

# Predicting the Actual Usage of Online Health Care Service among Rural Citizens through E-Governance Initiatives during COVID-19 Using Machine Learning

M. Bhuvana<sup>1</sup>, S. Vasantha<sup>2\*</sup>

<sup>1</sup>ICSSR Post-Doctoral Researcher, Department of MBA, Vels Institute of Science, Technology & Advanced Studies (VISTAS), Chennai.  
E-mail: bhuvana.sms@velsuniv.ac.in

<sup>2\*</sup>Professor, Department of MBA, Vels Institute of Science, Technology & Advanced Studies (VISTAS), Chennai.  
E-mail: vasantha.sms@velsuniv.ac.in

## Abstract

In various countries across the globe, communication between the citizens and the government takes place through online mode which helps them to reach extensively. These innovative initiatives in technologies have restructured the lifestyle of the citizens residing in our country. The Indian government has revamped its process through outstanding digital transformation in facilitating its services in many fields like insurance, banking, education, and health care services for the citizens. The phrase e-governance has been introduced in the 17<sup>th</sup> century to concentrate on structuring the applications for facilitating services to the citizens. The deadly virus of COVID-19 has been spread all over the countries in December 2019 in Wuhan city, China. The whole world has been drastically affected and the Indian government has taken several initiatives and precautionary measures to safeguard the life of the people. Various health care applications have been developed to facilitate teleconsultation services to the people, especially in remote villages, since in developing countries like India 70 percentage of the entire population are occupied by the rural areas. The government authorities, officials, and health care workers have faced various obstacles to create knowledge and awareness about this deadly virus of COVID-19 among rural citizens. The government officials have instructed the rural citizens to maintain social distancing, use hand sanitizers, and access teleconsultation services to meet their immediate health requirements. Hence the present study has found out the recurrence of usage of e-governance health care applications among the citizens in rural areas and predicted that the exact requirement of the citizens in rural areas for effectively using the e-governance applications for health through machine learning technique in r studio.

**Keywords:** Actual Usage, COVID-19, E-governance Health Care Applications, Rural Citizens, Public Trust, Service Quality, Information Quality.

DOI: 10.47750/pnr.2022.13.S03.023

## INTRODUCTION

The process of offering online government services for the citizens living in the society is called the element “E-governance”. It is the most convenient platform for both people and the government for exchanging information (Armstrong, et.al, 2012). In India, 69.98 percentage of the population is occupied in villages (World Bank, 2018). Hence the government services must reach the rural citizens since they occupy wider space in our country (GOI, 2015). A new deadly pneumonia virus called COVID-19 (Novel Coronavirus 2019) has been determined by WHO (World Health Organization) in China (WHO, 2020). This deadly virus affects the respiratory tract of humans. Most of the developed countries have been identified with lakhs of infected cases (Civil Service India, 2020). The whole world remains in indefinite lockdown for more than 9 months, and

the World Health Organization has directed the people to take precautionary measures like maintaining social distancing, wearing a face mask, frequently use hand sanitizers, and follow maximum hygiene and safety measures to fight against this deadly virus. The Indian Government has made multiple safety measures to secure the lives of the people particularly in villages from Coronavirus since the awareness about this deadly virus is found to be less among the rural people.

During this epidemic condition of COVID-19, to offer health care services, the Government of India has decided to facilitate technology-oriented services for health to the rural poor under CSC (Common Service Centres). Various technology-oriented health care services like Teleconsultation Services, Tele-Diagnosis, and general health care advice from medical experts have been facilitated to the low-income group people in villages (CSC Health,

2020). The Indian Government has structured the application called “Arokiya Setu App” in April 2020 for distancing the people from this deadly virus by highlighting the places where this virus has been extensively spread. “E-Sanjeevani” is another application that has been developed by the Government of India for providing teleconsultation services that associate people with experienced medical experts through video conferencing (C-DAC, 2020). Therefore, in the present world situation, globally “Health” is considered as the most important factor among all the people irrespective of their socio-economic status during this panic situation of Coronavirus. Hence the current research study is concentrated on examining the determinants that are highly associated with the e-governance health care applications usage among rural people. The present study has also done an in-depth analysis on predicting the exact dimension that increases the e-governance health care applications usage by the rural people.

#### **DIMENSIONS OF “ACTUAL USAGE” OF ONLINE HEALTH CARE SERVICES AMONG CITIZENS IN VILLAGES THROUGH E-GOVERNANCE INITIATIVES**

Individual’s behavioral reaction is represented their Actual Usage of a system. It describes the frequency of usage and measures the time spent by each individual in using a specific system (David, 1993). It is the extent to which a person connects with the system that increases their job performance (Davis, 1989). The research study has measured the actual usage behavior of an individual by measuring their attitude for accessing the system (Davis and Venkatesh, 1996 and Etienne, *et.al*, 2015). A study has designed the theoretical framework for the adoption of technology. The authors have built a conceptual model through Technology Acceptance Model.

#### **Information Quality (IQ)**

“IQ (Information Quality)” is determined as the data quality that represents a single aspect of a variable (Wang and Strong, 1996). In an organization, the employees perform their task daily by accessing the information, technology, and the other resource that delivers the products or services to their customers. Therefore the information gained from any system should be relevant and have good quality to serve the customers (Alter, 2013). The basic objective of any system is to facilitate the information to the employees to perform the specific tasks (Petter *et al*, 2012). It is proved that the information system is highly dependent on the Information quality components for satisfying the users (Gable *et al*, 2008). The researchers have analyzed that “accuracy”, “ease of understanding”, “consistency”, “personalization”, “relevance”, “timeliness”, and “security” are the dimensions that measure the information quality of a system (Petter, *et. al*, 2012).

#### **Service Quality (SQ)**

“Service” is determined as the association of intangible, inseparable, and unstable system outcome that meet the system's needs (Gupta, Bhaskar, Singh, 2016). Responsiveness, Tangibility, Empathy, and Assurance are the various components of service quality in banking, transport, and tourism industries (Parasuraman, 1988). Fundamental factors that examine the service quality of an organization have been determined by researchers in many studies (Gronroos, 1984) Responsiveness, personalization, quality, and reliability are to be examined for measuring service quality (Lee and Lin, 2005). Researchers have constructed the service quality in association with training and staff skills. The researchers have considered process, subjective, and the outcome are the three factors for analyzing service quality (Galloway and Ho, 1996). Authors have also highlighted that the factors of service quality are used as the strategy for marketing to enhance the efficiency of an organization (Asubonteng *et al*, 1996).

#### **Public Trust**

The phrase “Trust” is defined as the fundamental need of a person living in the country related to their united values, dissimilarities, and preferences. It is described as the expectations of the people from the government that they would like to obsess (Cheema and Popovski, 2010). The hesitation of citizens in utilizing e-governance services through smartphones, websites, internet portals, and kiosks has a huge impact on efficiency in facilitating government services. Various researchers have stated that ICT is found to be the most efficient tool for attaining citizens’ trust in adopting e-governance services (Moon, 2003). Obtaining Services online are faster, cheaper, faster, and utilized easily throughout the world. Hence a large amount of money has been spent lavishly by the global nations for achieving peoples’ trust towards obtaining government services online (Mahmood, 2019). Various researchers have analyzed the variable “trust” through the successful execution of e-governance services. Siraj and Nasir (2020) have also highlighted that accessing tools like websites, digital payment systems, and social media are highly helpful for people towards accessing government services. The efficiency of these initiatives through technology increases the communication between the government and the citizens.

#### **GAP ANALYSIS**

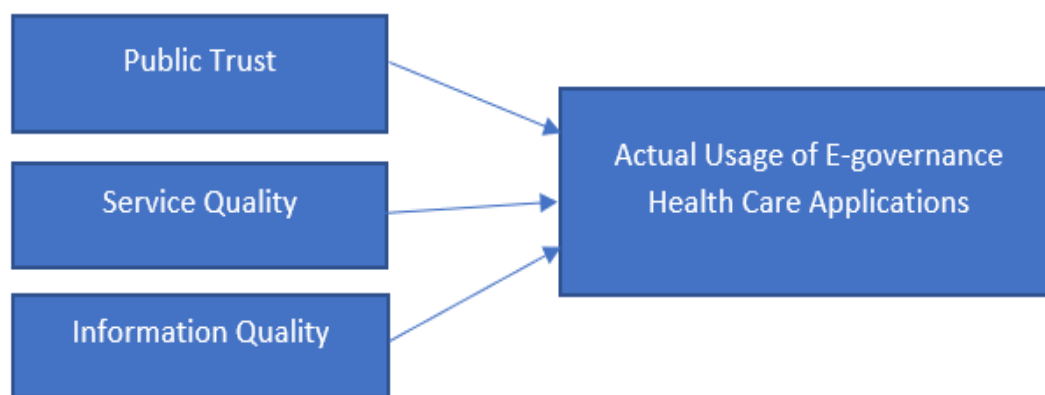
Many studies have strengthened their findings by highlighting various issues and challenges encountered by the citizens in rural villages for using government services online. The Government of India has made several steps and invested lakhs and millions of rupees for designing health care applications, for providing health care services through ICT for the rural people especially during this pandemic

condition of Coronavirus. But, still adopting those technology-based health care services is are found to be challenging by the rural citizens.

Hence this research study is an effort taken by the researchers

for measuring the needs of the rural citizens for using Health applications. The authors have also predicted the exact requirement of the rural citizens towards their actual usage of e-governance health care applications.

### CONCEPTUAL MODEL ON ACTUAL USAGE MODEL FOR E-GOVERNANCE HEALTH CARE APPLICATIONS



**(Independent Variable)**

**(Dependent Variable)**

Figure 1: Actual Usage Model for E-Governance Health Care Applications (Rural Citizen-EGOV.HA-AU Model)

Source: Authors' Model

The current study has used, D&M, 2003 (Delone and Mclean) model and the citizen-centric e-governance success model (Jafari, et.al, 2011) for designing the proposed conceptual model named “**Actual Usage Model for E-governance Health Care Applications (Rural Citizen-EGOV.HA-AU Model)**”. In D & M (2003), the authors have analysed the net benefits gained by the citizens for using a specific system. In the citizen-centric model, the authors have identified the elements that are highly associated with the requirements and needs of the people for effectively utilizing the e-governance system. In the current research study, the authors have taken “Public Trust”, “Service Quality”, and “Information Quality” as components for determining the usage of online health care applications through e-governance initiatives among rural citizens. The preferred theoretical model constructed by the researchers is displayed in Fig 1.

### METHODS

The researchers have designed a questionnaire for analyzing the e-governance health care applications usage by the rural citizens residing in Kanchipuram District. The authors have used a descriptive research design throughout the study.

Purposive and random sampling techniques have been used by the researchers for primary data collection since the complete study has been organized through selecting the rural villages randomly in the Kanchipuram district. The present research study is highly based on the purpose of collecting 300 rural respondents who were using e-governance applications for health in the district of Kanchipuram and its rural literacy rate is found to be 76 % which is lesser than the average literacy rate (80.23%) of the state Tamil Nadu. Moreover, the total number of CSCs (Common Service Centres) in Kanchipuram district is found to be 41 for servicing the entire rural population of Kanchipuram district (3,998,252). Hence this highlights that one CSC can be accessible for the population size of 97518. Therefore the authors purposively targeted the Kanchipuram district for conducting the study for collecting the primary data. The demographic profile of rural respondents has been displayed in Table 1. From table 1 it is highlighted that only 8.8 percentage of the rural respondents always access e-governance health care applications. The machine learning technique in r-studio was used by the authors to analyze the exact determinant that is highly significant with the actual usage of online health care applications.

**Table 1: Demographic Statistics of the Rural Citizens**

Gender	Frequency	Percent
Female	141	47.0
Male	159	53.0
<b>Age</b>		
18 - 26	64	21.3
26 - 35	114	38.0
36 - 45	75	25.0
56 and above	47	15.7
<b>Monthly Income</b>		
Less than 10k	86	28.7
10k to 15k	138	46.0
15k to 20k	59	19.7
Greater than 20k	17	5.7
<b>Education</b>		
Below 10th STD	66	22.0
Higher Secondary	79	26.3
Under Graduate	84	28.0
Professional	71	23.7
<b>Frequency of Accessing e-governance Health Care Applications</b>		
Never	69	18.4
Rarely	180	38.8
Sometimes	147	24.8
Often	54	9.2
Always	50	8.8
<b>Total</b>	<b>300</b>	<b>100.0</b>

## ANALYSIS OF DATA

The descriptive analysis for the research study has been measured by utilizing a software tool called Statistical Package for Social Sciences (SPSS 21). Through conducting the pilot study with the selected 150 respondents in the villages of the Kanchipuram district, the reliability of the questionnaire designed by the researchers has been analyzed. Cronbach's alpha value is found to be 0.88 from the reliability test. Therefore, the internal consistency of the structured questionnaire is found to be reliable (Mohsen and Reg, 2011). The researchers have adopted "Neural Network Analysis" as a machine learning technique in r studio for analyzing the exact variable that is highly related to the outcome variable "Actual Usage" of e-governance health care applications.

## Predicting the Actual Usage of Online health care applications among the rural citizens through e-governance initiatives using Neural Networks Analysis

The element "Neural Network" is determined as the neurons that exist in the neuronal system of human beings. Each neuron in the human body is related to the dendrites that pass the signals in the shape of electrical impulses to the other

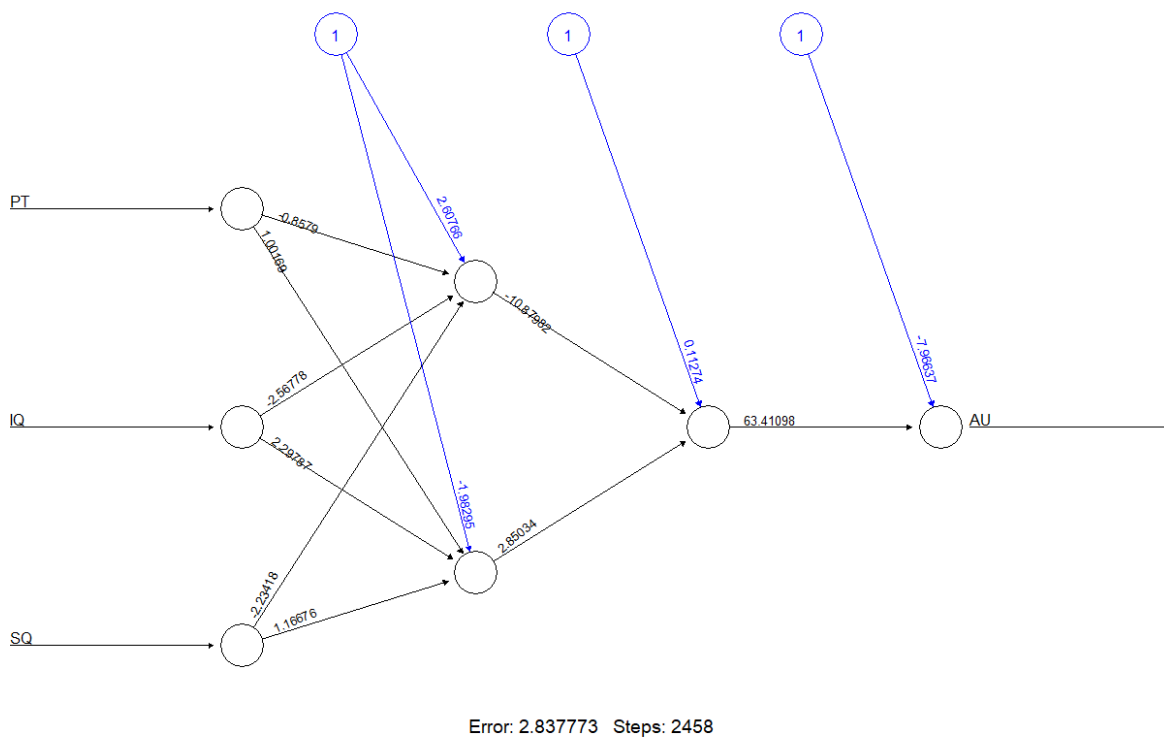
neurons present in the body. These signals are received as input in the form of an activation code by the human body for taking a particular action (Noon, 2013 & Johnson, 2004). After the in-depth examination and analysis, through receiving various inputs, the system produces the outcome for making a suitable decision (Gurney, 2004). All the variables are given as input, and the particular weights for each variable have been calculated and represented as "w". Through measuring the weights for each variable, by using the summary function, the true and false judgments have been analyzed. The actual prediction is tested and determined as the variable 'y'. These processes are continuously tested by the binary, numerical & categorical variables, and it is determined as "Single – Level Perception". The "Output (y)", "Hidden(h)", and "Input(x)" are the three major categories of neural networks and it is represented in Table 2.

**Table 2: Model Formulation**

SNO	Name of the Layer	Subscript	Description
1.	Input Layer	x(1,2,3,4...m)	Input variables used in the study
2.	Hidden Layer	h(1,2,3.....n)	Hidden weights extracted from the input layers
3.	Output Layer	y	Output variable analyzed from the weights of hidden layers

**Source: Lim, 2018**

The current research study has been conducted by using 300 sample data from the rural respondents f Kanchipuram District with the three input layers such as "Public Trust", "Service Quality", and "Information Quality". The variable "Actual Usage of e-governance health care applications" is taken as the output layer. There are two hidden layers generated with the corresponding weights through the function neural net(.). Figure 2 represents the neural network model for the preferred theoretical framework. From figure 2 it is proved that the outcome variable has obtained the maximum weights of "63.41098". This shows that from the input variable "Information Quality" is found to be the dimension that is strongly significant with the weights of 2.29787 with the output variable "Actual Usage" for attaining the highest score of "63.41098".



**Figure 2:** Neural Network Analysis (NNA) for Rural Citizen-EGOV.HA-AU Model  
Source: Author(s) Model

**Confusion Matrix**

To examine the true or false negatives the confusion matrix has been generated. Table 3 displays the confusion matrix for the data gathered from the rural respondents. Table 3 highlights that the proposed model produces 98 true negatives (0’s), 32 true positives (1’s), 18 false negatives, and 2 false positives.

**Table 3:** Confusion Matrix

	Prediction	
Actual	0	1
0	98	2
1	18	32

Table 3 shows that 88% (130/150) accuracy rate has been attained in predicting the actual usage of e-governance health care applications.

**RESEARCH FINDINGS AND DISCUSSION**

Table 1 shows that about 46 percent of the rural citizens fall under the income group between Rs.10,0001 to Rs.15000.

This proves that low-income people are not effectively accessing e-governance health care applications (Bhuvana & Vasantha, 2020). It is proved that 8.8 percentage of the rural respondents always access e-governance health care applications. Various research studies have highlighted that crowding, internet connectivity problems, closure of common service centers, and electric issues are the challenges encountered by the citizens in villages for using e-governance health care applications (Siraj and Nasir, 2020). Many authors have analyzed that providing health care services particularly for the elderly people in remote villages is found to be highly challenging (Margaret, Lorna, and Anne, 2015). Lack of awareness and infrastructure are the challenges that are significant to the channel of e-governance health care applications (Mohammad, et.al, 2019). Researchers have observed that lack of knowledge and awareness are the two major issues faced by the medical practitioners for promoting health care services among rural people (Rudolph et al., 2014).

The current research study has analyzed that the factor “Information Quality” is the primary dimension towards promoting the “actual usage” of online health applications by the citizens in villages. Authors of the present study have

constructed the theoretical framework and it has been validated by utilizing r-studio through machine learning technique called “Neural Network Analysis” by three different input layers namely “Public Trust”, “Service Quality”, and “Information Quality”. The dimension “Actual Usage” is considered as the output layer. It is found that the dimension “Information Quality” has secured maximum weights of 2.29787 as its contributions for obtaining the weights of 63.41098 for the outcome variable “Actual Usage”. The information gained from any system should be relevant and have good quality to serve the users (Alter, 2013). Hence the need and importance of quality of information should be identified by the developers for constructing any information systems to benefit the users. (Petter *et al.*, 2012). The findings of the present research study show that before constructing any applications related to the health care services especially for the rural citizens, their primary needs and requirements have to be first identified by the medical practitioners, and the application developers to make them adopt e-governance health care applications.

## CONCLUSION

In the current epidemic condition of COVID-19, accessing applications for health under initiatives of e-governance is found to be a better solution for the rural citizens for getting quality health services from medical experts. It is considered to be a huge transformation in medical informatics towards public health in facilitating ICT-based health care services. The researchers of the present research study have done their making contribution to examining the actual usage of online health care applications among rural citizens through e-governance initiatives. Through identifying the limitations of the previous research studies, the authors have examined the recurrence of using e-governance health care applications among the rural citizens and predicted that the determinant “Information Quality” is the priority requirement of the citizens in rural areas for effectively using the online health care applications facilitated by the government. A similar research study could be made by the researchers by identifying different dimensions that predict the actual usage of e-governance health care services among rural citizens.

## REFERENCES

Alter, S. (2013) Work System Theory: Overview of Core Concepts, Extensions, and Challenges for the Future, *Journal of the Association for Information Systems*, Vol 14, Issue 2, pp. 72-121.

Armstrong, L., & Gandhi, N. (2012). Factors influencing the use of information and communication technology (ICT) tools by the rural farmers in Ratnagiri District of Maharashtra, India, *Proceedings of The Third National Conference on Agro-Informatics and Precision Agriculture 2012*, pp. 58-63

Asubonteng, P., McCleary, K.J. and Swan, J.E. (1996), "SERVQUAL revisited: a critical review of service quality", *Journal of Services Marketing*, Vol. 10 Issue. 6, pp. 62-81.

Bhuvana, M and Vasantha,S. (2020). Determinants of Behavioral Intention

to Access E-Governance Services by Rural People with the Mediating Effect of Information and Communication (ICT) Literacy, *Jour of Adv Research in Dynamical & Control Systems*, Vol. 12, Issue-02, 176-187.

Cheema, G. and V. Popovski. (2010). “Engaging Civil Society: Emerging Trends in Democratic Governance.

Davis, Fred D. “Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology.” *MIS Quarterly*, vol. 13, no. 3, 1989, pp. 319–340.

Davis, Fred D.; Bagozzi, Richard P.; Warshaw, Paul R. User Acceptance Of Computer Technology: A Comparison Of Two, *Management Science*; Aug 1989; 35, 8; ABI/INFORM Global pg. 982

Etienne Erasmus, Sebastiaan Rothmann and Chrizanne van Eeden, A structural model of technology acceptance, *SA Journal of Industrial Psychology/SA Tydskrif vir Bedryfsielkunde*, 41(1), 2015.

Gable, Guy & Sedera, Darshana & Chan, Taizan. (2008). Re-Conceptualizing Information System Success: The IS-Impact Measurement Model. *Journal of the Association of Information Systems*. 9. 10.17705/1jais.00164.

Galloway, L. and S. K. Ho. “A model of service quality for training.” *Training for Quality 4* (1996): 20-26.

Government of India, India in Figures 2015, (Ministry of Statistics and Program Implementation, New Delhi: Central Statistics Office, 2015)

Gronroos, (1984) A Service Quality Model and its Marketing Implications, *European Journal of Marketing*, 18(4), 36-44.

Gupta, Bhaskar & Singh, (2016), Citizen adoption of e-government: A literature review and conceptual framework, *Electronic Government an International Journal* 12(2):160

Gurney, K. (2004). An introduction to Neural Network. UCL Press Limited is an imprint of the Taylor & Francis Group.

Johnson, S. A. (2004). Neural Coding Strategies and Mechanisms of Competition. *Cognitive Systems Research*.

Lee, G. and Lin, H. (2005), "Customer perceptions of e-service quality in online shopping", *International Journal of Retail & Distribution Management*, Vol. 33 No. 2, pp. 161-176. <https://doi.org/10.1108/09590550510581485>

Mahmood M. (2019). Does digital transformation of government lead to enhanced citizens' trust and confidence in government? Springer, ISBN 978-3-030-01759-0

Mohsen Tavakol and Reg Dennick. Making Sense of Cronbach's Alpha. *International Journal of Medical Education*. 2011; 2:53-5

Moon M J (2003) Can IT help government to restore public trust?: Declining public trust and potential prospects of IT in the public sector. *Proceedings of the 36th Annual Hawaii International Conference on System Sciences (HICCS 2003)*, Hawaii, HI, USA.

Noon, H. (2013). Artificial Neural Network: Beginning of the AI revolution.

Parasuraman, A., Zeithaml, V. A., & Berry, L. L. (1988). SERVQUAL: A multiple-item scale for measuring consumer perceptions of service quality. *Journal of Retailing*, 64(1), 12–40.

Richard Y. Wang & Diane M. Strong (1996) Beyond Accuracy: What Data Quality Means to Data Consumers, *Journal of Management Information Systems*, 12:4, 5-33

Rudolph et al, A study of the issues of eHealth care in developing countries: The case of Ghana, *Twentieth Americas Conference on Information Systems*, Savannah, 2014.

S. M. Jafari, N. A. Ali, M. Sambasivan and M. F. Said, "A respecification and extension of DeLone and McLean model of IS success in the citizen-centric e-governance," 2011 IEEE International Conference on Information Reuse & Integration, Las Vegas, NV, 2011, pp. 342-346

Siraj Ud Doullah and Nasir Uddin, Public Trust Building through Electronic Governance: An Analysis on Electronic Services in Bangladesh, *ITechnium Social Sciences Journal*, Vol. 7, 28-35, May 2020,

Venkatesh, V. and Davis, F.D. (1996) A Model of the Antecedents of

Perceived Ease of Use: Development and Test. *Decision Sciences*, 27, 451-481.

William H. DeLone & Ephraim R. McLean (2003) The DeLone and McLean Model of Information Systems Success: A Ten-Year Update, *Journal of Management Information Systems*, 19:4, 9-30.

Ibrahim, S., & Koksai, M. E. (2021). Commutativity of sixth-order time-varying linear systems. *Circuits, Systems, and Signal Processing*, 40(10), 4799-4832.

## WEBSITE SOURCES

World Health Organization (WHO) Publications, (2018), Rural Population, <https://www.who.int/publications>

Civil Service India, (2020), <https://www.civilserviceindia.com/subject/General-Studies/notes/egovernance.html>

CSC Health, (2020), E-Health Care Services <http://cschealth.in/Portalclass/index/services>