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PAST, PRESENT AND FUTURE OF E-GOVERNANCE: AN EMPIRICAL NETWORK ANALYSIS

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ABSTRACT

Implementation, usage, research and development in the domain of e-governance, advance in tandem with the research and developments in the various fields of Electronics, Computer science and Networking & Communication technology etc. The Research streams in the domain attained rapid momentum with the vibrant technology of internet in 1970 and its grass root implementation and wide acceptance. In this work, we performed main path analysis of the citation network constructed from the Bibliometric dataset of e-governance extracted using appropriate queries, from the standard research repository of Web Of Science (WOS). Main path analysis along with the content analysis of the core papers in the main path, identified four major phases in e-governance research. The phases started with the researches concentrated on information management and administration. In the subsequent stages up to the year 2010, there was a cross-over of topics on implementation-modelling and evaluation. The analysis also revealed that Web 2.0 technology, open data and adoption of alternate channels to increase government-customer interaction are the emerging topics and are the scope for future research in the domain. We anticipate the inclusion of social network as an embedded component in the hierarchy of e-governance administrative structure which will enhance the concept of participative government to the next level especially in case of underdeveloped and developing countries where the economy of the country is crucial in establishing the communication network. The work is extended outline a model of early warning and rescue system to handle natural calamities by incorporating web2.0 and social media in e-governance hierarchy of Kerala government. The system is suited to be incorporated in the e-governance system of the local bodies in the developing countries.

KEYWORDS: E-governance, E-government, Social Network Analysis, Social Media.

E-governance has been advancing at a rapid pace over a decade exhibiting high efficiency, transparency and citizen adoption. The UN survey report published in 2014 proclaimed that all 193 UN Member countries had delivered some form of online services to their citizen. Latest reports of UNPAN Survey reports published in 2016 observed that countries around the world are increasingly utilising innovative ICTs to deliver services and indulge citizen in government decision-making processes. The UN report remarked that 29 nations scored very-high, EGDI (e-governance Development Index) values as compared to ten countries in 2003 (Peña-López et al.,2016). It shows that extensive researches in various aspects of e-governance are being carried out all over the world.

E-governance is understood as the execution of government administrative activities using an electronic medium with an objective to engage, enable and empower the citizen. It has the advantages of facilitating services in an efficient, speedy and transparent way and ensure 24/7 hour usefulness (Jaeger and Thompson, 2005). The Organisation for Economic Co-Operation and Development (OECD) remarked that the use and availability of ICT services, particularly the internet, is a tool to achieve better government (Verdegem and Verleye, 2009). The ICT has immense power to act as driving force to trigger changes in an organisation. E-government extensively applies ICT to transform its internal and external relationships (van Reijswoud and de Jager, 2007).

There is revolutionary growth in research activities took upon a plethora of related topics, in recent years to boost the quality of e-governance. Heeks (1999) have proposed three main domains of implementation of e-governance models, based on taxonomies as E-administration (improving government processes), E-services (connecting citizen with their government) and E-society (building interactions with and within the civil society). Van Reijswoud and de Jager (2007) argued that implementation of e-governance takes place in three stages of Business Process Automation(BPA), Business Process Improvement(BPI) and Business Process Re-engineering (BPR) (van Reijswoud and de Jager, 2007; Moon, 2002; Moon and Norris, 2005).

There are several articles and reports on benchmarking of e-governance projects, factor analysis, system quality and efficiency. Recent survey reports and research findings show that factors in addition to the economy of a country play crucial roles in development and success of e-governance. A study by Sang et al. (2009) revealed that the role of determinants of the research model (trust, perceived usefulness and relative advantage) to promote user adaptability of e-governance is

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significant. E-governance created compact networked structures of public administration for integrated information management, knowledge procurement and dissemination. At the highest end of development, e-governance empowered citizen to participate in the decision-making process for the legitimacy of governments (de Jager and van Reijswoud, 2008). The diversity and rapid development in e-governance research demand highly efficient methods to identify quality research work in all the main and sub-domains of e-governance. One of the major scientific methods is the network analysis of scientific literature. In this paper, we used social network analysis to investigate the evolutionary trajectory and current major topics in research literature covering e-governance.

Social Network is a set of interconnected objects; objects are nodes or vertices, and connections are the edges. A social network can be directed or undirected graph. The social network analysis (SNA) is a method that illustrates the interaction between nodes in multiple domains such as Computer Science (Otte and Rousseau, 2002), Economics (Sankar et al., 2015), energy management (Xu et al., 2012) and disease (Saldanha et al., 2016) etc. In social network of scientific publications, nodes are the articles, and citations are the linkages between research literature discussing a common theme. To conduct network study citations are helpful as one reference paper provide citation links to many other papers forming a citation network of related topics (Kajikawa and Takeda, 2009). A high citation score of an article shows high impact in a particular discipline (Culnan, 1986). Current trends, patterns and emerging fields of research can be assessed by analysing the citations (Garfield and Merton, 1979). A theoretical model of citation network was proposed by Garfield and Merton (1979). Later it was used to identify scientific specialities by Griffith et al. (1974). Citation analysis ranks corpus in the order of the number of citations by other articles.

Topics of research can be extracted from research articles in the related field. Review of literature give an idea of significant developments, and the main path analysis identifies the major milestones in the path of evolution. Evolution of e-governance research literature has not yet been scientifically investigated systematically. In this work we carried out a detailed main path analysis coupled with cluster analysis, to trace the trajectory to identify major breakthrough, innovations, current trending topics apart from major research areas. The results of this analysis yield the roadmap with significant milestones in a timeline, emerging research fronts and future research prospects.

MATERIALS AND METHODS

Let G(E, V) be a graph representing the citation network extracted from the Web of Science(WOS), where V denotes the set of research articles (nodes) in the repository and E indicates the citation between the research articles. A directed edge from a node vi to vj exists if the article vi is cited in vj (Weingart et al., 2010). We created citation network by retrieving citation data of research articles related to e-governance and e-government from Web of Science(WOS). The main path analysis has the high calibre to trace the evolution of e-governance over time and also to detect the cross-over of research streams. The content analysis of the core articles in the main path of the citation network identifies the evolution of research topics over time. Analysis of contents of the end nodes, the nodes representing the latest publications, threw light upon the future trends of research.

Main Path Analysis

Main path analysis identifies the major articles which are interrelated and can trace the history of the development of the innovative ideas in a research topic. The nodes in the main path have a significant role in plotting the trajectory of development in a field (Hummon and Dereian, 1989; Batagelj, 2003). Main-path algorithms examine connectivity in acyclic networks and are especially interesting when nodes are time-dependent, as it selects the most representative nodes at different moments of time. In a citation network, time assigns direction to the links, and each node represents a distinct event at a time (Carley et al., 1993). Citations made to preceding articles and citation made by succeeding articles to a particular article determine it's relative location in the citation network. Main paths are constructed by considering the traversal weight of the link which is a measure of the number of times a link has been traversed from a set of starting (source) node to other sets of ending (sink) nodes. Important measures for assessing weights are the Node-Pair Projection Count (NPPC), Search Path Link Count (SPLC) and the Search Path Node Pair (SPNP) (Hummon and Dereian, 1989). Citation network traversal can be constructed using local main path search where the only single critical main path is traversed and global main path search where more than one critical main path resulted from subsequent development and diversions and diffusions in innovative research. We employed global main path analysis to view the trajectory of the evolution

of e-governance and to identify current trends and emerging topics and related literature.

Table 1: List of articles and their research topic in main path shown in Figure 1.

Label	Publication Details	Research Topic
Chen Yc, 2001	Chen Yc, 2001, Gov Inform Q, V18, P343	Role of application service providers
Layne K, 2001	Layne K, 2001, Gov Inform Q, V18, P122	E-governance system development
HoAtk, 2002	HoAtk, 2002, Public Admin Rev, V62, P434	Public administrative system
Doty P, 2002	Doty P, 2002, Gov Inform Q, V19, P369	Administration issues
McnealRs, 2003	McnealRs, 2003, SocSci Quart, V84, P52	Evaluating Information system
Reddick Cg, 2004	ReddickCg,2004, Gov Inform Q, V21, P51	Two stage development model
Grant G, 2005	Grant G, 2005, J Glob Inf Manag, V13, P1	Generic framework to assess e-government
Andersen Kv, 2006	Andersen Kv, 2006, Gov Inform Q, V23, P236	Data mobility Models
Gil-garciaJr, 2007	Gil-garciaJr, 2007, Gov Inform Q, V24, P266	Rules Implications in Administration hierarchy
Jaeger Pt, 2005	Jaeger Pt, 2005, Gov Inform Q, V22, P702	E-democracy and political implications
Reddick Cg, 2005	Reddick Cg, 2005, Gov Inform Q, V22, P38	Evaluation Of Citizen Interaction
Helbig N, 2009	HelbigN,2009,Gov Inform Q, V26, P89	Complexity imparted by digital divide
Gauld R, 2010	Gauld R, 2010, Gov Inform Q, V27, P177	Digital divide
Reddick Cg, 2012	ReddickCg,2012,Gov Inform Q, V29, P1	Multi channel communication
Weerakkody V,2013	Weerakkody V,2013, Int J Inform Manage, V33, P716	Social networking
Chen Jv, 2015	Chen Jv, 2015, Comput Hum Behav , V43 , P251	Social networking
Al-hujran O, 2015	Al-hujran O,2015,Comput Hum Behav, V53, P189	Evaluation: user acceptance
RanaNp, 2016	RanaNp, 2016, Comput Hum Behav, V59, P265	Case study: User adoption
Andersen Kn, 2012	Andersen Kn, 2012, Gov Inform Q, V29, P462	Social networking
Khan Gf, 2014	Khan Gf,2014,Online Inform Rev, V38, P95	Social networking channels
Bonson E, 2015	Bonson E, 2015, Gov Inform Q, V32, P52	Social networking channels
Goldfinch S,2011	Goldfinch S,2011, New Tech Work Employ, V26, P39	Process reengineering
Baldwin Jn, 2012	Baldwin Jn, 2012, Public Manag Rev, V14, P105	Evaluation: Attitude of employees
VelicuBc, 2012	VelicuBc, 2012, Rom J PolitSci, V12, P103	E-governance implementation issues
Bolivar Mpr, 2016	Boliver Mpr,2016,Inform TechnolDev, V22, P36	Evolution: Scientometric study
Sivarajah U, 2015	Gov Inform Q, V32, P473	Participatory governance: Web2.0 Technology
PorumbescuGa,2016	PorumbescuGa, 2016, Public Manag Rev, V18, P1308	Evaluation: User Acceptance
Zhang Sq, 2016	Zhang Sq, 2016, IsprsInt J Geo-inf, V5	Social networking
Janssen M, 2014	Janssen M, 2014, SocSci Comput Rev, V32, P694	Open data
Ranerup A, 2016	Ranerup A, 2016, Gov Inform Q, V33, P6	Business models in public service platforms
Susha I, 2015	SocSciComput Rev, V33, P613	Open data

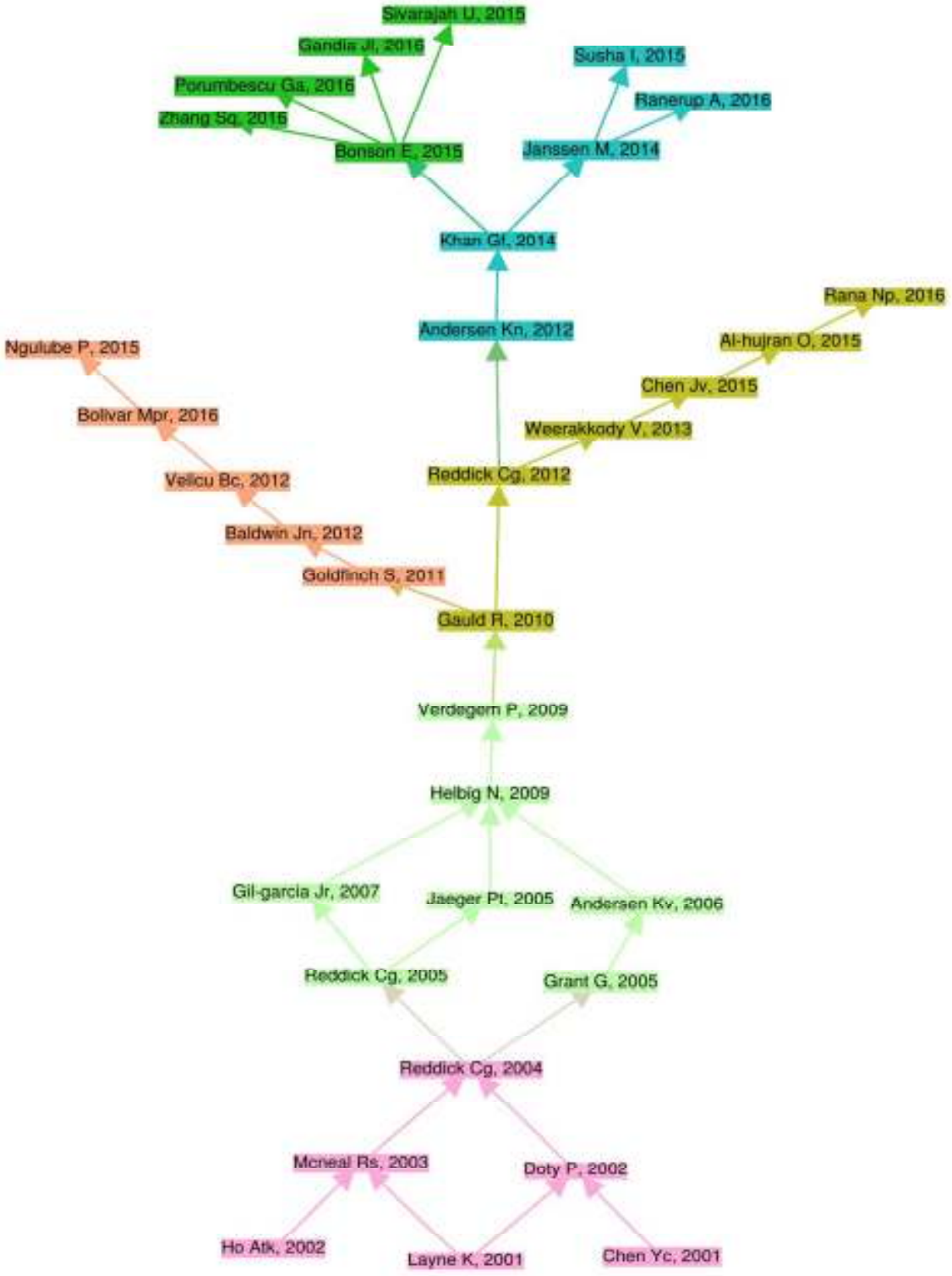

Figure 1: Main Path of e-governance literature. Phase #1 - Pink color, Phase#2- light Green color, Phase #3 – Orange color, Phase #4 - Yellow color, Phase #5 - Blue color and Phase #6 - Dark Green color

RESULTS

Citation data related to e-government during the period from 1989 to 2016 are retrieved from WOS by providing keywords including e-government or e-governance as query terms. The retrieved information mentioned in the above section is subsequently converted to citation network with the aid of software tools. Nodes represent articles and edges represent the citation links in the network. We extracted the main component for further analysis. This citation network is used for main path analysis.

Tracing Trajectory of Evolution of E-Governance Using Main-Path Analysis

The main global path extracted from citation network of e-governance research articles is shown in Fig. 2 and major articles in the main path are listed in Table. 1. The different colours of nodes in the main path distinguish six groups represented as Phases, based on the related topics. Detailed analysis of topics dealt in core nodes enlightens the path of evolution of research in divergent areas (Kajikawa and Takeda, 2009). In the main path, two base core paths and four major emerging sub-paths or branches are detected. The main path pursues the trajectory in the form of a tree with articles of Layne and Lee (2001), Chen and Gant (2001) and Ho and Coates (2002) forming the roots. Abstracted form of publication details and topics of discussion of articles in the main path are listed in Table. 1.

In the early stages of development of e-government history, digitisation process was not conducted in an integrated manner resulting in failure and chaos. The first phase of evolution of e-governance (up to the year 2005) was closely related to the development of a framework for transforming conventional administrative systems to digitized form. Different models protuberate with the intention to integrate the administrative framework on different perspectives, connected with change over to digitisation and automation. Layne and Lee (2001) addressed multiple issues in the administrative aspects of conversion to e-government and proposed a development model for the implementation of e-governance which was basic pioneer reference model. Chen and Gant (2001) discussed effective use of Application Service Providers (ASP) to transfer e-government benefits in local government level which attracted the attention of many other researchers. Doty and Erdelez (2002) used multiple data collection and analysis methods to characterise behavioural patterns of participants which impose a major challenge to e-government. Reddick (2004) conducted a study addressing major issues related to e-government.

The second phase of development started with the works of Reddick (2005) and Grant and Chau (2006) extending up to the study of Gauld et al. (2010) as shown in Fig.2 (Phase#2). Researches were carried out in harmony with the existing e-governance information systems such as development of e-governance structural framework (Grant and Chau, 2006), customer-centric e-government maturity models (Andersen and Henriksen, 2006), methods to increase interaction of citizen with the government (Reddick, 2005), implementation, identification of factors affecting quality, user acceptance etc. The article of Helbig et al. (2009) was at the convergence of research streams and studied the implications of the digital divide.

The third phase started with Gauld et al. (2010) who studied the digital divide in the society in accessing e-governance and formed the root of further bidirectional divergence in the main path. Articles of Reddick and Turner (2012) and Goldfinch et al. (2011) are remarkable works in the base of two divergent branches. Goldfinch et al. (2011) referred the study of Gauld et al. (2010) and triggered research in the topic of re-engineering. His work was the root of a bifurcation sequence formed by Baldwin et al. (2012), Velicu et al. (2012) and Rodríguez Bolívar et al. (2016) as the first major branch showing progress in the evolution of e-governance in topics of models of evaluation of user acceptance and re-engineering.

An article of Reddick and Turner (2012) was the root of next divergence in research formed by works of Andersen et al. (2012) and Weerakkody et al. (2013). Reddick and Turner (2012) published a base paper, focussed on the multichannel delivery system and customer interaction and satisfaction factors and strongly argued for multiple channels for communication in e-governance. Weerakkody et al. (2013), Chen et al. (2015) and Ranerup et al. (2016) formed second major emerging branch representing new trends of effective use of social networking in e-governance research.

In the third branch starting from Andersen et al. (2012) cited by Feroz Khan et al. (2014) formed a sequence of research in social networking and alternate channels of interactions. A study by Feroz Khan et al. (2014) was on the transition from e-government to social-government or participative government. E-democracy by participative governance is the emerging future trend in e-

governance where the citizen gets prominence in the hierarchical structure of government administration. Two sub-branches extended from his work, with roots as articles by Janssen and Zuiderwijk (2014) and Bonsón et al. (2015). The first sub-branch initiated from Janssen and Zuiderwijk (2014) proposed open data and social media have driven information business models. This article was referred by Ranerup et al. (2016), who brought forth a detailed study of different Business models in Public Service Providers (PSP) and by Susha et al. (2015) who discussed various aspects of open data analysis. Works of Susha et al. (2015) and Ranerup et al. (2016) are leaf nodes of citation network branch representing research topics of future developments. Perspectives of open data and adoption of social networking in e-governance are the core topics discussed in this sub-branch which are the future trends of research topics in e-governance.

Bonsón et al. (2015) conducted research based on the article of Feroz Khan et al. (2014) forming second sub-branch. Bonsón et al. (2015) discussed the impact of different media and stake holder's role on Western European local government social media pages. Bonsón et al. (2015) were referenced by the recently published article of Sivarajah et al. (2015), Zhang and Feick (2016) and Porumbescu (2016). Major topics of discussion in this sub-branch are user interactions through social networking and participatory governance and open data, the up coming trends in e-governance research.

The topic-wise sequential evolution of mainstream research on e-governance embedded in the main path are, information system, modelling, evaluation, user satisfaction, user adoption, process re-engineering, social networking and open data. Major streams of future research trends are also marked at the end of the main path. The analysis identifies that e-governance started with conventional mode of service delivery and reached the stage of participative governance, marked by the high involvement of citizen in the strategic decision-making process of government, by adopting platforms of Web.20 and using social networking means.

Road Mapping From E-Governance to Participative Governance

The purpose of our study is to trace the trajectory of evolution and to identify the emerging research fronts by carrying out a detailed network analysis on the corpus of research literature associated with e-governance. In the first phase or emerging stage (up to the year 2005) researchers concentrated on methods to improve conventional governance by integrating digitisation of government documents and facilitating publication of information and transformation models (Layne and Lee, 2001; Doty and Erdelez, 2002; McNeal et al., 2003; Reddick, 2004), and (Ho and Coates, 2002). In the next phase (during 2005 to 2010), a radical development of evolution in e-governance was being witnessed which focussed on customer-oriented services. During this period researches advanced in bidirectional divergent paths in modelling and evaluation on topics related to service quality, customer satisfaction and user adoption.

Willingness and mindset of stakeholders to accustom to the behavioural changes brought by e-governance promote users to access e-governance services. Privacy and security issues are the main reasons for stakeholders not using e-governance services which result in failure of e-governance. Verdegem and Verleye (2009) argued that improved online access is the primary requirement to attract a pool of potential users and thereby increase efficiency. The e-services must be transparent, accountable and accessible, breaking the restrictions of money and time to orient users towards it. So close monitoring and evaluation of the system is important at all stages of development as it brings transparency in the implementation of e-governance and increases effectiveness. The user-centric models on customer satisfaction, user adoption and models on process re-engineering are the major topics in this transition stage of e-governance. Current stage of e-governance research(2010-2016) has a bloomed with the introduction of Web2.0 technology which promoted the use of social networking to ensure public participation leading to e-democracy or participative governance. The authors emphasise the importance of social media and social networking which are innovative topics of research, enhancing participatory governance.

Alternate channels for accessing e-services are better options to improve transparency, openness and accountability (Sivarajah et al., 2015; de Jager and van Reijswoud, 2008). The citizen can cast online votes or participate in the government strategic decision-making process by voting through social networks; the government can disseminate information and gather opinions from the public at tremendous speed, trace major topics of discussion in social network groups are some of the advantages of social networking in e-governance based on Web 2.0 Technology.

From the analysis, it is evident that governance advances from conventional government oriented services

to citizen-oriented e-services by the inclusion of direct participation of the citizen in the decision-making process of government leading to e-democracy or participative governance. Main topics of discussion in recent years are Open data, Participatory governance/e-democracy, social networking, alternate communication channels and adoption of Web.2.0 as a platform for enhanced social interaction. Highlights are listed below:

- E-democracy citizen-oriented government where Social media can play a remarkable role in e-governance service delivery, hence to be included as a hierarchical element in governance administration especially in developing countries.
- Open government promoting e-participation is a good initiative to improve transparency, openness and accountability.
- Online votes, participate in the government strategic decision-making, disseminate information and gather opinions from the public at tremendous speed, trace major topics of discussion in social network groups are some of the advantages of social networking in e-governance based on Web 2.0 Technology.
- Web 2.0 technology adoption can perform vital role in establishing unlimited in government-stake holder interaction with cheap and easy to use mobile devices like smart phones.
- The importance of wider communication through social media in e-governance is high in managing emergency situations including natural calamities such as flood, Tsunami, earthquake, cyclones etc., where people are to be alarmed and shifted from a place or such emergency situations to be handled within a short span of time. This time factor is very much important as in a ministerial system where the sanction is to be attained from higher officials, administrators and ministers which take hours and some time days which may cost the lives of thousands of people. Situations including poisonous gas or chemical leakage from factories or carrying vehicles can also be done with alerts from government through social media.

The emergency situations including lost and found of children, lookout notice etc can be done through social media incorporated with e-governance:

- Emergency situations are handled in two ways; the first step is to make the people informed or make alarms about the probability of occurrence of such an incident; second is to perform rescue operations and inform people the precautions they can take or the steps they can adopt and to get help from others including government.

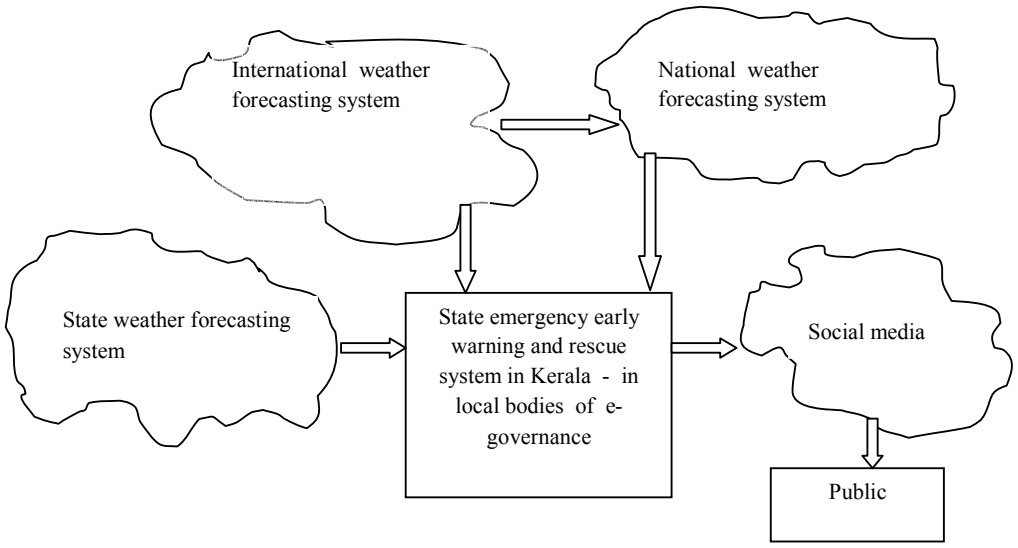

Figure 2: The proposed early warning and rescue information system in e-governance based on social media and Web2.0+ Technology.

Weather information can be given to common people through a trusted government portal through which frequent and up to date information from international or national agencies of weather observation where information is freely available. We propose an outline of an early warning and rescue system as shown in Fig. 2 to be incorporated in the hierarchy of e-governance in Kerala especially in connection with local governing bodies of the municipality, panchayat etc.

DISCUSSION

E-governance envisages effectiveness, precision, simplicity, economy, and extensive outreach for government services. The study is on citation network analysis of research literature related to e-governance using the clusters and main path. Study of the critical nodes in the citation network shows that priority of research topics change with time and there persist constant and revolutionary change in maturity levels of e-government development in the global perspective. The main path analysis of citation network gives emerging path of research development in e-governance literature, which is a token of the trajectory of the e-governance practice. The content analysis of the articles in the main path identified information and administrative system modelling; quality survey and evaluation on user adoption and customer satisfaction; relevance of process re-engineering; open data and role of social networking leading to the participative government as the major topics of research. In the emerging stage of development of e-government which spans up to the year 2005, the information system was the focus of research. After that, user satisfaction gained. The timeline between 2005 and 2015 represents a period of enhanced transaction, interaction and communication which exhibits exponential growth in implementation, research and development in e-governance

Our study reveals that in early stages, e-governance research was on conventional static models for information dissemination and reached the current stage of participative e-governance, focussing on Web 2.0 technology and social media as well as other channels for extensive customer interaction. These technologies help in information dissemination and opinion gathering for decision making and thereby restructure government as a participatory government**.** We propose the outline of an emergency handling system in e-governance hierarchy of Kerala government, incorporating the potential of social media and web2.0+ technology to make alarms and inform the rescue measure to be adopted in case of emergency situations like Tsunami, cyclones, floods etc. The future e-governance strategic plans of developing countries must give due attention to social media and other alternate channels, for information dissemination and collection of user responses as it is the cheapest and fastest ICT means of communication with high and wide reach to the citizen. We anticipate the inclusion of social network as an embedded component in the hierarchy of e-governance administrative structure which will enhance the concept of participative government to the next level especially in case of underdeveloped and developing countries where the economy of the country is crucial in developing communication network. The study shows how scientific research can bring in technology for the development of the society.

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