by Jin et al. (26), the role of household ventilation in decreasing the impact of indoor air pollutants on the risk of lung cancer was assessed. The authors found that a good ventilation in kitchen and bedroom was inversely associated with the risk of lung cancer, which could be due to the significant reduction in the exposure to indoor air pollutants arising from second hand smoke, high-temperature cooking oil fumes, coal used for cooking, and solid fuels used for heating. It was concluded that ventilation along with the cessation of tobacco may be a preventive measure for lung cancer. Similarly, Pramitha et al. (27) established a positive association was found between indoor particulate matter size 2.5 micrometers (PM<sub>2.5</sub>) concentration and lung function impairment. Additionally, indoor humidity outside the ideal range of 40-70%, and inadequate house ventilation were associated with lung function impairment.

Chum et al. (28) investigated the association of exposures in a residential environment with cardiovascular diseases including myocardial infarction, angina, coronary heart disease, stroke, and congestive heart failure. Environmental noise, proximity to a major road, and exposure to violent crimes were independently associated with higher odds of cardiovascular diseases. Other factors such as reduced access to parks/ recreation, food stores, and increased access to fast food restaurants were associated with higher odds of cardiovascular diseases. Similarly, a study by Rohde et al. (29) examined the association of residence floor level and cardiovascular disease and found a positive association. The prevalence of all three health outcomes- stroke, venous thromboembolism, and intermittent claudication increased by increase in floor level. The authors discuss that this could be attributed to various factors including poor psychosocial environment, atmospheric electrical parameters, and association of building height with socioeconomic status.

The association between household factors and incidence of malaria in Uganda's highly endemic region was explored by Snyman et al. (30). The authors found that as compared to residing in a traditional house, residing in a modern house with non-earth floors, non-thatched roofs, and non-mud walls was associated with roughly half the incidence of malaria. Moreover, various factors were related to the lower incidence of malaria including residing in a town rather than in a rural setting; bedroom with openings such as windows, eaves, and

airbricks to the outside; and presence of an educated and older primary caregiver.

Shah et al. (31) analysed the association of housing quality and mental health, particularly in context of pest infestation and depressive symptoms. The authors found that residents in housing with cockroach infestation had nearly three times the risk of experiencing high depressive symptoms as compared to those housing without infestation. Moreover, both cockroach and mouse infestation were associated with more than five times the risk of depressive symptoms. Another study by Pevalin et al. (32) also assessed the impact of persistent poor housing conditions on mental health. Factors directly related to poor housing conditions included- lack of adequate light, absence of adequate heating, condensation, leaky roof, damp walls or roof, and rot in the walls or floor. The authors

concluded that the increase in the persistence of housing problems had a deteriorating effect on mental health.

Amerio et al. (33) explored the association of poor housing with increased risk of depressive symptoms in Italy during the lockdown period due to COVID-19 outbreak. Factors associated with the risk of moderate to severe depressive symptoms included residing in apartments less than 60 m<sup>2</sup>, with poor-quality views, with unusable balcony, and scarce indoor quality. Moreover, participants who reported worsened working performance from home were more likely to report depression. Overall, the reviewed studies indicate a strong relationship between housing conditions and health outcomes; and further accentuates the measures to be undertaken to prevent the adverse health outcomes associated with poor housing.

**Table 1:** Association of health risks and outcomes with cause attributed to housing conditions

Author	Year	Country	Study Design	Participants (N)	Cause Attributed to Housing Conditions	Health Risk/Outcome
Evci et al. (24)	2006	Turkey	Cross-sectional study	3277	Floor level, room count, and home characteristics-ventilation system, grabbing bar, ground coating, indoor steps or staircases, handrails, damaged staircase, and height differences in staircases	Home accidents- falls, cuts, hits, electricity accidents, and poisoning
Gustafson et al. (25)	2013	United States	Cross-sectional study	371	Indoor thermal environment	Skin conditions such as pruritus, rash, and scaling
Jin et al. (26)	2014	China	Case-control study	1424	Household ventilation	Prevention of lung cancer
Chum et al. (28)	2015	Canada	Cross-sectional study	2411	Environmental noise, proximity to major roads, and exposure to violent crimes, access to parks/ recreation, food stores, and fast food restaurants	Cardiovascular diseases including myocardial infarction, angina, coronary heart disease, stroke, and congestive heart failure
Snyman et al. (30)	2015	Uganda	Cohort Study	515	House construction (traditional/modern), location of household (rural/town), openings to outside	Incidence of malaria
Rohde et al. (29)	2016	Norway	Cross-sectional study	11169	Floor level	Stroke, venous thromboembolism, intermittent claudication
Pevalin et al. (32)	2017	Britain	Cross-sectional study	16234	Housing conditions such as adequate lighting, heating, condensation, leaky roof, damp walls or roof, and rot in walls or floor	Measurement of mental health
Shah et al. (31)	2018	United States	Cross-sectional study	461	Household cockroach and mouse infestation	Moderate and severe depressive symptoms
Pramitha et al. (27)	2019	Indonesia	Cross-sectional study	109	PM <sub>2.5</sub> concentration, indoor humidity, house ventilation	Lung function impairment
Amerio et al. (33)	2020	Italy	Cross-sectional study	8177	Housing dimension, accessibility of balcony, quality of view from apartment, quality of indoor area, and worsening of working performance.	Moderate and severe depressive symptoms

### III. CHALLENGES OF DEMOGRAPHIC CHANGES ON HOUSING AND HEALTH

In 2019, the global population was 7.7 billion, and the United Nations (UN) has projected a world population of 9.7 billion in 2050 and more than 11 billion in 2100 (34, 35). The UN report (35) emphasizes that the ageing population is rising as a result of declining fertility levels, increasing life expectancy, and majority of

countries facing reduction in population size. Moreover, 78.5% of the 3.86 billion projected increased population from 2015 to 2100, will arise from poorest regions of the world, primarily due to the slowly declining fertility (34). This enormous increment in the global population will certainly have a massive impact on the housing as well as health sector.



### a) Rapid growth of ageing population

The age distribution of world population from 1950 to 2018 and projection until 2100 is illustrated in Figure 1. The projections indicate an increasing share of ageing population with the improvement in global health and declining mortality (36). In 2019, 1 in 11 (9%) people were over 65 years of age, which is projected to become 1 in 6 (16%) people by 2050 (35). Moreover, 1 in 4 Europeans and North Americans could be 65 years of age or over by 2050. The population group of 80 years

of age or over is projected to triple from 143 million (2019) to 426 million (2050). The most appropriate population subgroup to best explain the association of poor housing and ill health is older people. This is because the highest prevalence of chronic illnesses is seen in older people, they are likely to spend most of their time at home, they are most vulnerable to ill effects of poor housing conditions, and they are most likely to live in poor housing conditions (23, 37).

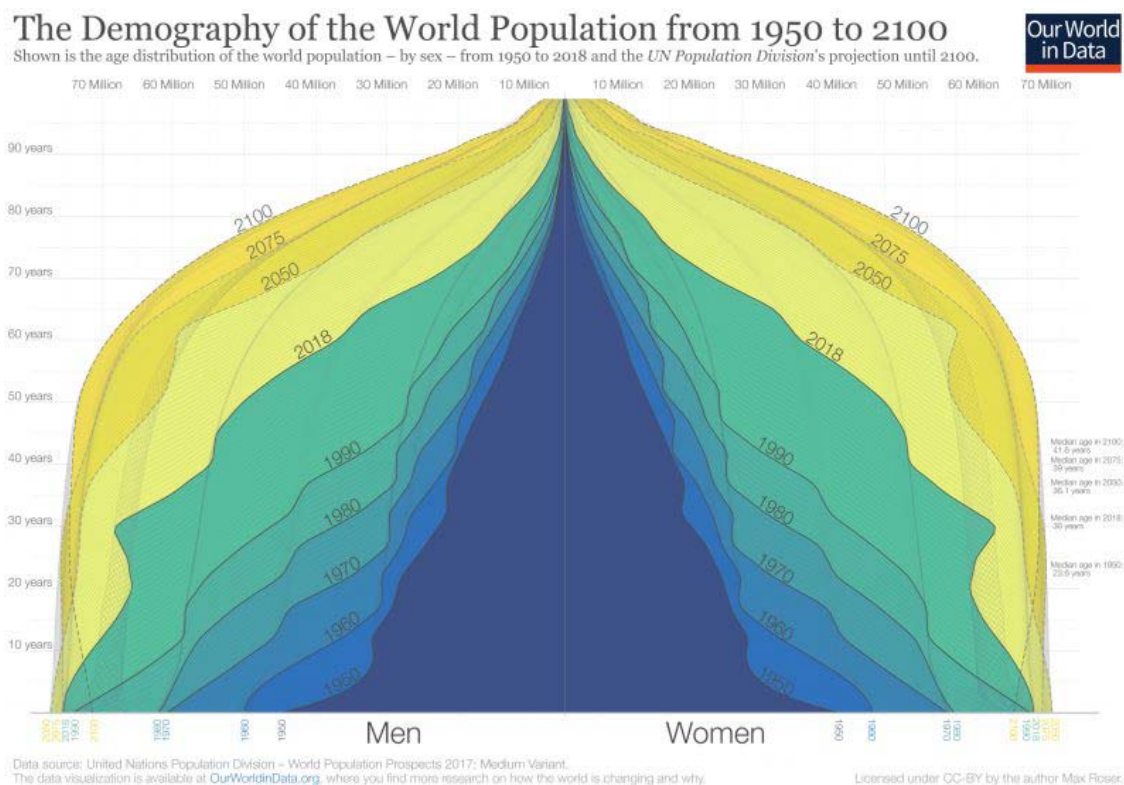


Figure 1: Age distribution of world population from 1950 to 2018 and projection until 2100 (36)

Particularly for older adults, specific housing related interventions may be beneficial. Hazard reduction interventions can be successful in reducing injuries as a result of falls which is common in older adults (38). Home hazard assessment can also be a useful educational strategy for fall reduction along with installation of safety devices including nonslip stripping on steps, double sided tape for mats and rugs, and grab rails (39). However, as structural modifications can be both difficult and expensive, these should be considered in the earlier design stage when developing housing for older adults. Similarly, residential design addressing older adults with dementia can help them live an independent life (23). The major areas of concern include- easy access to outside spaces, ease in way finding, individualisation of personal and communal spaces, appropriate use of colour and contrast, and lighting and opportunities to engage with the environment(40). Similarly, interventions such as wheelchair access and installation of grab rail should be

adopted early in the residential design phase for older adults with disability and mobility issues to prevent any health issues arising due to fall related injuries(41).

Addressing the ageing population, research is being conducted globally into the effects of housing on health. A qualitative study conducted by Somrongthong et al. (42) assessed the impact of housing and older people's living experience in rural Thailand. The authors found that the design of the houses did not entirely support the older people's individual daily activities, nor did it cater for health care equipment. Inadequate housing was a cause of several accidents and health risks were attributed to unsafe and insufficient lighting, furniture and floor surfaces, and beds and toilets with incompatible height for older people. A study conducted in South Australia (43) examined the effects of ageing on housing and urban development. The current and future housing necessities was dissimilar within as well as between some groups, which was associated with the older South Australian's age, location of residence,

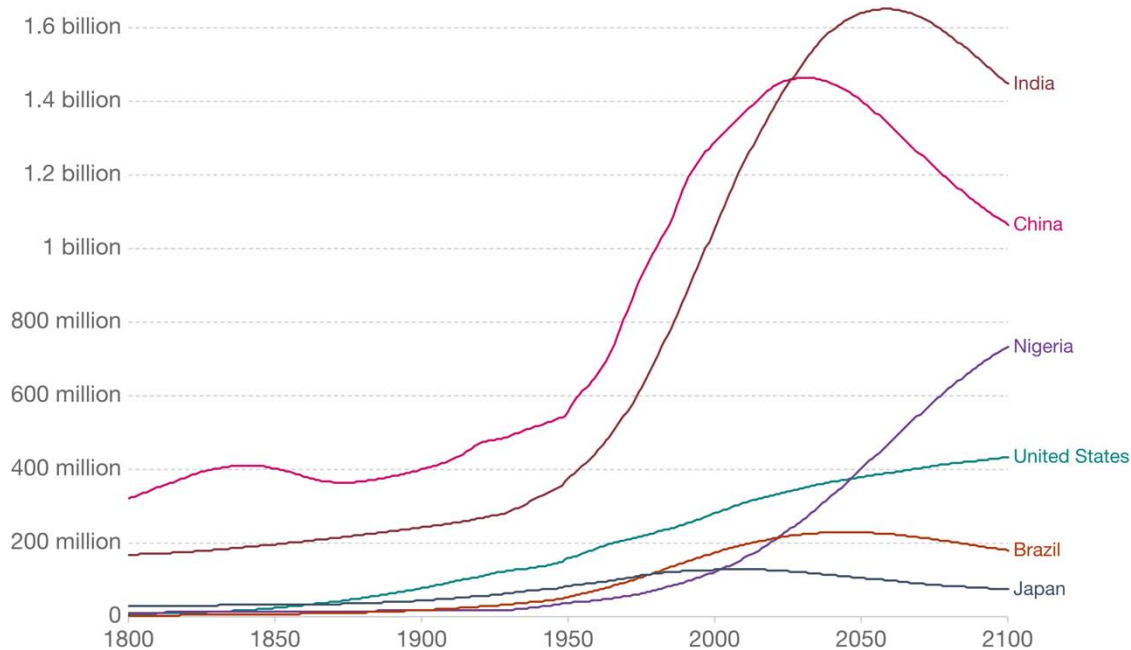
socio-economic status, and the assets that they hold. The study highlighted the need of support for ageing in place, an appropriate house design, and options for affordable and adequate accommodation in proper locations. Fox et al. (44) explored the housing needs of older adults in Ireland, and found that those in standard housing were less likely to undertake adjustments that enabled ageing in place, while those in sheltered housing reported positive outcomes and were content with the home design. Moreover, older adults in standard housing felt less safe at home, reported more illness and disability, and were worried about the future. The study highlighted the need of flexible and adaptable social housing designs to address the needs of older people over time. Overall, regardless of the country of origin, there is overwhelming evidence on the need of adequate and appropriate housing that cater to the ageing population.

#### b) Changing distribution of the world population

The population growth by country from 1800 to 2017 and projection until 2100 is shown in Figure 2.

### Population, 1800 to 2100

Historical estimates of population, combined with the projected population to 2100 based on the UN's medium variant scenario.



Source: Gapminder & UN Population Revision (2017) Medium Scenario  
Note: Historical country data is shown based on today's geographical borders.

OurWorldInData.org/future-population-growth • CC BY

Figure 2: Population growth by country from 1800 to 2017 and projection until 2100 (36)

The demographic shift due to fastest growing population in the low-income countries will put a major burden on the housing as well as health sector. Along with the rising housing demand in Africa, the housing structure is also being transformed from mud walls to concrete and brick walls, and thatch roofs to corrugated

metal roofs(45), which presents a decent prospect to improve health and wellbeing of the at-risk population(46). A study conducted by Tusting et al. (47) indicated that the incidence of improved housing, which was defined as housing with durable construction, sufficient living area, and improved water and sanitation,

doubled from 2000 to 2015. However, it was found that almost half of African population in urban areas still reside in unimproved housing conditions. This was moderately because of unimproved sanitation, which emphasises the need of urgent improvement of water and sanitation infrastructure. Moreover, housing design plays an essential role as it is associated with diverse health outcomes such as soil-transmitted helminths, malaria, mental health, respiratory disease, diarrhoeal disease, and leishmaniasis (47). Housing improvements could also combat the poor growth outcomes as well as childhood infectious diseases and lead to improved child health in sub-Saharan Africa (48).

On the other hand, the growing population in developing countries will also bring new challenges as a result of urbanisation and unprecedented growth of slums. The global population living in urban areas is projected to increase from 30% in 1950 to 66% by 2050 (49). Of the total projected increase in the global urban population from 2014 to 2050, 37% is anticipated to arise from India, China, and Nigeria. The chief reasons for migration from rural to urban areas include poverty, unemployment, and absence of adequate medical and educational amenities, which further increase the pressure on prevailing urban infrastructure (50). The unaffordability of urban housing causes the migrants to reside in slums and squatter settlements. Slums continue to increase along with the rising migrant population, and also because of the limitations of planning practices to address residents' needs. Approximately 1 billion people reside in slums and these slums are a major threat to human health (7). For those residing in slums, the health risks associated with housing include those from poor sanitation, unvented cooking amenities, hazardous electrical connections, overcrowding, structurally defective dwellings, inadequate housing amenities, unsafe infrastructure, and toxic building materials. In India, approximately 1 in 6 city residents presently live in an urban slum having unsanitary conditions unsuitable for human habitation (50). As India is projected to become the world's most populous country by 2027 (35), this demographic change will certainly have a negative impact on both housing conditions and overall health. It is therefore vital to address the issues arising due to the changing distribution of the world population.

#### IV. CONCLUSIONS

The interrelationship between housing and health is complex and multifactorial. Given the increasing amount of time people spend at homes, adequate housing conditions are essential. Nevertheless, poor housing conditions is a major public health issue due to its global prevalence and the consequential health burden. Additionally, the current demographic changes indicate that adequate housing

will become increasingly important. The rapidly increasing ageing population and increased urbanisation are some of the challenges arising due to demographic changes, which could have a negative impact on both housing conditions and health outcomes. This review summarised the evidence from existing literature on the effect of housing on health and the challenges arising due to demographic changes. Various health risks and outcomes attributed to poor housing conditions were identified including home accidents in elderly, skin conditions, respiratory diseases, cardiovascular diseases, malaria, and mental health. On the other hand, two major challenges arising due to demographic change- rapid growth of ageing population and changing distribution of the world population were identified, which would significantly increase the pressure on both housing and health sectors. Research emphasise the need of adequate and suitable housing that cater to the increasing ageing population. Similarly, the unprecedented population growth in low income countries and rapid urbanisation globally indicate the need of urgent action to curb the negative consequences on both housing and health. Future research on the relationship between housing and health should consider the wide implications of demographic changes so as to provide credible information and encourage housing and health sectors to implement effective interventions.

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# School Type, Lifestyle Factors and the Risk of Metabolic Syndrome in Nigerian Adolescents

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**GJSFR-I Classification:** FOR Code: 111799



*Strictly as per the compliance and regulations of:*



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**Results:** Prevalence of MetS was 5.6% (public= 5.1%, private= 0.5%). After controlling for all variables in the model, school type ( $R^2=17.3\%$ ) and fatness ( $R^2=2.7\%$ ) were significantly associated with MRS, respectively with the school type recording a stronger unique contribution ( $\beta = 0.494$ ,  $p<0.0005$ ) than fatness ( $\beta = 0.149$ ,  $p=0.023$ ). The likelihood of an adolescent in public school developing MetS risk is 3.0 (95% CI=1.21-7.62,  $p=0.018$ ) times that of his/her peer in private school. The odd of an adolescent developing MetS risk is 1.4 (95% CI=1.20-1.72,  $p<0.0005$ ) times with a unit increase in age.

**Conclusion:** School type was a strong predictor of MetS risk. Adolescents in public school were at higher risk of metabolic syndrome compared to their peers in private school. These results suggest that stakeholders in education and health promotion should pay particular attention to school type when planning preventive strategies for reducing cardiometabolic disease risk in adolescents.

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## 1. INTRODUCTION

Metabolic syndrome (MetS) is the aggregation of adverse cardiovascular disease (CVD) and metabolic risk factors that include abdominal adiposity, hypertension, hyperglycemia, hypertriglyceridemia and hypoalphalipoproteinemia.<sup>1</sup> The coexistence of any three or more of these CVD risk factors in the same person constitutes MetS which in recent times has become a major health challenge

worldwide, increasing the risk of CVD, Type 2 diabetes mellitus (T2DM) and some forms of cancer in adults.<sup>2,3</sup> Metabolic syndrome was first described by Gerald Reaven in 1988 and since then, numerous definitions and diagnostic criteria have been presented<sup>4</sup>. However, the International Diabetic Federation (IDF)<sup>5</sup> proposed a definition in 2007 in which the presence of central obesity and any other two risk factors constitute MetS. Despite these different definitions of MetS, the common denominator of this syndrome is insulin resistance.<sup>1</sup>

Like many other regions, MetS is becoming common in Africa. In a review of the literature, Okafor<sup>6</sup> reported prevalence rates of MetS in some African countries including Nigeria as ranging from 15.9% to 36%. Onyenekwu and Colleagues<sup>7</sup> also reported MetS prevalence rate of 14.3% in adolescents and young adults from Ogun State, Nigeria.

Determination of MetS epidemiology in adolescents is important as it does not only reveal the magnitude of the problem but enables stakeholders in health promotion to identify the targets for timely intervention. Since most studies in Nigeria take place in school settings which most of the time did not stratify samples on the basis of school type, it is difficult to identify the type of school (public or private) with higher vulnerability to cardiometabolic disease (CMD) risk. There are significant socioeconomic disparities between students from public and private schools. In Nigeria, students attending private schools are mainly from parents of high socioeconomic status (SES), who are perceived to be more likely to engage in sedentary activities such as excessive screen times, little or no physical activity and consumption of energy-laden fast food which could lead to overweight (OW) and obesity (OB). In comparison, their peers in public schools, most of who are from low/medium SES are perceived to be more active as they often walk and bike to school.

In a study of 1,338 Brazilian children aged nine to eleven years, Ferreira and Co-workers<sup>8</sup> reported the prevalence of obesity in private and public schools to be 19.9% Vs 9.0% and hypertension in private and public schools to be 21.2% Vs 11.4%, respectively. In all cases, the rates were higher in private schools compared to public schools. They concluded that children from private schools have higher SES, BMI and HTN<sup>8</sup> compared to those from public schools. Overweight and OB prevalence rates of 11.8% Vs 11.7% have been reported in Nigerian students attending private schools

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compared to rates of 3.3% Vs 0.9% among their peers in public schools, respectively.<sup>9</sup> In contrast, students from private schools displayed a significantly ( $p=0.032$ ) more favorable mean systolic blood pressure (SBP) than their counterparts in public schools (95.5% Vs 96.8%). In a study of CVD risk in 37,504 Brazilian adolescents (ERICA), MetS prevalence rates of 2.8% and 1.9% were observed in public and private school student, respectively.<sup>10</sup> Similarly, in the gender-specific analysis, both boys and girls in public schools displayed higher prevalence rates than their counterparts in private schools. In a population-based study of young adolescents from Eastern France<sup>11</sup>, prevalence of overweight was 22.7%, higher in low SES zones and in public schools than in private schools.

Two modifiable lifestyle risk factors known to be associated with MetS or CVD in youth are cardiorespiratory fitness (CRF) and body fatness<sup>12</sup>. Studies investigating the relationship among CRF, fatness and MetS have reported the existence of independent association among these variables.<sup>13,14</sup> However, a few others have either documented independent association of fatness but not fitness with CVD risk<sup>15</sup> or fitness, but not fatness with CVD risk.<sup>16</sup> The consideration of fitness and fatness in the study of cardiometabolic disease is therefore important.

There is paucity of data on the epidemiology of MetS in Nigerian youth, especially on the basis of sociodemographic factors. Many of the available studies focused on the prevalence of the individual components of MetS.<sup>9,17</sup> The available study on prevalence of MetS in youth did not make comparison on the basis of school type.<sup>7</sup> Thus, the purpose of this study was primarily to examine the relationship of school type with clustered metabolic risk score (MRS). The study also determined the contribution of fitness and fatness in predicting MRS. A secondary purpose of the study was to characterize the MetS risk profile of Nigerian adolescents based upon school type. It was hypothesized that the type of school attended by adolescents could predict their MetS risk. If school type can be shown to influence children's MetS risk, this could suggest a consideration of additional strategy by stakeholders in health promotion and education for reducing risk of MetS among the youth.

## II. MATERIALS AND METHODS

### a) Participants

Participants consisted of a total of 218 apparently healthy secondary school children (115 girls and 110 boys) ranging in age from 11 to 18 years from two schools. This is a cross-sectional school-based study conducted between September and November, 2019 prior to the scourge of Covid-19 pandemic. Participants were selected using probability sampling procedure in which they were systematically drawn from

the class registers in each school. Details of the sampling procedure, inclusion and exclusion criteria have been previously described<sup>16</sup>. Written informed consent of parents and assent of children were obtained before participation. All tests were conducted between 9:00am and noon, and the research protocol was conducted in accordance with the principles of the Declaration of Helsinki and approved by the Ethics Review Board of Kogi State University, Nigeria before data collection commenced. Throughout the duration of the project, all tests were performed in the same order by the same members of the testing team to ensure consistency.

### b) Study Setting

The present study was conducted at two schools, a public school (Public) in Dekina Local Government Area (LGA) and the other, a private (Private) school in Ofu LGA, all in Kogi East Senatorial District, Kogi State of Nigeria. The public school represented a typical Nigerian public school which is non-residential where students commute to school daily by walking or bicycling. Typically, the schools close by 2:00 pm, after which students go home and hardly return to school for any other activity. The private school, a residential catholic school, belongs to a group of schools with a population of 16 schools spread throughout the country. The school operates a stringent daily schedule: Students start lesson by 8:00 am after completing some cleaning work in their dormitories. They close by 2:00 pm, go for lunch and siesta. Participation in games is between 5:00 to 6:30 pm daily. All activities are compulsory.

Public schools are government owned, attended mostly by children from low and middle socioeconomic class (SEC), while private schools are expensive, of high academic quality and attended mostly by children from the upper SEC. Generally, there is more discipline in privately-owned missionary schools than public schools in the country.

### c) Anthropometric measurements

Participants' anthropometric characteristics were measured according to standard procedure.<sup>18</sup> Body mass and stature were assessed indoors in each school with the aid of an electronic weighing scale (Seca digital floor scale, Sec-880; Seca, Birmingham, UK) and a wall-mounted stadiometer (Model Sec-206; Seca, UK). Height was measured to the nearest 0.1cm and body mass was evaluated with participants in minimal clothing to the nearest 0.1kg. Participants' body mass indices (BMI) in ( $\text{kg.m}^{-2}$ ) were computed, and used to estimate body fatness. Details of the sex and age-specific classification of BMI into healthy weight (HW) and overweight (OW) are presented in the FITNESSGRAM revised data.<sup>19</sup>

Both the triceps and medial calf skinfold thickness were measured on the right side of



participants' bodies with the aid of the Harpenden skinfold calipers (Creative Health Products, MI, USA). All measurements were taken twice and the average of two readings recorded. The revised regression equations of Slaughter et al, as cited<sup>20</sup> for black children, were used to estimate % fat from the sum of triceps and medial calf skinfolds.

The waist circumference (WC) was measured to the nearest 0.1cm with a retractable metal tape (Creative Health Products, MI, USA) at the level of umbilicus midway between the lower rib margin and the iliac crest at the end of a quiet expiration. Two measurements were made and the average recorded. The WC was used to estimate abdominal fat.<sup>21</sup>

#### d) *Fitness testing*

Participants' CRF was assessed using the 20 meter multistage shuttle run test (20-MST) protocol. The 20-MST is a widely used, valid, and reliable test of aerobic fitness which has been shown to enhance motivation among children and adolescents.<sup>22</sup> The number of laps completed by each participant was used to estimate his/her CRF.<sup>23</sup> In order to assess the relationship between CRF and cardiometabolic risk factors, the total sample was divided into two groups (fit and unfit) based on their performances according to FITNESSGRAM sex and age revised health-related cut-points.<sup>19</sup> Details of the administrative procedure of the test are described elsewhere.<sup>14</sup>

#### e) *Biochemical measurement*

Fasting plasma glucose (GLU), high density lipoprotein cholesterol (HDL), and triglycerides (TG) were obtained through finger stick blood samples and analyzed with a CardioCheck Plus Analyzer (CCPA) (PTS Diagnostics, Indianapolis, IN, USA). The reliability and validity of CCPA have been reported.<sup>24</sup> Details of the specific procedure have been published elsewhere.<sup>16</sup>

#### f) *Blood pressure measurement*

Blood pressure measurements were taken while participants occupied a sitting position after 10 minutes of quiet rest with an automated digital BP monitor (HEM-705 CP; Omron, Tokyo, Japan). The resting SBP, diastolic blood pressure (DBP) and pulse rate were monitored on each participant's right arm using appropriate cuff sizes. This instrument has been shown to be accurate.<sup>25</sup> Measurements were taken twice at 2-minute intervals, and the average of the two readings recorded.

#### g) *Continuous metabolic risk score*

A continuous metabolic risk score was computed from the following variables: plasma GLU, SBP, WC, HDL, and TG. Each of these variables was standardized by subtracting the mean value for each sex group from the individual's value and then dividing by the value of standard deviation [ $z = (\text{value} - \text{mean})/\text{SD}$ ]. The standardized HDL was multiplied by -1

because it is inversely related to the MetS risk. The z-scores of the individual risk factor were summed to create a clustered metabolic risk score (MRS) with a lower score indicating a more favorable metabolic risk profile. Since there is no unanimous definition of MetS in youth, authorities (ADA and EASD)<sup>26</sup> have recommended the use of a continuous value of MetS score. This approach has been used in pediatric populations previously.<sup>27,28</sup>

#### h) *Reference values for risk abnormalities*

Participants were classified as having MetS if they had three out of the following: TG concentration of  $\geq 1.7\text{mmol}$ ; HDL concentration of  $\leq 1.04\text{mmol}$ ; glucose concentration of  $\geq 5.6\text{mmol}$ ; SBP level  $\geq 130\text{ mmHg}$ ; and WC in the 90<sup>th</sup> percentile for age and sex as recommended by the International Diabetic Federation (IDF)<sup>5</sup>. However, participants with one or two risk factors were considered at risk of MetS. The metabolic risk profile (MRP) of participants was determined by grouping them into two: those without risk factors as "no risk" and those with one or more risk factors as "risk".

#### i) *Data Analysis*

Descriptive statistics (mean  $\pm$  SD) of measured and derived variables were used to characterize the sample. Data were checked for normality of distribution before analysis and transformation made where necessary. All categorical variables were dummy-coded before statistical analyses. The independent samples t-test was used to examine differences in physical characteristics, performance, and features of metabolic syndrome between public and private schools. The Chi-square contingency test was used to evaluate the association between school type and different number of metabolic risks. Hierarchical multiple regression analyses were conducted to determine the independent association between school type, gender, fitness, fatness and composite metabolic risk scores. The independent association of school type, gender, fitness, fatness and MRP was examined using binary logistic regression model. Odd ratios of being at risk of metabolic syndrome were calculated between school types. The model was adjusted for age as a confounding variable. All statistical analyses were performed using the Statistical Package for the Social Sciences (Windows Version 20; SPSS Inc, Chicago IL, USA) at an alpha level of 0.05 or less.

### III. RESULTS

Demographic, anthropometric, biochemical and performance characteristics of participants are presented in Table 1. There were more participants (53.8%) from private school compared to those from public school (46.2%). When school type was stratified by risk status, we found metabolic risk prevalence to be 13.7% in private school and 33.5% in public school.

When school type was stratified by gender, MetS risk prevalence was 24.4% in males and 22.8% in females. Regarding physical characteristics, private school children were on the average younger ( $p<0.0005$ ) and taller ( $p=0.025$ ) compared to their peers from the public school. Data analyzed on the basis of MRP indicated

that participants from the private school displayed lower values of WC ( $p<0.0005$ ), SBP ( $p<0.0005$ ), GLU ( $p<0.0005$ ), TG ( $p=0.035$ ) and MRS ( $p<0.0005$ ), but better aerobic fitness ( $p=0.0005$ ) than their counterparts from public school.

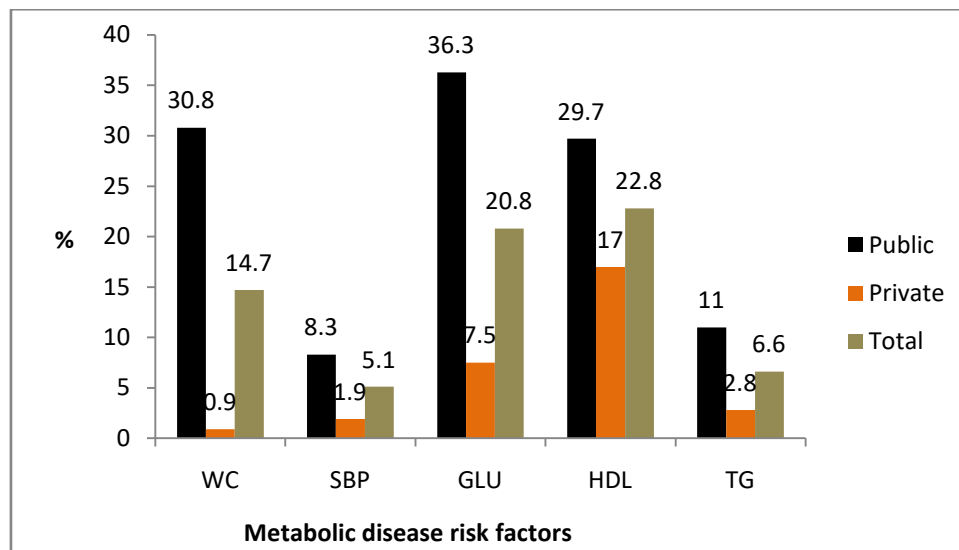
**Table 1:** General characteristics of participants stratified by school type and risk profile (n = 197)

Variable	Public (N = 91)			Private (N = 106)		
	Risk (66)	No Risk (25)	Combined (91)	Risk (27)	No Risk (79)	Combined (106)
Male	36 (78.3)	10 (21.7)	46 (100)	12 (23.5)	39 (76.5)	51 (100)
Female	30 (66.7)	15 (33.3)	45 (100)	15 (27.3)	40 (72.7)	55 (100)
Age (y)	16.0±1.9	15.4±2.1	15.9 ± 1.9	15.1±1.6	13.1±1.6	13.6 ± 1.8†
Stature (cm)	160.0±8.9	154.6±8.9	158.3 ± 9.2	165.0±8.4	160.2±10.5	161.4 ± 10.6*
Body mass(kg)	53.9±12.8	50.4±10.8	52.9 ± 12.3	60.1±11.0	50.4±12.5	52.9 ± 12.8
Body fat (%)	15.2±7.7	17.0±7.0	15.7 ± 7.5	17.5±9.3	14.7±5.5	15.4 ± 6.7
BMI (kg.m <sup>-2</sup> )	20.9±3.7	20.8±3.0	20.9 ± 3.5	22.0±3.2	19.5±3.5	20.1 ± 3.4
WC (cm)	73.4±8.2	71.5±5.4	72.9 ± 7.5	61.3±5.3	58.8±2.5	59.5 ± 3.4†
SBP (mmHg)	114.8±13.2	109.4±14.8	113.3 ± 137	105.2±17.0	95.9±14.6	98.3 ± 15.7†
GLU (mmol)	5.5±0.7	5.0±0.5	5.4 ± 0.7	5.1±1.0	4.7±0.5	4.8 ± 0.7†
HDL (mmol)	1.2±0.3	1.5±0.3	1.3 ± 0.3	1.1±0.3	1.5±0.4	1.4 ± 0.4
TG (mmol)	1.2±1.0	1.0±0.3	1.1 ± 0.9	1.2±1.1	0.8±0.3	0.9 ± 0.8*
MRS	-5.9±1.1	-7.4±1.1	-6.3 ± 1.9	-7.9±2.1	-9.4±1.0	-9.0 ± 1.5†
20-MST (lap)	22.3±12.4	19.1±7.3	21.4 ± 11.3	36.7±16.1	42.0±14.8	40.6 ± 15.3†

\* $p<0.05$ , \*\* $p<0.01$ ; † $p<0.0005$

Figure 1 presents the number and proportions of participants in each type of school considered to be at risk of individual features of MetS. There were higher proportions of adolescents at risk of MetS in the public school compared to the private school across all risk

factors. The risk of hypoalbuminemia (23%), hyperglycemia (21%) and abdominal obesity (15%) were most prevalent among the participants, with majority from public school.



**Figure 1:** Prevalence of metabolic risk abnormalities by school type

Figure 2 shows the observed number of adolescents with metabolic risk factors based on school type. In order to determine if school type was associated with different numbers of metabolic risk, the Chi-square test of independence was computed and the results showed a statistically significant ( $\chi^2_{(3,197)}=47.71$ ,

$p<0.0005$ ; Cramer's  $V=0.492$ ) association, with adolescents from private school displaying disproportionately fewer metabolic risks. Further analysis indicated that school type accounted for 49.2% of metabolic risk profile.

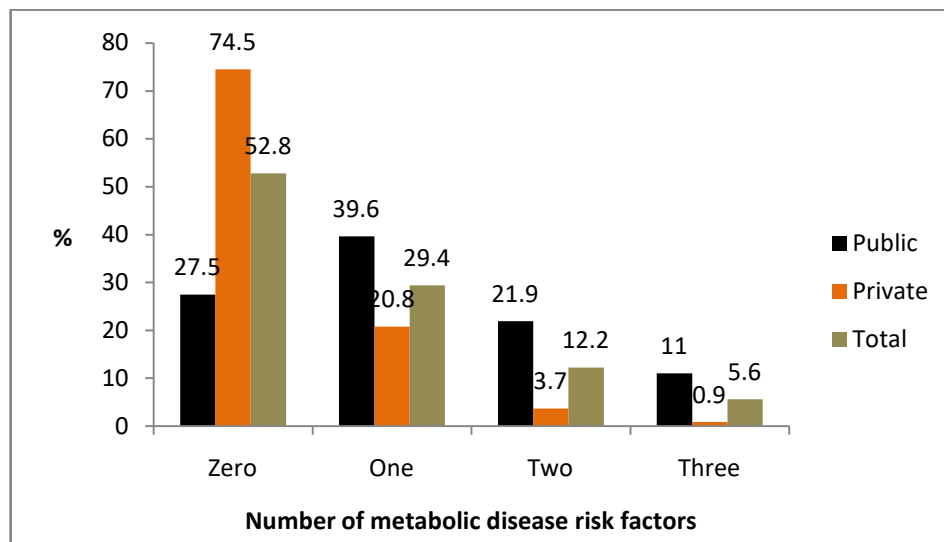


Figure 2: Metabolic syndrome risk factor distribution by school type

Results of the hierarchical multiple regression models assessing the ability of school type, fitness and fatness to predict MRS after controlling for age and gender are presented in Table 2. Age and gender were entered in step 1, explaining 20.1% of the variance in MRS. Addition of school type, fitness and fatness in step 2 increased the total variance explained to 45.1 %,

( $F_{(5,190)}=31.41$ ,  $p<0.0005$ ) after controlling for all the variables in the model. In the final model, School type and fatness were the only significant predictors, with school type recording a higher beta value ( $\beta =0.494$ ,  $p<0.0005$ ) than fatness ( $\beta =0.149$ ,  $p=0.023$ ).

Table 2: Predictors of metabolic syndrome risk

Predictors	$R^2$	Model 1		$R^2$	Model 2	
		$\beta$	$P$		$\beta$	$P$
Age	0.209	0.438	0.0005	0.451	0.069	0.335
Gender	-	0.125	0.051	-	0.042	0.523
School type	-	-	-	-	0.494	0.0005
20-MST	-	-	-	-	-0.132	0.092
BMI	-	-	-	-	0.149	0.023

Results of the logistic regression model assessing the impact of school type, fitness, fatness and age on metabolic risk profile was significant ( $\chi^2$  4 N=197=67.1,  $p<0.0005$ ). Only age (OR=1.4, 95% CI=1.20-1.72,  $p<0.0005$ ) and school type (OR=3.0, 95% CI=1.21-7.62,  $p=0.018$ ) had significant effect. These results indicate that the model was able to differentiate adolescents with from those without MetS risk. Age made a significant contribution with an odd ratio of 1.44 suggesting that the odd of developing MetS risk increases by a factor of 1.4 with a unit increase in age. As for the school type, the results showed likelihood of a public school student developing MetS risk being 3 times that of his peer in private school.

#### IV. DISCUSSION

Metabolic syndrome is characterized by both cardiovascular and metabolic system derangements resulting from abdominal fat accumulation and insulin resistance, with CVD and T2DM as its major

sequelae<sup>29</sup> Although the pathophysiology of MetS is not well understood, Brotman and Girod<sup>30</sup> have proposed that MetS is a state of insulin counter-regulatory overdrive in which there is a chronic duel between insulin and counter-regulatory hormones, such as glucagon, glucocorticoids and catecholamines along with free-fatty acids (FFA). In the biochemical tug-of-war, insulin attempts to store fuel while counter-regulatory hormones and FFA try to prevent fuel storage. This unending battle is thought to cause the complex abnormalities of MetS.

Since childhood MetS often leads to adult condition, its early detection and management are germane in the prevention and management of CVD and T2DM during adult life. Adolescents constitute a major part of the general population and future workforce in any society. Their health status is therefore of paramount importance, especially in a resource-limited and low average life expectancy country like Nigeria.

In the present study, the prevalence of MetS among participants was 5.6% with participants from public school displaying a higher rate (5.1%). This result is comparable with the 4.7% (Public=2.8%; Private=1.9%) reported for Brazilian adolescents,<sup>10</sup> 5% noted for Iranian children and adolescents<sup>31</sup> and 5.9% observed in South African adolescents<sup>32</sup> but higher than the global<sup>33</sup> adolescent prevalence of 3.3%. The result is also lower than the prevalence of 14% found for Nigerian adolescents and young adults<sup>7</sup>. Our findings are in agreement with those of the Brazilian study.<sup>10</sup> Potential reasons for the strikingly high prevalence rate in the Nigerian sample<sup>7</sup> may be due to the older age (18 years) and higher weight status which comprised overweight and obese participants. Sampling variations and measurement protocols may be additional reasons.

We observed that the proportion of adolescents with central obesity having MetS was higher than any other component irrespective of school type or gender (data not shown). Indeed, of the 11 adolescents with MetS, 10 had central obesity. This result is at variance with findings from the ERICA study<sup>10</sup> in which elevated TG and BP were most common among the sample with MetS. Our result is also inconsistent with those of adolescents and young adults from South-West Nigeria<sup>7</sup> where hypoalphalipoproteinemia was most prevalent among those with MetS.

In this study, hypoalphalipoproteinemia was the most prevalent metabolic risk abnormality. This was followed by central obesity and hyperglycemia. In all cases, greater proportions of participants from public school were more at risk of these abnormalities. In the ERICA study,<sup>10</sup> the most prevalent individual component of MetS was low HDL. This agrees with our results. The high hypoalphalipoproteinemia in our study is a cause for concern, as HDL is considered the most potent independent CVD risk factor because of its protective role against coronary atherosclerosis.<sup>34</sup> If abnormality of HDL becomes an issue at this early age, it calls for urgent intervention to prevent CVD burden in adult life.

Our results indicate that school type was independently associated with MRS after adjustment for age and gender. This is not surprising, as several previous studies<sup>8-11</sup> investigating the association of school type with MetS and its individual components have documented similar findings. However, most of these studies<sup>8,9,35</sup> found students from private schools displaying more unfavorable metabolic risks and other health indicators compared to their peers from public schools while a few studies (including the present one)<sup>10,11</sup> reported otherwise. Plausible reasons for our results include: differences in age, fitness levels, socioeconomic background and residential status of study participants. We observed that adolescents from private school were younger and fitter (Table 1). These variables are generally known to positively influence health status. As earlier noted, Nigerian students

attending private schools come mainly from family backgrounds with high SES, while those attending public schools are mainly from low/middle SES. Unlike in the past when parents were less educated with low economic power, contemporary Nigerian parents are more informed and able to take better public health decisions affecting family members, particularly in the areas of good nutrition, physical exercise and other personal health issues, than their counterparts in the past. Parents of low SES lack the capacity to address such health issues. Furthermore, students from public schools being older and exposed to harsh environmental stressors occasioned by their poor socioeconomic settings are relatively more likely to be disadvantaged with regard to optimal health and quality of life generally. In addition, the residential status of students attending private school in our study conferred additional advantage. Unlike those attending public school, they live in boarding facility with good daily schedule that include compulsory evening games and general enforcement of discipline.

The present study has certain limitations. The cross-sectional design used for data collection precludes determination of causality. Only two schools were involved in this study which may not be representative of similar schools in the study area. Future studies need to involve more schools to strengthen extrapolation. However, the strength of this study lies in its use of health-related cut-points to measure fitness and weight status.

## V. CONCLUSION

The prevalence of MetS in this study is moderate and higher among students from public school. Adolescents from private school generally displayed better metabolic profile than those from public school. Hypoalphalipoproteinemia was the most prevalent component of MetS among the participants irrespective of school type. However, school type was the strongest determinant of metabolic profile of the Nigerian adolescents. From public health perspective, findings from this study highlight the need to implement measures that promote healthy lifestyles within the school environment, particularly in public schools. Early identification of youth with cardiometabolic disease risk is critical for prevention of MetS later in life.

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*Authors' contribution*

D.I.M. participated in the conceptualization, study design, data collection, analyses and writing of the original draft; M.N.A contributed to the design of study, formal analysis, and interpretation of results; N.O.A. contributed to data collection and analysis. All authors have read and approved the final version of the manuscript.

*Conflict of interest*

The authors declare no conflict of interests

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Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

## TIPS FOR WRITING A GOOD QUALITY SCIENCE FRONTIER RESEARCH PAPER

Techniques for writing a good quality Science Frontier Research paper:

**1. Choosing the topic:** In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

**2. Think like evaluators:** If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

**3. Ask your guides:** If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

**4. Use of computer is recommended:** As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

**5. Use the internet for help:** An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.



**6. Bookmarks are useful:** When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

**7. Revise what you wrote:** When you write anything, always read it, summarize it, and then finalize it.

**8. Make every effort:** Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

**9. Produce good diagrams of your own:** Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

**10. Use proper verb tense:** Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

**11. Pick a good study spot:** Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

**12. Know what you know:** Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

**13. Use good grammar:** Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

**14. Arrangement of information:** Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

**15. Never start at the last minute:** Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

**16. Multitasking in research is not good:** Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

**17. Never copy others' work:** Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

**18. Go to seminars:** Attend seminars if the topic is relevant to your research area. Utilize all your resources.

**19. Refresh your mind after intervals:** Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.





**20. Think technically:** Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

**21. Adding unnecessary information:** Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

**22. Report concluded results:** Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

**23. Upon conclusion:** Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium through which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

## INFORMAL GUIDELINES OF RESEARCH PAPER WRITING

### Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

### Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

*The introduction:* This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

### The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

### General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

**To make a paper clear:** Adhere to recommended page limits.



### *Mistakes to avoid:*

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

### **Title page:**

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

**Abstract:** This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

*Reason for writing the article—theory, overall issue, purpose.*

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

### **Approach:**

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

### **Introduction:**

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.



*The following approach can create a valuable beginning:*

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

#### **Approach:**

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

#### **Procedures (methods and materials):**

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

#### **Materials:**

*Materials may be reported in part of a section or else they may be recognized along with your measures.*

#### **Methods:**

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

#### **Approach:**

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

#### **What to keep away from:**

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.



**Results:**

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

**Content:**

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

**What to stay away from:**

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

**Approach:**

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

**Figures and tables:**

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

**Discussion:**

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."



Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

#### **Approach:**

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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Topics	Grades		
	A-B	C-D	E-F
<b>Abstract</b>	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
<b>Introduction</b>	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
<b>Methods and Procedures</b>	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
<b>Result</b>	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
<b>Discussion</b>	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
<b>References</b>	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring



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