Challenges and Opportunities in the Field Of Information and Communications Technology (Ict) due to Covid-19 Pandemic and Migration Towards The New Normal

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Abstract: This paper presented events and scenarios involving the roles of engineering and technology. This paper also covered various industry settings where challenges and opportunities in the field of Information and Communication Technology (ICT) are prevalent and significant.

First, summary of historical events involving pandemic and/or plague was introduced. The term quarantine was emphasized in this paper as this involves movement control that could hamper the economy. Such movement controls are called in various names depending on the degree of strictness enforced by respective countries (lock – down, community quarantine, zoning containment and so forth).

Second, stages and impacts of different Industrial Revolutions were discussed. Although digital transformation was associated only during the Third Industrial Revolution, it led to numerous technological advancements. Drawbacks of technological advancements were also discussed specifically the right sizing of numerous companies and organizations.

Third, selected technologies were showcased. These include the following but not limited to: Public Key Infrastructure (PKI), Rural Impact Sourcing (RIS) and Disaster Risk Reduction Management (DRRM). While these technologies were tailor-fit for Philippine scenarios, faithful reconstruction is possible in order to be tailor-fit in other countries both affected and unaffected by COVID-19 Pandemic.

Fourth, provisions for agenda of Gender and Development (GAD) are also presented pursuant the thrusts of international mandates to empower different sectors of the society. Specifically, ICT based and ICT enabled jobs give equal opportunities.

Fifth, ICT challenges and opportunities stipulated in this paper were evaluated from local to global perspective towards resilient and sustainable economy.

Keywords: disaster resilience, economy, ICT, new normal

1. Introduction

While there are still distinctions between *health care* and *engineering* professions, the latter had proven its significant roles in world economy through times. At present however, *health care* professionals (physicians, nurses and laboratory technicians) are considered in-demand and essential during the COVID-19 Pandemic. Communities and media salute these *health care* professionals for their dedicated services offered to humanity. History shows their roles in dealing with the pandemic. Health care profession had also undergone several stages of development. Although it is still debatable the exact date when *quarantine* was first implemented, the concept of *quarantine* involves *movement contro*l.

As observed in Table 1, there is a *hypothetical disease* named Disease X speculated to affect a large – scale population should this disease occur and spread [1][2].

Table 1 Events Involving Plagues / Pandemics [1]

Event	Remarks
Athenian Plague	Estimated that this occurred around 430 – 426 B.C., the exact cause was unknown. The *overcrowded* city – state of Athens was severely hit.
Antonine Plague	Occurred in 165 – 180 A.D. which hit larger area i.e. territories of Roman Empire.
Justinian Plague	Occurred around sixth century A.D. and considered the first large scale plague in the recorded history.
The Black Death	This is the plague that hit Europe and Asia during the mid – 1300s
"Spanish Flu"	Regarded as the first global pandemic (1918 – 1920) that gave detrimental impacts to the several

	countries
Smallpox in the former Yugoslavia	Occurred in 1972, *travel restrictions* were enforced
HIV Pandemic	Observed in 1980's as "slow progressing" yet feared by the people around the globe.
SARS	Occurred in 2003
"Swine Flu"	Occurred in 2009
Ebola Outbreak	Occurred in 2014 – 2016
ZIKA	Identified in 2015
Disease X	A hypothetical, speculated disease serves a *model* for research

On the other hand, Table 2 features salient points of Industrial Revolution. The Industrial Revolution is a transition of practices, systems and policies due to either scientific or technological changes. The first recorded industrial revolution regarded as the "First Industrial Revolution" (1IR) flourished in Europe when the steam engine was invented. This revolutionized the working environment as the mechanical output had been improved significantly that time. "Water and steam" driven industries were prevalent.

Table 2 Salient Points of Industrial Revolutions [3]

Stages	**Salient Points**
First Industrial Revolution (1IR)	• "Mechanization" was introduced • "Water and steam" driven industries
Second Industrial Revolution (2IR)	• Some "water and steam" driven industries were still present at this period but most were driven by internal combustion engines • Electrification was introduced.
Third Industrial Revolution (3IR)	• "Electromechanical systems" are now electronically controlled • Automation is present almost every industries • Information and Communications Technology (ICT) emerged.
Fourth Industrial Revolution (4IR)	• Features Artificial Intelligence • Continuous digital transformation (ICT is still present)

The *Second Industrial Revolution* (2IR) followed. Although "water and steam" system was still present, *internal combustion engines* and *electrification* were introduced.

It was the *Third Industrial Revolution* (3IR) when *electronically* controlled *electromechanical systems.* These electronic computers (emphasizing the word electronic in order to be distinct from mechanical computers such as difference and analytical engine) revolutionized not only the *electromechanical systems* but as well as *business*.

There are several issues whether or not the *Fourth Industrial Revolution (4IR)* is already present in the world. Its features are present yet not all places in the world are efficiently covered by *utility services* such as electricity and ICT.

2. Methods

Data from historical records were gathered and put into comparative studies together with studies involving surge of ICT utilization during this present COVID – 19 Pandemic [1][2][3][24]. Both historical backgrounds of *plague / pandemic* and *industrial revolutions* featured several stages and scope of concern. It also reflected that *technological advancements* were not a guarantee to be safe from the impacts of the contagion. *Health sciences* were limited in this study but these historical events are considered essential as well as history of *Industrial Revolutions*. While this paper was more focused on the latter, consideration of *historical* events is essential both in *health sciences* and in *engineering* spearheading the engagement on life – long learning. Contrary to the popular misconception that engineering involves little historical background since engineers are trained to analyze and perform mathematical calculation, *history serves as a reference for research and development as well as guide when dealing with formulation of safety protocols* [19][20][21]. Prior to COVID – 19 Pandemic, two major components of Information and Communications Technology (ICT) namely *information infrastructure (infostructure)* and *capacity building* were being built and conducted respectively in the Philippines by the Department of Information and Communications Technology (DICT). There was also a paper presented during the 37th Conference of ASEAN Federation of Engineering Organisations (CAFEO 37) which stated how ICT contribute to disaster resilience and sustainable Asia – Pacific Region [4].

The definition of ICT is stated in the Republic Act No. 9292 (Electronics Engineering Law of 2004) and Republic Act No. 10844 (DICT Law of 2016) respectively under the Philippine laws [5] [6]. On the other hand, ICT was also stated by the International Telecommunications Union (ITU) through one of the reports by the Secretary General [7].

Selected ICT projects and practices were presented in this paper in order to assess and evaluate the resilience from the pandemic. As per *movement control* (*quarantine*) protocols and *distancing* enforced by concerned government agencies, physical contacts among peers, clients and partner stakeholders were discouraged. Most of transactions are *online* rather than *face – to – face* (*F2F*) in order to minimize the risk of contagion. However, less *F2F* transactions might put parties at security risk in the *cyberspace*.

3. Discussion

The Implementation of Public Key Infrastructure (PKI)

This infrastructure is the synthesis of hardware, software, dataware and peopleware necessary to create, manage, distribute, use, store and revoke digital certificates in which such digital certificate can serve as a valid identification and signature of an individual [8]. Considering that the *Electronic Commerce Act of 2000 (E – Commerce Law)* and the *Ease of Doing of Doing Business and Efficient Government Service Delivery Act of 2018 (EODB Law)* were approved in the Philippines, the significant increase in registration for PKI was prevalent during the *Enhanced Community Quarantine* (ECQ, the most stringent safety protocol implemented in the Philippines during the COVID – 19 Pandemic on the first semester of 2020). PKI features, higher level of security of digital signatures as *cyber threats* were pronounced during this pandemic. A mere scanning of a signature and pasting the same in a document to be forged is easy for perpetrators of *cybercrimes*. The challenges in full adaptation of PKI in the Philippines are the availability of devices for every individual and intensive capacity building for every citizen. As *information security* protocol, sharing of devices is considered as unsafe practice.

The Rural Impact Sourcing (RIS) and Disaster Risk Reduction Management (DRRM)

The RIS is another project of the Department of Information and Communications Technology (DICT) that had been shortlisted in the 2019 World Summit on the Information Society (WSIS) Prizes under the Capability Building Category of the International Telecommunications Union (ITU) [9].

RIS aims to create ICT-enabled jobs in the socio-economically disadvantaged areas in order to mitigate the repercussions of *hegemony* [10][11]. As reflected in global data, most people migrate from countryside to the city. The *hegemony* creates brain drain as well as economic imbalance. Congested cities pose a number of security and environmental risks. Involvement of the people in ICT jobs and digital entrepreneurships will contribute both to the economy as well as to the decongestion of urban areas especially the Metro Manila.

The *decongestio*n of Metro Manila is necessary in order to mitigate the possible casualties if a 7.2 magnitude earthquake strikes, and to sequester emission of pollutants [12]. While *frontliners* such as rescuers are prevalent during the disaster response operation, DRRM also covers the *forecasting* and *anticipating* risks and hazards that could create chaos and catastrophe.

Both ASEAN and APEC are engaged in building infostructures that aims toward *digital transformation*. These projects are career opportunities for *engineers* and *technicians.* Consequently, *operations and maintenance* (O & M) phase would further create more job opportunities. Table 4 presents scenarios of either opportunities or challenges in the implementation and utilization of ICT infrastructures and applications.

Table 4 ICT Opportunities and Challenges

Opportunities / Challenges	**Remarks**
Improved access for ICT infostructure and services	• Building and operating information infrastructure (infostructure) creates career opportunities for *engineers* and *technicians*, and will further address the requirements towards the new normal.
Disaster-Resilient Livelihood and Businesses	• Government created the Public Service Continuity Plan (PSCP) which is analogous to Business Continuity Plan (BCP). • Government provides capacity building for people to be ICT equipped towards the new normal (and even before the pandemic).
Increased Institutional Capacities of National and Local Disaster Risk Reduction and management (DRRM)	• Planning and fostering partnership with different stakeholders would be a challenge as data in the *hazard registry* differs from stakeholders to stakeholders
Affected Communities are Provided with Gender- and Conflict-Sensitive Basic Necessities and Services (Agenda of Gender and Development, also known as GAD)	• *Senior citizens* (60 years and above), pregnant, persons with medical conditions and persons below 21 years (despite that 18 years is the legal age in the Philippines) are considered *vulnerable sectors* during the *quarantine*. • Improved ICT infra and capacity building for citizens, people can secure ICT jobs regardless of gender and age.

Upon commissioning of *infrostructures*, *capacity building* would be the new challenge as digital literacy among citizens is difficult to implement considering that these topics are already infused in the school curriculum. In the case of the DICT in the Philippines, *capacity building* had been implemented prior to COVID – 19 pandemic. With this COVID – 19 Pandemic, *digital literacy* for the citizens not only in the Philippines would be part of the new normal. "*Narrowing the Digital Divide*" is the objective being fulfilled in the Philippines as well as across the globe.

ICT challenges were not only encountered in working sector but as well as education sectors. Since safety and security is the priority of both government and parents, Flexible Learning Schemes are implemented in educational institutions. DICT fostered partnership with Aurora State College of Technology (ASCOT) in launching ICT projects and programs including the Flexible Learning Schemes which was drafted by both ASCOT and DICT under the supervision of the Commission on Higher Education (CHED) [13][14]. Challenges in the education sector did not end with flexible learning schemes as not all students have access in ICT as their home are located in remote areas.

With the threats of COVID – 19 prompting countries to enforce its respective *movement control schemes*, *face – to – face* (F2F) transactions had been minimized. While online transactions are convenient method of dealing with clients, co – workers and / or stakeholders, there are *cybersecurity risks* involved. These risks and threats are the following but not limited to *phishing*, *vhishing* and *identity theft*. Risks of identity theft might be prevented by securing the credentials of an individual by using Public Key Infrastructure (PKI). However, despite of the existing *EODB Law and E – Commerce Law*, implementation of PKI had encountered challenges i.e. adapting by various government agencies and private sectors. Consequently, *marginalized sectors* have also difficulties of coping with ICT as they have limited equitable access to *utility services*.

Figure 1: PKI Services [8]

On the other hand, another issue to be addressed this pandemic are agenda for Gender and Development (GAD). Senior citizens, pregnant and minors (less than 18 years old under Philippine law but as per *quarantine* guidelines, below 21 years old are not allowed to go outside) are restricted of travelling. The conflict seems that people below 21 years are prohibited to go outside their home yet people at least 18 years old can already work. Same dilemma applies with pregnant who used to work in their companies before pandemic hit. ICT through *work from home (WFH)* scheme can address this GAD issues. Figure 2 indicates the demographic vulnerabilities in the National Capital Region (NCR). This region in the Philippines has the highest cases of COVID – 19.

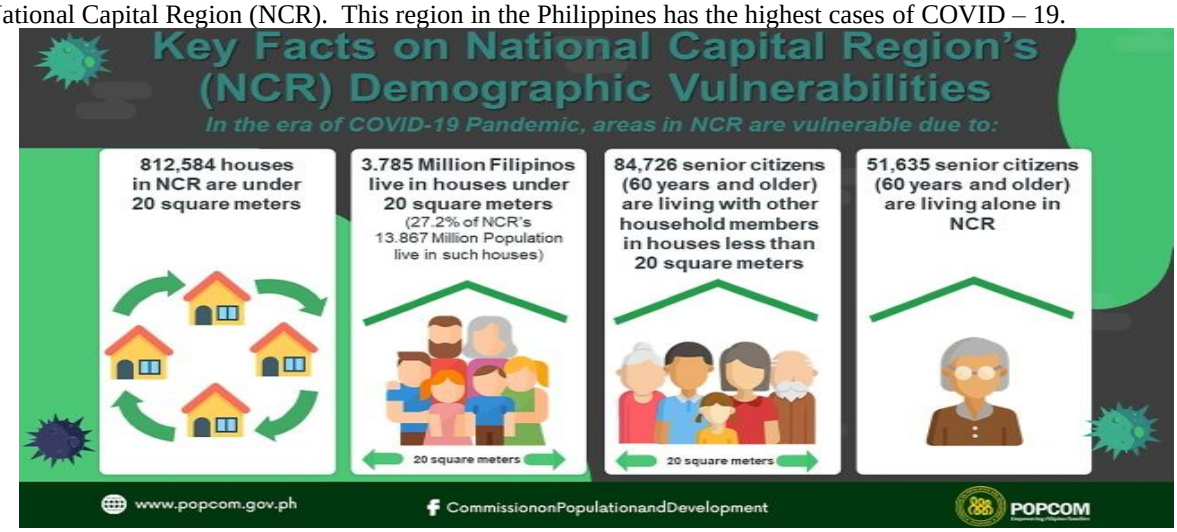

Figure 2: Demographic Vulnerabilities [15]

Moreover, *capacity building* for younger generations would not be difficult provided that *equitable access* to education and ICT platforms and services are available. In this scenario, there is a weigh shifting of balance between *challenges* and *opportunities*. There were beneficial effects of *computer gaming* in the skills development of the youth [22]. These are the following but not limited to: reflex, analytical, logical and even vocabulary skills. However, this *pandemic* may pose another challenge such as risks of mental health deprivation due to lack of socialization among people. While people are waiting either for the vaccine or for the containment of this *pandemic*, a *new normal* may arise i.e. trends in *business* and *education* enabled by ICT. It was discussed in this paper that ICT is the totality of electronic means to access, create, collect, store, process, receive, transmit,

present and disseminate information [6]. Moreover, ICT is under the scope of practice of Electronics Engineering [5].

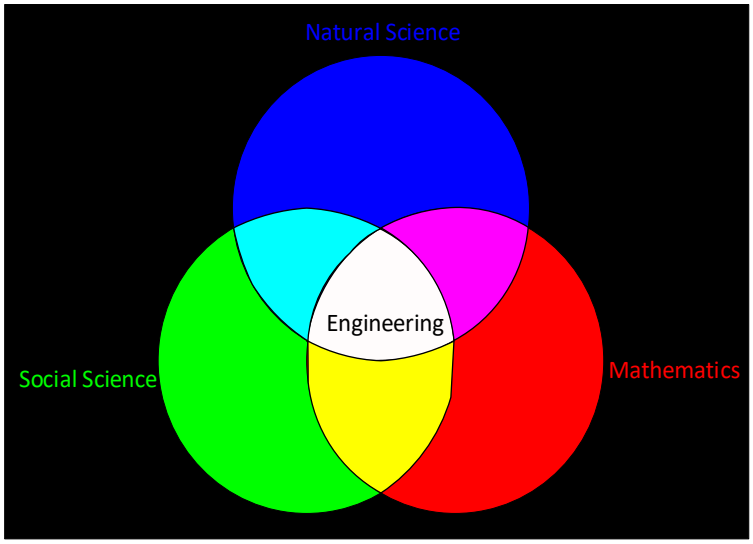

Figure 3: Venn Diagram representing the "Engineering Profession" as synergy of various disciplines [23]

4. Conclusions

The COVID – 19 Pandemic had brought detrimental impacts both to the health of people and to the global economy. *Quarantine* had been practiced through the years in order to contain the disease but involved *movement controls*. These movement control schemes hamper logistics and trade, bringing detrimental impact to the economy. On the other hand, there were several *industrial revolutions* that transformed economic norms. These industrial revolutions had brought both beneficial and detrimental effects upon its introduction. As there are still debates whether Fourth Industrial Revolution (4IR) is now present, the Third Industrial Revolution (3IR) has still challenges to cope i.e. implementation in the countryside, retooling of workforce, and *capacity building* for citizens. Should 4IR would be fully introduced, ICT would be its one of major platform.

This paper assessed and evaluated the trade – off between safety and economy. Even though the former is paramount over the latter, both *health care professionals* and *engineering professionals* have vital roles in overcoming this crisis for better living. The COVID – 19 being categorized as *pandemic* i.e, occurring in wide area such as multiple countries, problems occurred in a particular country might be similar with other countries.

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