Assessment of E-Readiness Infrastructure in India through Growth of Telecommunication Services

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ABSTRACT
The developments in the field of information technology and hyper-connectivity across institutions and individuals had resulted significant interactions all over the world. Each country has made best efforts to create infrastructure for application of information technology for government services. The digital platforms are providing hassle free services with transparency and cost effectiveness. The Government of India also launched National e-Governance Plan (NeGP) consisting of twenty seven Mission Mode Projects and eight components in the year 2006. Health, Education, Public Distribution System (PDS) and Posts were added to the list of mission mode projects on May 18, 2006. Present study has been carried out to ascertain the status of Indian economy in terms of E-governance Development Index at global level. Further, the telecommunication network is the basic requirement for providing and availing e-government and digital services. Published data has been compiled to ascertain the growth of telecommunication services in India in terms of telephone connections, internet services users in India.
Key Words: *EGDI, ICT, Subscriber Base, Tele-density.*

I.   Introduction

United Nations Department of Economic and Social Affairs (UN DESA) publishes the E-governance Development Index (EGDI) based on survey report since 2001 biennially. United Nations Survey is the only global report for the assessment of e-government development status of all United Nations Member countries. It recognizes that each country should decide upon the level and extent of its e-government initiatives in keeping with its own national development priorities and achieving the sustainable development goals (SDGs). The Survey is intended mainly for policy makers, government officials, academia, civil society, private sector and other practitioners and experts in the areas of sustainable development, public administration, digital government, and ICTs for development. The assessment measures e-government performance of member countries indicating the relative position of each country. The index has established itself as a leading benchmarking reference on e-government, and a policy tool for decision makers over past ten editions. EGDI serves as a benchmarking and development tool for countries to learn from each other, identify areas of strength and challenges in e-government and shape their policies and strategies in this area. It presents the trends and relative rankings of e-government development across 193 Member States through a quantitative composite index. E-Government Development Index (EGDI) computed by the United Nations, Department of Economic and Social Affairs (UN DESA) indicates the relative status of e-governance development across nations in respect of specified parameters. Mathematically, the EGDI is a weighted average of normalized scores on three most important dimensions of e-government, namely:

* Scope and quality of online services (Online Service Index, OSI),
* Development status of telecommunication infrastructure (Telecommunication Infrastructure Index, TII),
* Inherent human capital (Human Capital Index, HCI).

$$EGDI = 1/3 \text{ (OSI normalized + TII normalized + HCI normalized)}$$

The Ministry of Electronics and Information Technology, Government of India is the nodal agency for Monitoring of E-Government Development Index in the country. The ministry is responsible to improve the ranking of the country as per global standards. The Ministry of Electronics and Information Technology, Government of India is working to develop and improve the basic infrastructure for improving the quality of online services in the country. The rank of India as per United Nations E-government survey is presented in Table: 1

Table: 1
United Nations E-government Survey: Position of Indian Economy

Year	EGDI Composite Score	Rank
2012	0.380	125th
2014	0.3834	118th
2016	0.4637	107th
2018	0.5669	96th
2020	0.5964	100th
2022	0.5883	105th

Source: UN E-governance Survey Reports

Note: Number of participating countries: 193

The table indicates that the composite score computed on the basis of well-defined parameters to assess the position of E-governance for United Nations member countries indicates that the EGDI Composite Score in respect of Indian economy was 0.3834 only in 2014 and the value of score has improved to 0.5883 in 2022 indicating improvement in EGDI. Rank wise position indicates that Indian economy was at 118th position in 2014 which improved to 96th position in 2018. Overall, EGDI Rank in respect of Indian economy has been hundred or more in most of the years of study period except in the year 2018. But in subsequent years, the India moved to 105th position as per survey report of 2022. So, it may be concluded that there is improvement in EGDI Rank of India still there is strong need to improve the E-government services to improve the ranking of Indian economy as per global standards.

Development of E-readiness Infrastructure in India

Department of Electronics was established in 1977 in Indian economy to promote e-governance. The government took first step towards implementation of e governance by establishing National Informatics Centre (NIC). Most of the government offices were equipped with computers by 1980 but role of technology was limited to the use of word processing only. With the span of time and developments in the field of information and communication technology, Government of India took remarkable step for implementing e-governance by launching the National Satellite Based Network NICNET in 1987.

Telecom Regulatory Authority of India

Telecom Regulatory Authority of India (TRAI) is successfully regulating the Telecom and Broadcasting sectors since its inception in 1997. TRAI's mission is to nurture growth in the country in a manner and at a pace which will enable India to become the global leader in the emerging global information society. One of the main objectives of TRAI is to provide a fair and transparent policy environment to promote level playing field and facilitate fair competition. TRAI has always been at the forefront of digital revolution of the country and has contributed enormously to the expansion of the Telecom and Broadcasting sectors making them key enablers of Digital India and Smart cities. It is a testament to the working of TRAI that both the sectors have witnessed remarkable growth in the past two decades, not only in terms of quantity and geographical reach but also the quality of service offered to the consumers. Keeping pace with the rapid changes in these fields and areas anticipating the impact of various developments and coming up with timely solutions, TRAI has promoted orderly growth in these fields and areas. TRAI's interventions in Telecom and Broadcasting sectors have taken many forms, ranging from recommendations to the government on key issues like licensing, spectrum valuation and competition to regulations on tariff, quality of service and consumer protection. TRAI maintains a strong focus on transparency, multiplicity of perspective and harmonization of stakeholders' interests as regulator.

District Information System of the National Informatics Centre (DISNIC) was established thereafter. NICNET was the first government informatics network across the country with well equipped facilities like TELNET, FTP, and internet facility along with database services. The coverage of NICNET has been extended from state headquarters to district headquarters up to 1980. Keeping in view the importance of information technology, the government established Ministry of Information Technology in the year 2000. Government of India identified 12-points minimum agenda for implementation of e-governance. The Government of India launched National e-Governance Plan (NeGP) consisting of twenty seven Mission Mode Projects and eight

components in the year 2006. Health, Education, Public Distribution System (PDS) and Posts were added to the list of mission mode projects on May 18, 2006. The total number of Mission Mode Projects further increased to thirty one in the year 2011. The Government also approved the vision, approach, strategy, key components, implementation methodology, and management structure for the various National E Governance Projects. However, the approval of National e governance projects does not provide financial approval(s) in respect of these Mission Mode Projects and components under the scheme.

Various policy initiatives and projects have been undertaken to develop core and support infrastructure to implement the e-Governance in a holistic manner. The basic infrastructure facilities include State Data Centers, State Wide Area Networks to provide information transferability for national projects, Common Services Centers and middleware gateways for implementation of National e-Governance Service Delivery Gateway. State e-Governance Service Delivery Gateway and Mobile e-Governance Service Delivery Gateway have been established for state level e governance projects. . The support components include framing of policies and guidelines on internet security, development of human resource, citizen engagement, use of social media also defining standards pertaining to metadata, inter operability, enterprise architecture, and Information Security. New policy guidelines and initiatives include a framework for authentication, like e-Pramana and G-I cloud which will also offer the benefits of cloud computing for various e-Governance projects.

Review of Literature: E-readiness infrastructure

Constantin Corina, Taylor Richard D., Park Eun-A and Cho Young Shin (2006), described the limitations of single composite indices of information to measure the digital divide overtime and across nations and justified the need for 4C model. The study suggested considering overtime changes taking place in different countries. The study is based on analysis of published data obtained from World Bank's publication (World Development Indicators Database and ITU World Telecommunication Indicators 2002. The study found that the digital divide between developed and developing countries is reducing due to more application of technology by the developing countries. The model suggested four c comprising connectivity, capability, content and context for measuring the digital divide and examining the impact of any of the four factors in isolation has limited application. The model also took into consideration the demographic variables, economic indicators, media usage, availability of ICT infrastructure of the sample units. The capability index emerged as better predictor of internet usage. The model further differentiated between e readiness and e usage. Findings of the study indicate that the present model is first step towards developing more theoretically informed model of measurement of digital divide.

Dada Danish (2006) described the concept of e-readiness for developing countries as these countries do not have strong information technology infrastructure or necessary skill set amongst the population. Minimum basic facilities, education level and government regulatory framework are required to avail the benefits of ICT and e readiness provides evaluation parameters for the factors of e readiness. Group support system in two developing countries i.e. Tanzania and South Africa were selected for the study. The group support system is a socio technical system used to focus and structure group deliberations. The research was based upon total thirty group support system meetings out of which twenty four were conducted in Tanzania with three hundred twenty eight people and eleven in South Africa with seventy eight people. The organizational factors covered the performance expectancy, effort expectancy and social influence. Findings of the research revealed meaningful difference between e-readiness score of two countries. Moreover, various measures of e readiness available in the existing literature have both positive and negative aspects.

Osaimi, Al Khalid, A.Abdulmohsen and Bakry Haj (2006) provided a broad framework for e-readiness assessment based on e readiness environment, availability of technology, organizational preparedness, and strategies for adoption and perception of the people for the evaluation of e-governance & e-business. The multilevel integrated approach described the integration of e readiness using strategy, technology, organization, people and environment (STOPE). The multi-level integrated approach based on five domains was used to build framework for e readiness assessment. The description of the model provides the comprehensiveness and flexibility for the factors. Environment as a factor scored most in segment wise score followed by strategy. Organization scored low and the overall composite e-readiness grade was 2.16 on the scale of 4.The model can be applied to measure the country level e readiness as well as organization level e readiness.

Mutula Stephen M., Brakel Pieter Van (2006), described that increase in internet penetration and use of information technology for managing business affairs has resulted in considering e readiness as an important term Computer Systems Policy Project described the concept of e readiness having high speed access in a competitive market with continuous use of ICT for education, public utilities, business, health care services with user privacy and online security. Review of e readiness assessment tools for the study revealed that e readiness assessment tools focused more on infrastructure and business environment and ignored the relevance of information access. The study described that availability of information should be considered as an important constituent in addition to ICT, business considerations, human resources and policy regulations. The present model contains five important segments namely information readiness, enterprise readiness, human resource

readiness, ICT readiness and external environment readiness. Effective information management is quite important for taking informed decisions for growth of business and economic development of the country.

Zaied A N H, Khairalla F A and Al-Rashid W in 2007 described the challenges for implementation of e government in developing countries which include ICT infrastructure, policy issues, huan capital development, change management, strategy, leadership role and partnership and collaboration. The study studied e-readiness assessment perceptions towards information and communication technology environment in public organizations in the country of Kuwait. The study covered two hundred fifty respondents from twenty different public organizations. The study parameters included human skills, infrastructure & connectivity. The overall e-readiness of the public organizations for e-government was fifty-four percent only. Additionally, less than half proportion of the respondents agreed that their organisations have adequate and appropriate connectivity, infrastructure and information technology related human skills to implement the e-governance system. The overall e readiness of the public sector organizations for e governance is fifty-four only despite various efforts of public organizations in Kuwait. Moreover, the information environment is also not sufficient enough for implementation of e governance.

ChutturMohammaad (2009), the study examined the chronological developments regarding technology acceptance model (TAM) from 1958 to 2007. Theory of reasoned action was based on the beliefs and evaluations, narrative beliefs and behavioural intentions leading to actual behavior. The variables for technology acceptance model included E-mail, voicemail, application of e commerce methods, use of data bases and decision support system. Extended technological acceptance model described computer efficacy, perceptions of external control, computer anxiety, computer playfulness, perceived enjoyment as factors leading to perceived usefulness and perceived ease of use which finally has impact on behavioural intentions to use technology. Further Yong and Yoo suggested that attitude should also be considered as an important factor for use of technology acceptance model. Frequent application of the model indicates the relevance of the model but its assumptions and practical effectiveness has varied opinion. Final version of technology acceptance model takes into consideration the external variables affecting the perceived usefulness and perceived ease of use along with behavioural intentions for actual system use. Application of technology acceptance model for different studies have provided confirmatory results and thus the model is considered important in explaining and prediction the system use.

Ogunyemi Abiodun and Johnston Kevin A, (2012), developed and validated the conceptual e readiness framework for measuring country level and organization level preparedness, industrial relationships and resistance to change for implementation of e readiness at organization level in the light of external factors. Eighty three South African organizations across sectors banking and finance, information technology, telecommunication, government, retail, education that have adopted and implemented server virtualization responded for conducting online survey. The questionnaire contained the quantitative approach of measuring the responses. Economic Intelligence unit provided five parameters assessment for e readiness for the nations. The parameters cover internet connectivity, business environment, legal environment, government policy and vision and consumer and business adoption. National e readiness, organizational preparedness, industrial relationships and external influence has positive relationship of e readiness of the organizations while internal resistance emerged as negative contributor for organizational level e readiness. The analysis of the survey results indicated that South Africa is having suitable environment for e readiness. Moreover, the results also indicated that e readiness of the country is positive contributor for organizational acceptance to the technology. Full adoption of technology of course requires availability of basic infrastructure at national level. Moreover, early adopters may try innovations before the stage of full adoption.

II.   Methodology

Large numbers of initiatives have also been undertaken by Central Ministries and different State Governments to foster the implementation of e governance in the past. Continuous and sustained efforts have been initiated at multiple levels to improve the delivery of public services and to simplify the process of accessing public services. Implementation of E-Governance in India has steadily evolved from computerization of Government Departments to the initiatives that encapsulate the finer points of Governance, such as citizen centricity, service orientation and transparency. Experience of previous e-Governance initiatives has also played an important role in shaping the progressive e-Governance strategy at the country level. Adequate care has been exercised to speed up e-Governance implementation across the various spheres of Government at National Level, State Level and Local levels. Programme based approach has been adopted which is guided by common vision and strategy. This approach also focuses on potential of cost savings through sharing of core and support infrastructure, increasing interoperability in terms of well defied standards, and presenting a seamless view of Government to citizens. "Make all Government services accessible to the common man in his locality, through common service delivery outlets, and ensure efficiency, transparency, and reliability of such services at affordable costs to realize the basic needs of the common man".

Present study is an attempt to ascertain the impact of government initiatives on growth of telecommunication infrastructure in India for adoption of e-government initiatives. The article has been written with following objective:

- To ascertain the growth in the subscribers base for telecommunication services.
- To study the growth in terms of subscriber base for wire line internet subscribers
- To study the growth in the subscriber base for wireless internet subscribers.
- To present the status of Tele- density for urban and rural locations.

Study Period

The published data related to the number of telecom services subscribers has been collected from Annual Reports of Telecom Regulatory Authority of Indian has been obtained from 2013-14 to 2022-23. Hence, the study period is ten years.

III.   Discussion and Findings:

Indian Telecom Sector: Infrastructure for E-Governance

Government of India has focused on the development of telecom sector in the country for the success of e-governance campaign. The Government is committed to enhance the reach of mobile network to all over the country especially the remote and rural areas in particular to convert India into a digital economy. The Government of India has taken up 'Bharat Net' programme to link each of the two lakh fifty thousand Gram Panchayats of India through Broadband optical fiber network. The completion of the project will provide connectivity (with a 100 mbps of bandwidth) for over six hundred million rural people of the country. The telecommunication sector is also offering the benefits from cheaper calls to cheaper data with the entry of Reliance JioInfocom Ltd. in September 2016. The pricing policy of Reliance Jio has forced other telecom operators in the market to reduce voice and data tariffs. Moreover, the booming internet marketing industry and increased use of social media has also resulted in adoption of e governance practices in India. Indian telecommunication sector has experienced rapid growth in the past few years. The fair competition among telecom service providers has resulted in availability of telecom services at affordable prices.

Telecommunication companies are entities that facilitate communication and connectivity without the need for physical interaction. Whether it's making phone calls, accessing the internet, or exchanging written messages via emails and SMS, the telecom sector offers comprehensive solutions at our fingertips. Telecommunication has enabled global communication through the use of cables, wires, waves, and wireless technology. The companies operating in this sector encompass Internet Service Providers, wired and wireless telephone operators, cable companies, and satellite providers.

Growth in Subscriber Base of Indian Telecommunication Sector

The growth in respect of any product or service may be evident in terms of number of users of the product or service. The telecommunication services in the country are available to the people of the country through their subscription for the services. The subscriber base of wireless and wire line connections is presented in Table: 2

Table: 2
Subscriber Base Telecommunication Services

Year	Wireless Subscribers (Million)	% age Share	Wire Line Subscribers (Million)	% age Share	Total Subscribers (Million)
2013-14	904.51	96.95	28.50	3.05	933.01
2014-15	969.89	97.33	26.59	2.67	996.48
2015-16	1033.63	97.62	25.22	2.38	1058.85
2016-17	1170.18	97.96	24.40	2.04	1194.58
2017-18	1183.41	98.11	22.81	1.89	1206.22
2018-19	1161.81	98.17	21.70	1.83	1183.51
2019-20	1157.75	98.28	20.22	1.72	1177.97
2020-21	1180.96	98.32	20.24	1.68	1201.20
2021-22	1142.09	97.87	24.84	2.13	1166.93
2022-23	1143.93	97.58	28.41	2.42	1172.34

Source: Compiled from Annual Reports of Telecom Regulatory Authority of India (Various Issues)

The date relating to subscriber base indicates that majority of the subscribers have subscribed for wireless connections as compared to wire line. More than ninety five per cent of the total subscribers have wireless connections during the study period while the per cent share of wire line subscribes to total subscribers not

exceeded three point zero five per cent of the total subscribers. So, it may be concluded that majority of the subscribers prefer wireless connections and the preference for wire line connections is quite low during the entire period.

Internet Services

E-governance projects require internet facility for recording, storing and communicating information among users of e-services. The speed of internet also affects the quality of e-governance services. The number of subscribers of mobile wireless internet connections is presented in Table: 3

Table: 3
Internet Connections Mobile Wireless (Phone +Dongle)

Year	Wireless Broadband Subscribers (Million)	% age Share	Wireless Narrowband Subscribers (Million)	% age Share	Total Wireless Internet Subscribers (Million)
2013-14	45.61	19.60	187.04	80.40	232.650
2014-15	83.24	29.43	199.57	70.57	282.810
2015-16	132.24	41.11	189.41	58.89	321.660
2016-17	257.71	64.42	142.32	35.58	400.040
2017-18	394.193	83.47	78.056	16.53	472.249
2018-19	543.308	88.52	70.156	11.43	613.745
2019-20	667.659	92.71	52.507	7.29	720.166
2020-21	754.674	94.50	43.955	5.50	798.629
2021-22	759.873	95.41	36.559	4.59	796.432
2022-23	811.985	95.96	34.228	4.04	846.213

Source: Compiled from Annual Reports of Telecom Regulatory Authority of India (Various Issues)

The total number of wireless broadband subscribers has increased significantly from forty-five million six lac ten thousand to approximately eight hundred twelve million while the number of narrowband subscribers has reduced from one hundred eighty seven million subscribers to thirty four million only during the study period. The per cent age share of wireless broad band subscribers has increased from approximately twenty per cent age to ninety six per cent during the period. On the other hand the per cent age share wireless narrow band subscribers have reduced from eighty per cent to four per cent only. So, it may be concluded that the total number of wireless broadband subscribed during the study period. Wireless broad band subscribers have increased at a faster rate.

Fixed Wire line Broadband Subscribers

Fixed wire line internet facility is also available and the total subscribers of wire line subscribers having broadband connections and narrowband wire line connections is presented in Table:4

Table: 4
Fixed Wire Line Internet Subscribers

Year	Wire line Broadband Subscribers (Million)	% age Share	Wire line Narrowband Subscribers (Million)	% age Share	Total Wire line Internet Subscribers (Million)
2013-14	0.40	90.91	0.04	9.09	0.44
2014-15	0.44	91.67	0.03	6.25	0.48
2015-16	0.525	94.94	0.028	5.06	0.553
2016-17	0.560	96.22	0.022	3.78	0.582
2017-18	0.457	97.03	0.014	2.97	0.471
2018-19	1.297	99.39	0.008	0.61	1.305
2019-20	1.297	99.39	0.008	0.61	1.305
2020-21	0.606	99.18	0.006	0.98	0.611

2021-22	1.176	99.49	0.006	0.51	1.182
2022-23	1.093	99.27	0.008	0.73	1.101

Source: Compiled from Annual Reports of Telecom Regulatory Authority of India (Various Issues)

The number of fixed wire line broadband subscribers has increased from ninety one per cent of total wire line subscribers to almost ninety nine per cent of total wire line subscribers during the study period. The per cent age share of wire line narrow band subscribers has reduced from nine per cent to even less than one per cent of total wire line internet subscribers. Total number of wire line internet subscribers in the country is approximately one point one million subscribers and most of them have subscribed the fixed wire line broad band connections.

Total number of internet subscribers irrespective of wire line or wireless type of connection has been computed to know the users of internet services has been calculated and presented in Table: 5

Table: 5
Total Internet Subscribers

Year	Broadband Subscribers (Million)	% age Share	Narrowband Subscribers (Million)	% age Share	Total Subscribers (Million	Growth Rate (%age)
2013-14	60.87	24.19	190.72	75.81	251.59	---
2014-15	99.20	32.81	203.15	67.19	302.35	20.18
2015-16	149.75	43.70	192.90	56.30	342.65	13.33
2016-17	276.52	65.50	145.68	34.50	422.20	23.22
2017-18	412.604	83.53	81.355	16.47	493.959	17.00
2018-19	563.308	88.47	73.421	11.53	636.729	28.90
2019-20	687.441	92.50	55.753	7.50	743.194	16.72
2020-21	778.095	94.28	47.207	5.72	825.301	11.05
2021-22	788.295	95.56	36.593	4.44	824.888	10.99
2022-23	846.569	96.06	34.686	3.94	881.255	6.83

Source: Compiled from Annual Reports of Telecom Regulatory Authority of India (Various Issues)

The total number on internet subscribers was approximately two hundred fifty two million in 2013-14 which increased to eight hundred eighty one million in 2022-23. The per cent age share of broadband subscribers was twenty four per cent 2013-14 which has increased to ninety six per cent in 2022-23. On the other hand, the per cent age share of narrow band subscribers has reduced from approximately seventy six per cent to almost four per cent only. So, it may be concluded that the number of broad band internet subscribers has increased at a faster rate and number of narrowband internet subscribers has reduced. This may be due to the increased use of internet services and also the reduced tariff for broad band services in the country.

Tele-density in India

Tele-density is measured as number of telephone connections per hundred persons and the term is used as a parameter for comparison at national and international level. There may be multiple factors that may affect the Tele-density such as availability of telecommunications services, income level of the people, tariff rates and usage of the services. Tele-density may vary across different geographical locations and availability of net work for telecommunication services. The summarized information regarding Tele-density in urban and rural locations is presented in Table: 6

Table: 6
Tele-density in India

Year	Urban Tele-density (%age)	Rural Tele-density (%age)	Overall Tele-density (%age)
2013-14	139.86	43.27	72.94
2014-15	143.08	47.78	77.27
2015-16	148.73	50.88	81.38
2016-17	166.71	56.47	91.08
2017-18	161.17	58.67	91.09

2018-19	155.49	57.13	88.46
2019-20	138.41	58.54	85.87
2020-21	137.08	60.08	86.68
2021-22	130.17	57.85	83.07
2022-23	128.45	57.46	82.46
Average	144.92	54.81	84.03

Source: Compiled from Annual Reports of Telecom Regulatory Authority of India (Various Issues)

The overall Tele-density in India ranged from seventy three per cent to ninety one per cent. The overall Tele-density was highest in the year 2017-18 and reduced thereafter. There seems to be significant difference in the Tele-density of urban locations and rural. The urban Tele-density ranged from one forty per cent to one sixty percent during the study period. Urban Tele-density has been highest in the year 2016-17 and has reduced thereafter. Rural Tele-density ranged from forty three per cent to sixty per cent. The rural Tele-density was highest in the year 2020-21. This may be because of the Covid -19 pandemic as the educational institutions were closed in the month of March 2020. Physical movement of persons was not permitted. Hence, there was more need to telecommunication network. All this resulted in growth of Tele-density in rural areas.

IV.   Conclusion

The EGDI Composite Score computed on the basis of well-defined parameters to assess the position of E-governance for United Nations member countries indicated that the value of Index was 0.3834 only in 2014 and improved to 0.5883 in 2022 indicating improvement respect of Indian in EGDI. However, Indian economy enjoyed better global ranking in the year 2018. The subscriber base of wireless telephone connection as increased substantially. Similarly, the per cent age share of subscriber base of broadband subscribers has increased and the per cent age share of narrowband subscriber base has reduced during the same period. Regarding urban and rural Tele-density, it is observed that the urban Tele- density is high as compared to rural Tele-density in India. Hence, there is need to improve the telecommunication infrastructure in rural locations for increasing the usage of digital services.

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