Journal of Business, Accounting, and Economic Research
ISSN 3064-7991
Volume 12 Issue 2
April-June 2024
Impact Factor: 6.03
Enquiry: contact@continentalpub.online
Published by Continental Publication | https://continentalpub.online/index.php/Business-Accounting-Economic

ACCELERATING SUPPLY CHAIN FLEXIBILITY IN EPIDEMICS THROUGH ICT INNOVATIONS

Akua Ama Owusu-Danso
Department of Procurement and Supply Science, Koforidua Technical University, Koforidua, Ghana

Abstract: *The emergence of the COVID-19 pandemic in local communities, businesses, and nations worldwide precipitated an unprecedented level of uncertainty, necessitating a rapid and coordinated global response to mitigate its adverse effects on humanity. This paper contends that the existence of robust information and communication technology (ICT) systems played a pivotal role in averting a more catastrophic outcome of the pandemic. Unlike the time-consuming development and deployment of vaccines, the pre-existing ICT infrastructure swiftly mobilized to address the overwhelming challenges posed by the pandemic. Through an analysis of the global response to COVID-19, this paper highlights the indispensable role of ICT systems in facilitating communication, disseminating vital information, enabling remote work and education, and supporting healthcare systems during times of crisis. Furthermore, it explores how various ICT tools such as telemedicine, remote monitoring, contact tracing apps, and data analytics contributed to the containment and management of the pandemic. By leveraging existing digital technologies and platforms, governments, businesses, and communities were able to adapt to the rapidly evolving situation, implement effective mitigation strategies, and coordinate collaborative efforts on a global scale. This paper underscores the resilience and adaptability of ICT systems in the face of unprecedented challenges, emphasizing their critical role as a foundational infrastructure for societal resilience and response to future crises.*

Keywords: *COVID-19 pandemic, Information and communication technology (ICT), Global response Crisis management, Digital resilience*

1.0 Introduction

The uncertainty that covid-19 introduced within local communities, businesses and nations in our world required a globally spontaneous response that could mitigate the adverse effect the disease had on humanity. This paper argues that but for ever ready ICT systems, the global catastrophe of Covid-19 would have been more disastrous than anticipated. In other words, what actually migrated Covid-19 was the ever-ready ICT infrastructure system that existed in readiness and responded to the global catastrophe as compared to the vaccination development that took some time to develop and to response to the overwhelming pandemic of such magnitude.

The internet for example responded in an unprecedented manner in the sharing of local remedies to mitigate the spread of the Covid-19 virus within local communities and globally (Priyadarshini & Bhaumik, 2020; Chakma et al., 2021). ICT systems ensured the dissemination of useful information to fight the pandemic. Relevant audiovisual and messages were shared among

Vol. 12 No. 2 | Imp. Factor: 6.039
DOI: https://doi.org/10.5281/zenodo.14135254

different ethnic groups, nationals and local platform to migrate the spread of the virus. This paper further argues that but for the readiness of the ICT system in place the virus will have taken so many lives. The health professionals shared vital and relevant information across the world to help humanity prevent a potential extinction. The World Health Organization (WHO) relied on the resilient ICT systems (including the internet and cyber) to deliver their standard protocols, regular daily updates reaching a global audience, but for the resilience of ICT systems their regular updates of vital information would not have reach a global audience. Individual renowned expert virologist used ICT tools, including, social media (Facebook, facetime, utube, WhatsApp etc.) to reach so many people all over the world to support individuals, communities, organizations and nations in the prevention of a world at distress. ICT systems also helped to spread misinformation and conspiracy theories globally on the epidemic. So, the dichotomy of information was all made possible by the use of ICT systems as axis for good and evil. Many ICT (zoom, google, etc.) platforms were used for extensive collaborative responses to support organizations, scientist and health workers who were at the forefront of the global pandemic. We argue that ICT resilience should be given the needed attention in the resilience literature. ICT resilience can influence other variables negatively or positively.

2.0 Literature

What is resilience?

Many definitions exit in the resilience literature, in 1973, Holing defined resilience as "the ability of systems to absorb changes… and still persist" (Holling 1973, p. 3). "The capacity of a system to survive, adapt and grow in the face of change and uncertainty" (Fiksel, 2006, p. 21). Resilience is "the capacity of a system to absorb disturbance, undergo change, and retain essentially the same function, structure, identity, and feedbacks" (Longstaff et al. 2010, p. 2). Supply chain defines resilience by Stewart et al. (2009), as "the capability of supply chain operators to manage the consequences, which impact their ability to exchange value with supply chain partners located within and outside the impact area".

Other definitions, include, (Gilbert 2010, p. 11)," Resilience is defined as the ability to minimize the costs of a disaster, to return to a state as good as or better than the status quo, and to do so in the shortest feasible time". Resilience is the "ability of systems, infrastructures, government, business, communities, and individuals to resist, tolerate, absorb, recover from, prepare for, or adapt to an adverse occurrence that causes harm, destruction, or loss" (Schabacker et al., 2019). Further definitions suggest, "resilience' refers to the ability to adapt to changing conditions and withstand and rapidly recover from disruption due to emergencies" (McAllister et al., 2022). Folke et. al., 2010, argue the need to define specific resilience from general resilience and contextual resilience. However, according to Folke et al., 2010, this has to be done with the perspective of other resilience in mind because each ecosystem is made of so many constituents.

Our definition of ICT resilience is based on connectivity (local and global audience), relevant content, different alternatives, service delivery, survival, robustness and solves the anticipated challenge swiftly without discriminating (diversity and inclusion). The ICT gap between rural and urban committees exit and is pronounced. Rural underdeveloped communities not connected to the internet infrastructure lack quality content within their threshold. However, ICT systems resilience deals with the inherent ability of the system to stand in the advent of daring unanticipated consequences of grieve

Vol. 12 No. 2 | Imp. Factor: 6.039
DOI: https://doi.org/10.5281/zenodo.14135254
unimaginable magnitude, whether man-made or natural. ICT resilience restores hope by making sure that the content expectation of client is satisfied. ICT resilience ensures that alternatives route exit to verify the content of the information to satisfy the curiosity of the client.

Thus, **ICT resilience** is the ability of a reliable ICT system prepared in advance (right investment) and anticipates the occurrence of disaster (now or future), having a workable recovering alternative route, to mitigate and restore hope by reaching and satisfying local and or global audience expectations, with the trust that the ICT system shall deliver the ICT services (content and context) without discriminating timely. It is the ability of a robust ICT system to mitigate made-made or natural disasters timely in a local or a global environment without discriminating. ICT resilience is the understanding that the ICT infrastructure (hardware, software, connectivity, users, procedure, control, and data resources) put in place will deliver the ICT services irrespective of how bad the devastation will be. There is a need for researchers to pay attention to ICT resilience (ICTR).

ICTR ensured the sharing of experiences among expert scientists, frontline medical staff, and local traditional remedies content to mitigate covid-19 while the vaccine was undergoing development. While it took a longer time to develop a remedy to deal with the disaster the ICT systems were ready to deal with the covid-19 catastrophe responsibly. Expert scientist, health workers, frontline staff, traditional medicine, alternative medicine, etc. shared promptly their workable experience readily over the ICT systems to reach local communities and a global audience without discriminating, because there was a pandemic. The humanity in people reached others globally because of resilience of ICT systems, without which the catastrophe will have been more devastating than was experienced.

During the covid-19, local, national and international education had to rely fully on the resilience of ICT systems. Basic through to tertiary education had to rely solely on ICT resilience to survive (Espino-Díaz et. al, 2021). Some training and conferences were canceled but the many trainings and conferences that were not canceled had to heavily rely on the resilience of ICT systems to be delivered. ICT resilience carried the world of education and training on its shoulders to ensure that all these services were delivered to satisfy the client. Trainers and educators had to adapt to the ICT system that was already in place to effectively execute their mandate in their respective communities and to their audiences both local and international. But for ICT resilience education and training the globe will have come to a halt exacerbating the already wide gap between the informed and uninformed (Kizilcec and Halawa, 2015; Lembani et. al., 2019; Marinoni et al, 2020). In some countries schools had to close down entirely for one to two years to deal with the spread of the virus (Espino-Díaz et. al, 2021).

But what made it possible for learners to be taught was the fact that ICT systems were in place from global to local communities. 59% of educational institutions completely closed down and 80% of respondents that covid-19 impact, affect their students' enrolment numbers (Marinoni et. al, 2020).

In business and commerce, ICT resilience was able to handle effectively the pressure that was put on it by moving most business transactions online. The growth of e-commerce within the pandemic period was unprecedented and ICT systems were able to sustain the growth of sales over the internet and other payment platforms. Payment moved drastically to e-payments platforms during covid-19 (Ani, 2020). The sales of goods and services increased drastically over the internet. Supply chain distribution channels had to rely heavily on the ICT system that existed already and was ready to efficiently deal

Vol. 12 No. 2 | Imp. Factor: 6.039
DOI: https://doi.org/10.5281/zenodo.14135254
with the unprecedented information flow across the globe. E-commerce during the pandemic was the only means through which goods and services could be delivered but the general way of supplying goods and services traditionally gravely affected global trade, in Malaysia the negative impact on businesses affected sales and the customers' buying behavior (Hasanat et. al, 2020). However, what really migrated the downward trend of global trade was ICT systems that already existed (Ani, 2020).

Local and International news organizations have always relied heavily on the ICT systems to disseminate news to their indented audience. Mainstream media and social media have use ICT system extensively for their coverage reaching the remotest places in the world. Covid-19 took the world by surprise and there was the need to quickly and adequately inform the world population of a global pandemic swiftly to avert the magnitude of the catastrophe that the world was facing. WHO which is mandated to inform the world about this pandemic had to rely on the resilience of ICT system to effectively reach the globe and its pollution. The world needed vital information to adequately deal with the virus so that the spread could be contained to avert a major human disaster. Citizens and communities needed information to act fast and decisively to deal with the spread of the virus. In other to do this effectively and promptly resilient ICT system which already existed and was ready in anticipation for a calamity of such magnitude had to be unleashed to deal with the disease associated with the virus infection. But for the resilience of this ICT systems already put in place in the past by organizations, consortiums, communities and individuals both local and global, the devastation of the pandemic will have been catastrophic. However, but for timely information dissemination by World Health Organization (WHO), expert virologist, frontline staff, traditional medical experts and individual experience who relied heavily on ICT resilience the world have been in a bad state by now. People freely shared their experiences with the virus, medication that worked and those that did not work on various private and social media platforms. Their private information was all shared without discriminating freely with the world and this was made possible by the share reliance of ICT systems because it took some time for the vaccine to be developed. The negative side was the misinformation that also spread in equal measure as vital information on the virus, however, the same resilient ICT systems presented the opportunity for the bad information to be verified to ascertain the veracity of the good from the bad. Reportage from various local communities and national were all put on the internet for the consumption of a wider global audience. Documentaries of different levels of devastation from local communities were shared through private and public media outlets by ICT systems to the world. Short video and miniskirts on how to prevent the virus from spreading were all made available on the internet to help guide people behavior to help prevent the pandemic.

3.0 ICT Resilience Framework

Vol. 12 No. 2 | Imp. Factor: 6.039
DOI: https://doi.org/10.5281/zenodo.14135254

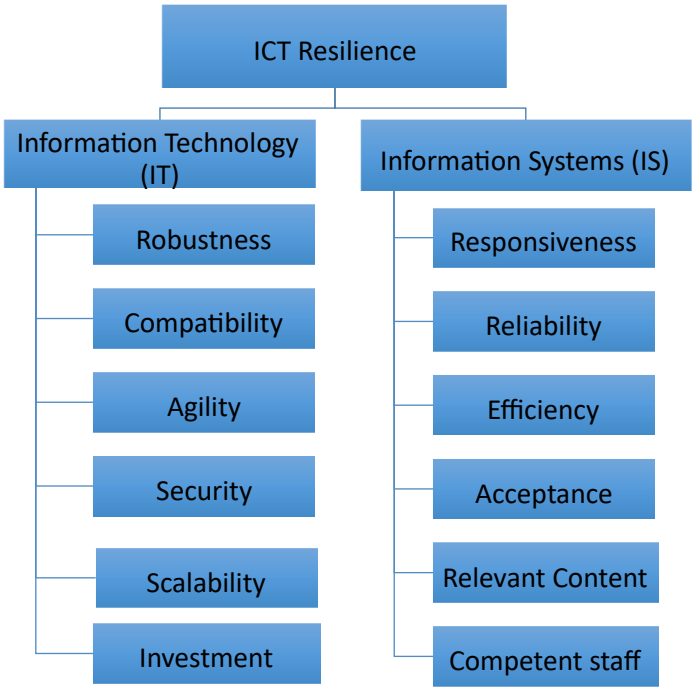

Fig 1: ICT Resilience Framework

Agility– agility is the ability of a system to adjust to or move quickly and easily to accommodate current trends with an evolving environment. Supply Chain however refers to, "how fast production processes and material flows' (Acar, et al, 2014). ICT agility refers to swift changes' adaptability within the external environment of the organizations. "Agile working is about bringing people, processes, connectivity and technology, time and place together to find the most appropriate and effective way of working to carry out a particular task. ICT agility is the ability of an ICT system to adapt responsively to the situational needs of the organization. An agile ICT system should be flexible enough to allow for other modules of the systems to be added on seamlessly without affecting the structure of the core ICT system in place.

Compatibility- "Compatibility is the capacity for two or more systems to work together without having to be altered to do so". Compatible ICT ensures that ICT applications use the same data formats. The ability of the system to allow all other platforms to communicate/synchronize seamlessly with the developed ICT system in place without a system collapse. The ability of an ICT system be compatible depends on the ICT system to accept and allow other systems developed with other platforms to fully integrate with the system under consideration. There are different platforms software (applications), hardware, connectivity, data platforms, etc. within ICT systems. It is imperative that different organizations will have peculiar ICT platforms which will have to communicate with other organization systems to ensure that connectivity and data can be shared among these organizations. To ensure that two or more organizations work together seamlessly, there is a need that the ICT systems of these organizations are compatible and can be adequately synchronized. Therefore, for ICT to be resilient it is a must that ICT systems of organizations can communicate effectively in a compatible manner.

Vol. 12 No. 2 | Imp. Factor: 6.039
DOI: https://doi.org/10.5281/zenodo.14135254

Scalability - for ICT system to be resilient system processing demands should be able to expand or reduce to accommodate an urgent need within the system to the benefit of the organization. ICT scalability deal with the size of business operations within the organization, the industry and beyond to take full advantage of the scale (Big or small). When business operations contract or expand within the organization the cost of operation should naturally respond accordingly to the adjustments. The ability of an ICT system (hardware, software, data, platform, etc.) to function well (in context) is to change in size or volume in order to meet a user's need.

Acceptance- ICT systems acceptability is for the user of the required system to fully appreciate the system and use it to the benefit of the users. The resilience of an ICT is the continuous belief that the ICT system will deliver what it was intended to do. The perceived usefulness and perceived ease of use of the ICT system ensure that system is accepted and applied for the intended purpose.

ICT resilience ensures that the trust and dependability in the ICT system are absolute. The trust in the internet, its vital content, and its continued use of it make it acceptable to its global users during the covid-19 pandemic. Individuals, communities, organizations, etc. all rely on the ICT systems (internet, etc.) reliability for information and content it provides for those who sought to have the content to support themselves.

Efficiency and Fit-for-purpose–The resilience of an ICT system is the way the system is able to handles request seamless operations effectively by addressing the challenge at hand. ICT resilient system allow the user(s) to make a quick transition from an idea to operationalization because it gives user(s) the ability to be flexible and also be distinctive when required. The design of a resilient ICT system is able to deal adequately with its intended purpose. Single and multiple users can all access relevant information(data) simultaneously and timely, ensuring that it improves the outcomes of the users. Resilient ICT guarantees that the system and the information obtained are fit for purpose. The resilience nature of any ICT system ensures that the expectations of all the stakeholders (user, service providers, content providers, etc.) are met currently and in the future. A resilient ICT system should have as some of its constituents; completeness, ease to use, uniqueness, ensure continuity, etc.

Reliability – the essence of reliability is that the system will not fail. In the advent of a disaster, reliability ensures that a resilient ICT system is trustworthy and will perform consistently. A resilient ICT system is consistent, and trustworthy and will deliver irrespective of the circumstance it finds itself. Reliability of an ICT system ensures that there is timely delivery of services to users of the system. The belief in the internet (a resilient ICT system) is what makes so many people rely heavily on it although they know the dangers associated with using such systems. Individuals, communities, organizations, and governments trust that the internet is safe and so they put content both private and public on it. They trust that it will not fail them so their confidence in the system.

Responsiveness - Responsiveness as a concept of computer science refers to the specific ability of a system or functional unit to complete assigned tasks within a given time". A resilient ICT system must be responsive. The results of a resilient ICT system should satisfy the responsiveness criteria of locating the required content within a reasonable time. The internet system is responsive to the needs of users in local communities, organizations, and nations.

Investment in an ICT system adds value to the system. The right investment is what makes ICT systems

Vol. 12 No. 2 | Imp. Factor: 6.039
DOI: https://doi.org/10.5281/zenodo.14135254
resilient. The investment ensures that there are redundancies in the ICT system to meet the growing needs of the time.

ICT Security

The complexity of interconnected ICT systems has led to the unintentional creation of vulnerabilities which expose connected individuals, organizations and nations to negative consequences in performance of their duties from unprecedented planned and unplanned attacks. The increasing over-dependence of systems on information technology (IT) has been fundamental to the management of increasingly complex systems and operations. However, in light of the recent surge in attacks on these ICT services, such enhanced connectivity has also led to new dynamics and paradigms for maintaining the availability, integrity and confidentiality of these services. The unintended and intended attacks should be anticipated, as a result of that, the developers of this ICT system must build resilience into the system to help mitigate the occurrences of these happening. The more secure an ICT system is the more resilient it is. The security of the ICT system ensures that the system is trusted. ICT security covers a whole range of protocols which includes; awareness, netiquette, controls and monitoring, procedures, audits, measures, safe transmission, data storage, and disposal, etc. The ICT resilience ensures that irrespective of the disturbance to the ICT system, ICT services will reach the intended clients in a secure way without the trust that relevant content has been delivered without discrimination but inclusive.

Relevant content - the resilience of an ICT system is the fact that relevant content will be located irrespective of the location of the user(s) as long as they have connectivity. Relevant content on the internet exists as long as the user understands how to perform a specific query to locate the content. Due to the global nature of telecommunication, computer networks and the iniquitousness of ICT systems looking for relevant content is almost guaranteed. Without relevant content, no ICT system can be resilient. When a user (s) are looking for content relevant to help them take decisions, they should be able to locate the content to help them make an informed decision(s). Locating relevant data has become relatively easier than previously when the world was not connected to a computer system. Facts on the internet can be checked and rechecked to ascertain the veracity of the information.

Competent ICT staff

Education and continuous training produce the required competencies. Some of these technical ICT staff have undergone apprenticeship training by working with skillful superiors. Competence staff guarantees organizations' success (Chokheli, 2012). Competent staff refers to persons able, both physically and mentally, to carry out the duties assigned. Qualified personnel who are trained and given the requisite skill and who have sufficient knowledge in IT and are fit notwithstanding their innovative ideas ensures that they are employed in IT firms to add value (Lukjanova et. al., 2019; Molin et. al, 2021). Competence and skillful staff are the greatest assets to the organization. Their competencies help them to develop workable solutions. These created solutions generate value that accrues to the organizations they work for. Solutions to the numerous challenges in the world are resolved with the competencies of employees, who put their skills at the disposal of their organization or communities to resolve these challenges. The more competent ICT staff are the more resilient the ICT systems and services they develop. But for the competencies of the ICT staff who developed computer networks and

Vol. 12 No. 2 | Imp. Factor: 6.039
DOI: https://doi.org/10.5281/zenodo.14135254

ICT services (Pettersson, 2018) around the world the internet will have collapse in the covid-19 pandemic. The resilience of the internet was able to deal with the burden that Covid-19 placed on it.

4.0 Conclusion

There is no literature on ICT resilience as a construct, however ICT resilience sustains ICT services both locally and globally. It supports many disciplines and their services which are mostly delivered online. The online space is widening and becoming more sophisticated with many complexities in IT infrastructure and IT services. There is a need to develop this construct to contribute to the body of knowledge in the resilience literature.

References

Acar, G., Eubank, C., Englehardt, S., Juarez, M., Narayanan, A., & Diaz, C. (2014, November). The web never forgets: Persistent tracking mechanisms in the wild. In *Proceedings of the 2014 ACM SIGSAC Conference on Computer and Communications Security* (pp. 674-689).

Ani, N. (2020). The Use of E-Payment During COVID-19 Outbreak. *International Journal of Scientific*.

Chakma, U., Li, B., & Kabuhung, G. (2021). Creating online metacognitive spaces: Graduate research writing during the covid-19 pandemic. *Issues in Educational Research*, *31*(1), 37-55.

Chokheli, E. (2012). The perfecting tasks of management of organizational changes in business companies. *Economics*, (7-8), 130-139.

Espino-Díaz, L., Fernández-Caminero, G., Hernández-Lloret, C. M., González-González, H., & Álvarez-Castillo, J. L. (2021). Emotional intelligence and executive functions in the prediction of prosocial behavior in high school students. An Interdisciplinary approach between neuroscience and education. *Children*, *8*(9), 759.

Fiksel, J. (2006). Sustainability and resilience: toward a systems approach. *Sustainability: Science, Practice and Policy*, *2*(2), 14-21.

Folke, C., Carpenter, S. R., Walker, B., Scheffer, M., Chapin, T., & Rockström, J. (2010). Resilience thinking: integrating resilience, adaptability and transformability. *Ecology and society*, *15*(4).

Gilbert, J. K. (2010, April). The role of visual representations in the learning and teaching of science: An introduction. In *Asia-Pacific Forum on Science Learning & Teaching* (Vol. 11, No. 1).

Hasanat, M. W., Hoque, A., Shikha, F. A., Anwar, M., Hamid, A. B. A., & Tat, H. H. (2020). The impact of coronavirus (COVID-19) on e-business in Malaysia. *Asian Journal of Multidisciplinary Studies*, *3*(1), 85-90. Holling, C. S. (1973). Resilience and stability of ecological systems. *Annual review of ecology and systematics*, 1-23.

Vol. 12 No. 2 | Imp. Factor: 6.039
DOI: https://doi.org/10.5281/zenodo.14135254

Kizilcec, R. F., & Halawa, S. (2015, March). Attrition and achievement gaps in online learning. In *Proceedings of the second (2015) ACM conference on learning@ scale* (pp. 57-66).

Lembani, R., Gunter, A., Breines, M., & Dalu, M. T. B. (2020). The same course, different access: the digital divide between urban and rural distance education students in South Africa. *Journal of Geography in Higher Education*, *44*(1), 70-84.

Longstaff, P. H., Armstrong, N. J., Perrin, K., Parker, W. M., & Hidek, M. A. (2010). Building resilient communities: A preliminary framework for assessment. *Homeland security affairs*, *6*(3), 1-23.

Lukjanova, J., Sushchenko, O., & Zyma, O. (2019). Educated and competent staff as important factor of innovation development of machine-building and metalworking industry in Latvia. In *MATEC Web of Conferences* (Vol. 297, p. 06006). EDP Sciences.

Marinoni, G., Van't Land, H., & Jensen, T. (2020). The impact of Covid-19 on higher education around the world. *IAU global survey report*, *23*.

McAllister, T. P., Walker Jr, R. F., & Baker, A. (2022). Assessment of Resilience in Codes, Standards, Regulations, and Best Practices for Buildings and Infrastructure Systems.

Molin, F., Haelermans, C., Cabus, S., & Groot, W. (2021). Do feedback strategies improve students' learning gain?Results of a randomized experiment using polling technology in physics classrooms. *Computers & Education*, *175*, 104339.

Pettersson, F. (2018). On the issues of digital competence in educational contexts–a review of literature. *Education and information technologies*, *23*(3), 1005-1021.

Priyadarshini, A., & Bhaumik, R. (2020). E-readiness of senior school learners to online learning transition amid COVID-19 lockdown. *Asian Journal of Distance Education*, *15*(1), 244-256.

Schabacker, D. S., Levy, L. A., Evans, N. J., Fowler, J. M., & Dickey, E. A. (2019). Assessing cyber biosecurity vulnerabilities and infrastructure resilience. *Frontiers in bioengineering and biotechnology*, *7*, 61.

Stewart, G. T., Kolluru, R., & Smith, M. (2009). Leveraging public-private partnerships to improve community resilience in times of disaster. *International Journal of Physical Distribution & Logistics Management*.