

Measuring the Efficiency of Digital Communities: A Case Study

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Abstract— A new type of citizen participation has recently emerged in the Islamic Middle East countries through discourse on social media Websites, which opened up opportunities for citizens' participation in socio-political movements. Despite Internet restrictions in the form of heavy imposed state filtering and censorship, the Internet and its various applications provide effective communication channels for acquiring free information and disseminating thoughts, ideas, opinions, reflections and information sharing about socio-cultural, political, environmental and economic matters. The results of this empirical study show that there is a linkage between information usage and citizens' organized social actions, in the form of waves of street demonstrations, as we have seen across the region, as citizens demand a more open society, freedom and democracy. By applying the theory of new media communication, this study has found that Information and Communication Technology (ICT) has not only played an important role in building digital communities across the region, but also citizens' who use effectively and efficiently ICT communication channels are more likely to participate in political discourse and mobilization.

Keywords - Social Media; ICT; Web 2.0; Information Use; Public Discourse; Digital Community; Data Envelopment Analysis.

I. INTRODUCTION

Information and communication technologies (ICTs) are viewed by many scholars as an environment for promoting freedom of expression, social inclusion [1, 2], and as a catalyst in elevating public discourse, political participation and mobilization [3, 4, 5, 6]. In this context ICTs have created a new powerful social actor called "digital citizen" or "e-citizen" [7, 8, 9]. Other scholars view ICTs as a source of emancipation [10] in which citizens are involved in communication discourse with the aim of improving human lives and creating a more just and fair society [11]. The increased popularity of the Internet has not only resulted in increased citizens' participation in public discourse, but also enabled them to request for more transparency and accountability [12, 13] from public servants, elective representatives and government officials. In other words citizens are able to actively participate in dialogues with democratic actors by raising concerns regarding local, national and global issues.

In non-democratic countries, however, the role of ICTs in communication discourse is a more complex process than those of free nations. On the one hand, ICTs have provided citizens the opportunity to access free information, learn more about the world outside of their home countries, (otherwise not available in the official print and broadcasting); on the other hand, these ICT communication channels are heavily monitored and censored by the elites in power. Stahl [11] points out that in many developing countries, ICT may not only be able to address numerous social issues, but more importantly, it should be viewed as "a solution to a range of social ills" ([11], p.162). In this context the overall aim of ICT is emancipating citizens with the ultimate goal of improving society. ICT through its various applications such as the Internet, TV and radio broadcastings, mobile SMS and MMS messages, e-mail, chat and so on, enabled people around the world to exchange political, social, cultural, science, history, literature and in short information in a borderless format and in shortest possible time. The Internet, for example, made it possible for millions of bloggers and users, in social networking sites, such as Twitter and Facebook, around the world, to create their own version of news or of cultural agencies. Youtube created a magnificent collection of video clips ranging from political, social, cultural, news and entertainment posted by people around the globe, a phenomenon that could not be predicted a few decades ago.

However, these ICTs are subject to heavy monitoring and filtering arrangements. According to various reports published by independent institutes such as Freedom House, Reporters Without Borders (RWB) and OpenNet Initiative (ONI), ICT censorship and content filtering is a common practice in countries controlled by authoritarian governments (see [14] for more details).

By using the theory of new media communication, the aim of this study is to investigate the intensity of ICT information usage in the Middle East to better understand the communication discourse in the region and their mobilization impacts on recent public unrests.

The rest of paper is organized as follows: Section II presents the theoretical basis of the concepts new media communication that we are using in our study; Section III investigates the efficiency of ICT usage in the Middle East; Section IV presents the Data Envelopment Analysis (DEA) of archival data, Section V discusses the findings of empirical results, and finally Section VI concludes the paper.

II. THE THEORY OF NEW MEDIA COMMUNICATION

Drawing on Manuel Castelles' [15] work *The rise of the network society*, it is argued that the new media has shaped today's social organizations and institutes to a large extent. This study applies the theory of new media communication [16, 17] to investigate the impact of ICTs on communication discourse within in the context of the Middle Eastern countries and particularly in Iran.

A modern networked society consists of organizations, individuals and groups in which they engage in communication discourse by the means of ICTs. The importance of the new technology is rooted in its ability to accelerate information dissemination and social interaction among individuals and groups [18] in a global search for fresh ideas and opportunities. ICT tools and services such as the Internet and mobile cell phones have created a new form of media called *mass self-communication* [16], in which the traditional one-way, one-to-many media structures (e.g., print and broadcast agencies) have transformed into a new form of communication which are in nature pluralistic, two-way and many-to-many communication. There is ample evidence that citizens use the new media to effectively and efficiently participate in communication discourse and political mobilization by challenging the dominant power.

Within the context of democratic institutes, Lievrouw [17] defines the pluralistic nature of new media in two broad categories or domains: an *institutional aspect* and a *personal/relational aspect*. While the institutional aspect of information exchange is mediated through the media, political, business and cultural structures (see Figure 1), coupled with ICTs, the personal/rational domain is a social network structure in which individuals and groups are able to not only share and disseminate information, but also participate in communication discourse.

As depicted in Figure 1, these two domains interact with each other by the means of ICTs. At the crux of this model, there exists a flow of information from and between these domains in which individuals and groups can effectively participate in democratic decision making processes. Such participation can impact the institutional arrangement by inventing and reinventing social and cultural organizations. However this process is influenced by many other parameters including, but not limited to the availability and accessibility of ICT resources and the capacity of individuals and groups in using such tools and services. In other words, the capacity of individuals/groups is influenced by personal factors such as ICT skills, motivation, social intelligence and communicative competencies, as well as the social, economic and cultural environments [17].

In other words, the capacity of individuals and groups in using ICTs is directly related to the efficiency of ICT information usage which will be discussed later. It is also important to note that ICT is widely used for communication discourse, in both democratic and non-democratic countries, despite the fact that in non-democratic countries, such as Iran, media is heavily controlled by the elites in power.

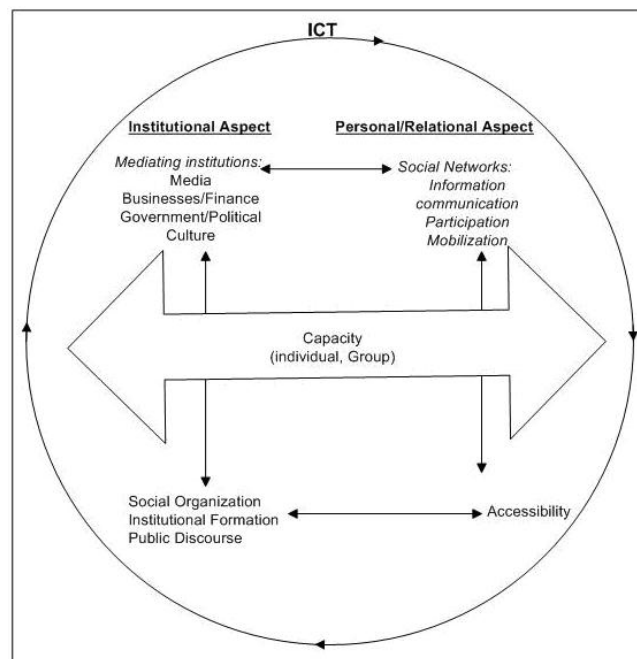


Figure 1. New Media Communication in a Networked Society
Adapted and modified from Lievrouw

A. Web2.0 Technology

O'Reilly [19] defines Web 2.0 as a network platform spanning all web-enabled devices by the means of delivering software as a continually-updated service through consuming, mixing and remixing data from multiple sources. Database management as a platform for knowledge management is an essential part of the new technology. For example, as mentioned by O'Reilly [19] Google is not just a collection of software tools, it's a specialized database, without data, the tools are useless; without the software, the data is unmanageable ([19], p.20). In contrast to the non-interactive top-down approach as seen in Web 1.0 publishing tool, Web 2.0 offers a new feature called participation which is essentially a bottom-up approach allowing a two-way communication between the publisher and the end users (e.g., blogs) [19, 20]. As such, Web 2.0 technology arrives with many new features as means of interconnected web of services such as blogs, wikis, social networking and content sharing websites (e.g., Facebook, Twitter and Youtube). These services and applications provided citizens the opportunity to participate in communication discourse more efficiently and effectively, or as noted by [20] the opportunities for citizens' political engagement via "the propagation of political content over multiple applications and rich user experiences on political websites" ([20], p.19). Using the new technology made it also possible for grassroots broadcasters and journalists to document events as they occur and post them on the social network sites (broadcast) and blogs, a phenomenon that was once the job of professional reporters working for expensive professional multinational broadcasters such as TV networks.

As discussed above, central to Web 2.0 technology is data storage and data sharing characterized by aggregation of huge amounts of information [20]. As such, those who can successfully mine, refine, and use these services are likely to engage in political discourse [20, 21]. In the context of this study, the citizen engagement in public discourse can be identified through the published articles and posted video clips and pictures on blogs and social networking and content sharing sites as well as users' comments and views about published documents. However these services are also the main target of state filtering and censorship as practiced extensively in the Middle East.

III. MEASURING ICT EFFICIENCY

ICT tools and services played a vital role in public discourse and mobilization in the recent wave of popular unrest in the Islamic countries of the Middle East and North Africa. While the official media controlled by governments were publishing the political and ideological agendas of the elites in power, the digital communities were established on the Net, particularly around social networking sites such as Twitter and Facebook. These communities were actively engaged in public discourse by disseminating thoughts, opinions and concerns about various socio-political and economic matters. Despite heavy filtering and censorship mechanisms imposed on Internet and mobile communication channels, many citizens in these countries used free anti-filtering tools and utilities available on the Net including proxy servers, to successfully bypass the filter and connect to other digital communities in the region and around the world. The intensity of street demonstrations and popular unrest identified as the "Green Movement" of Iran and the Arab Spring of the region indicate the vital role of the new media in public discourse.

This study used archival data for eleven Middle Eastern countries (Bahrain, Iran, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia and the United Arab Emirates) to investigate the efficiency of ICT information usage in the region for the period 1995-2007. Two different analytical methods were used for this investigation.

A. Method I: Regression Analysis

Based on the theory of new media communication discussed earlier, this study takes into account four main factors that may influence the level of ICT information usage in each country. These factors are the availability of ICT network infrastructure (variable *networks*), the level of educational attainment in each country, the level of human development index (variable *HDI*) and the level of economic growth as measured by per capita Gross Domestic Product per capita (variable *GDPP*).

It is important to note that the above variables are not the only factors that may influence the level of ICT information usage in each country. There are other factors that may directly or indirectly influence the level of information usage in each country, including, but not limited to, the existing level of democratic institutions, culture and the

level of infrastructure development (e.g., roads, power plants etc.) However, these factors are beyond the scope of this study.

To measure the efficiency of ICT information usage (variable *infouse*) in the Islamic Middle Eastern countries the following regression model was considered:

$$infouse_i = \alpha_0 + \alpha_1 \cdot networks_i + \alpha_2 \cdot edu_i + \alpha_3 \cdot hdi_i + \alpha_4 \cdot gdpp_i + \varepsilon_i \quad (1)$$

where the subscript *i* is an index of each country of this study over the period *t*; α_0 is a constant and α_1 through α_4 are unknown vector parameters. The error term is captured by ε_i .

B. Data Collection

For the purpose of this study four sets of data were considered, the first set of data was related to ICT indicators such as ICT network infrastructure and ICT information usage introduced by ITU-Orbicom [22] and ITU [23]. In its 2005 and 2007 publications *Measuring the Information Society*, ITU presented some indicators to measure the level of ICT expansion and ICT usage for each country on a global scale. These indicators shed light on our understandings about the pits and falls of ICT development in general and its usage in particular through an intensive comparative study. This study pooled two main indicators namely the *networks* index and the information usage index (*infouse*) related to eleven Islamic Middle Eastern countries from the above sources. While the *networks* index is composed of indices such as main telephone lines, cell phones, international network bandwidth (kbs per inhabitants), digital lines and cable TV, as well as the number of Internet secure Servers. The *infouse* index on the other hand is a complex variable of two other sets of variables, one measuring the information uptake by populace of each country and the other measures the intensity of such uptakes in form of the number of Internet users, the number of personal computers in use as well as the intensity of broadband and international telecom traffics (incoming and outgoing) among others (see [22, 23] for more details). Other data used in this study are related to variables such as the level of educational attainment (e.g., primary, secondary and tertiary), the level of human development index (HDI) and the level of economic growth in each country (GDPP).

Following the previous literature, we assume that the level of ICT expansion and the intensity of its usage are correlated with the level of economic development in each country. ICT tools and services require individuals as well as firms and public organizations to have enough economic resources to spend on these resources (e.g., PCs, servers, laptops, cell phones and the Internet). That is why people living in developed countries invest more on ICT tools and services than people in the developing countries. Therefore, we can expect that there is a positive correlation between the presence of communication networks and information usage and the level of economic development in each country as measured by GDPP. Data related to HDI index was collected from UNDP's database (<http://hdr.undp.org>)

while GDPP data was mainly obtained from ITU, UNDP and the World Bank database [24].

C. Regression Results

The measuring the efficiency of information usage was conducted in two separate yet interrelated steps. In the first step the standard Ordinary Least Square (OLS) regression method was applied on equation (1). Table I shows the results of regression analysis reported by STATA software version 9.1. As shown in Table I there is strong relationships between variable information usage (*infouse*) and parameters such as networks, GDPP and education as reported by the positive signs of variable coefficients and their related t-values and p-values. These impacts are statistically significant at 95% level while variable *HDI* was reported as statistically insignificant.

TABLE I. OLS REGRESSION

Number of obs = 121		R-squared = 0.9273				
F(4, 116) = 369.99		Adj. R-squared = 0.9248				
Prob > F = 0.0000		Root MSE = 15.141				
networks	Coef.	Std. Err.	t	P> t	95% Conf. Interval	
infouse	0.7728	0.0345	22.25	0.000	0.740	0.8416
hdi	-37.4838	22.5821	-1.66	0.100	-82.2107	7.2429
gdpp	0.0013	0.0003	4.45	0.000	0.0007	0.0002
edu	0.1644	0.0906	1.82	0.072	-0.1494	0.3438
_cons	-3.4078	12.3614	-0.28	0.783	-27.890	21.0758

In the second step of our regression approach, we obtained the score of each country with regards to their ICT efficiencies by using a post estimate equation-level analysis of the variance matrix. This process is a pretty standard method in which a fitted value of variance matrix is estimated in such a way that the sum of the residuals is set to zero.

TABLE II. UN-WEIGHTED ICT INFORMATION USAGE SCORES

Country	Score
Iran	41.042
Lebanon	40.039
Bahrain	38.889
Jordan	30.046
Qatar	29.899
UAE	26.534
Kuwait	21.929
Syria	20.028
Yemen	18.978
Saudi Arabia	17.814
Oman	17.630

The resultant vector is then used in a second run of regression by involving the other two main variables namely

networks (a reference to ICT network infrastructure) and *infouse*.

This process is referred to an un-weighted score estimation. The results of the second regression are reported in Table II. As shown in this table, three countries had the highest efficiency scores with regard to their ICT information usage: Iran, Lebanon and Bahrain with Iran at the lead with an efficiency score of 41 units.

The next step was to conduct an efficiency analysis, using a weighted method for comparison purposes and as a means of having a better estimation analysis of the digital communities across the region. The method used for this purpose is called DEA analysis.

IV. METHOD II: DEA ANALYSIS

DEA is a deterministic and non-parametric model [25] built around the stochastic frontier model [26]. The method is used as a means of benchmarking the most efficient unit(s) within a particular system.

The core component of DEA is a unit called the Decision Making Unit (DMU). Each DMU represents a complete set of recorded observations in which data are grouped as units of inputs and outputs. In other words, DEA calculates efficiency of each DMU within a dataset. A DMU can represent any type of measurable data, including metrics related to educational attainment and ICT data, such as the number of Internet users, the number of personal computers and/or the number of cell phones and fixed telephone lines in use. If DMUs are constructed using a simple model (e.g., single input and output) then the efficiency of DMU_i is defined by the following simple formula:

$$efficiency_i = y_i / x_i \tag{2}$$

where y_i in equation (2) denotes the output of observation i and x_i represents its related input.

In a more complex situation where, DMUs are defined using multiple inputs and outputs, each of which contains different weighting metrics, then the efficiency of DMU_i is defined as the sum of weighted outputs divided by the sum of the weighted inputs as depicted in following equation:

$$efficiency_i = \sum_{i=1}^n \alpha_i Y_i / \sum_{i=1}^n \beta_i X_i \tag{3}$$

where α_i and β_i denote the weighted values for the output variable Y_i and the input variable X_i respectively.

As depicted in equation (3), the results of efficiency calculation are strongly correlated with the selection of input and output weights. This is one of the main issues that should be addressed. In other words, we should answer the question of how do we setup values of the weights so that the ultimate results do not discriminate the other units to favour a particular DMU or several DMUs within a system.

DEA solves this problem by estimating the efficiency of each DMU through the implementation of a weighting mechanism that fits best for each DMU in the system [27]. In other words, the system allows the efficiency of each DMU to be maximized and then it will benchmark the most efficient ones. For the purpose of this empirical analysis the same dataset used in Method I was used in Method II. Based on countries performances in ICT information use (variable *infoUse*) and the existing level of network infrastructure (variable *networks*) development, as depicted in Figure 2, four countries Yemen, Iran, Lebanon and Bahrain have been placed on the efficiency curve.

Name	Minimum	Maximum	Mean	Standard Derivation
Edu	56.95	131.03	96.0373	20.9109
Networks	13.21	113.29	59.7327	32.511
HDI	0.46	0.8422	0.7465	0.102
GDPP	798.82	20233.55	10494.2897	6828.1155
InfoUse	28.4	152.73	79.1609	33.6799

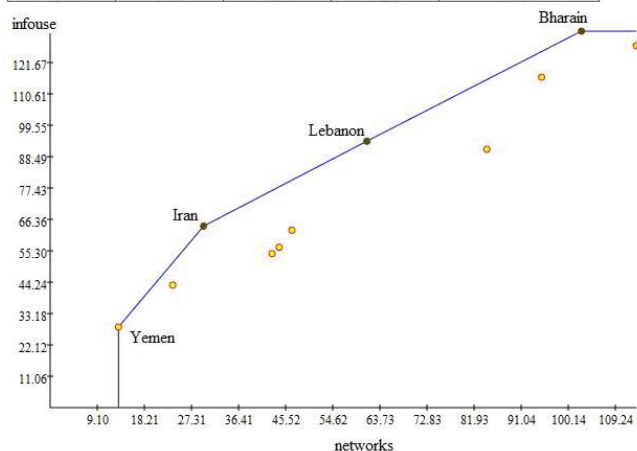


Figure 2. Descriptive statistics and the efficiency curve

A further investigation of the efficiency scores of countries in this study, as shown in Table III, indicates that among the Middle Eastern countries of this study, Bahrain and Iran had the highest efficiency scores and therefore were benchmarked as the most efficient countries in ICT information usage.

In addition, the DEA frequency analysis indicates that both Bahrain and Iran had the highest frequency scores with regards to their information usage and networks in comparison with other DMUs in the dataset. Lebanon and Yemen were placed thereafter. It is important to note that the efficiency scores are estimated based on the maximized weighted score that fits each country's performance the best.

In this context, albeit Yemen has the least developed ICT infrastructure, but when it comes to citizens' usage of information the country's efficiency index scores higher than other ICT developed nations such as Kuwait, Qatar and UAE.

V. DISCUSSION ON FINDINGS

Citizens in counties located on the efficiency curve (see Figure 2) namely: Yemen, Iran, Lebanon and Bahrain had the highest online presence during the popular unrests in the region. This is mainly associated with level of ICT adoption among citizens of these countries particularly among the younger and educated citizens. Information technology adoption is argued as one of the main sources of emancipation [11, 16, 28, 29]. The role of social influence in technology acceptance has been argued as one of the main drives behind citizens' acceptance of the new technology. Individuals engaging in the adoption of new technology achieve not only social status gains but also the pace of such an adoption is in part a result of individuals' desire in response to the social conditions [29]. Thurman [30] argues that the adoption of established news websites in expressing their views is driven by social and technological conditions in which low cost online content management tools helped facilitate a rapid growth in the number of and popularity of independently published websites and blogs that overlap the space traditionally occupied by the mainstream news media.

TABLE III. WEIGHTED CROSS-COUNTRY INFOUSE VS. NETWORKS EFFICIENCY

DMU	Efficiency	Bahrain	Iran	Jordan	Kuwait	Lebanon	Oman	Qatar	Saudi	Syria	UAE	Yemen
Bahrain	100	100	100	68.18	82.24	95.63	87.22	95.96	83.22	82.02	86.42	81.48
Iran	100	100	100	68.18	82.24	95.63	87.22	95.96	83.22	82.02	86.42	81.48
Jordan	68.18	100	100	68.18	82.24	95.63	87.22	95.96	83.22	82.02	86.42	81.48
Kuwait	82.24	100	100	68.18	82.24	95.63	87.22	95.96	83.22	82.02	86.42	81.48
Lebanon	95.63	100	100	68.18	82.24	95.63	87.22	95.96	83.22	82.02	86.42	81.48
Oman	87.22	100	100	68.18	82.24	95.63	87.22	95.96	83.22	82.02	86.42	81.48
Qatar	97.87	100	59.5	45	80.2	71.89	72.71	97.87	62.4	47.94	85.23	81.48
Saudi Arabia	83.22	100	100	68.18	82.24	95.63	87.22	95.96	83.22	82.02	86.42	43.65
Syria	84.55	59.94	100	58.66	50.04	71.15	59.24	56.87	62.07	84.55	52.23	81.48
UAE	86.42	100	100	68.18	82.24	95.63	87.22	95.96	83.22	82.02	86.42	99.7
Yemen	99.7	59.94	100	58.66	50.04	71.15	59.24	56.87	62.07	84.55	52.23	81.48

As such, the digital communities in these countries adopted and utilized ICT media effectively for mobilizing citizens in political discourse. Millions of pictures, video clips, text messages and articles posted on social networking sites, blogs and video sharing sites such as YouTube document the intensity use of ICTs in these countries in particular from Iran, Bahrain and Yemen.

Despite some differences in results reported by the weighted versus un-weighted analysis with regards to the efficiency of ICT usage in the Middle East, both methods scored Iran, Lebanon and Bahrain as the most ICT efficient countries in the region. The differences in reported scores (weighted and un-weighted) with regards to Yemen is due to the weighting mechanism deployed in DEA to benchmark the best performer(s) within the DMU dataset. In this context the un-weighted scoring mechanism used by OLS regression is different than the method used by DEA. The study of the Iranian digital community as the most efficient community in the region warrants a future discussion about this community. Despite the fact that the Iranian ICT network suffers from advanced technologies such as broadband, the Internet users in Iran are utilizing the existing bandwidth more efficiently than other countries in the region. Poor infrastructure development in Iran is one of main barriers to access to the information highway. To highlight this according to the 2009 ITU report, in year 2008 almost 32.5% of the population in Chile were connected to the Internet (measured based on the number of Internet users per 100 inhabitants) while 8.5% of these users were broadband users. In the same year 31.4% of Iranians were connected to the Internet, but only a very small number of users (0.41%) were connected to the Internet by the means of broadband. A comparison between Bahrain and Iran also reveals important information with regards to the poor ICT development in Iran, while 52% Bahrainis were connected to the Internet in year 2008, 14.18% of these users were broadband users.

Despite the underdeveloped infrastructure the digital community of Iran has created the largest blogosphere in the Middle East. Currently there are over 60,000 active blogs in Iran. In addition, the Iranian Facebook users constitute a bloc of over nine million users. In addition, on average Iranians exchange millions of SMS messages on a daily basis. This value increased to a remarkable high number of 110 million SMS per day during the 2009 presidential election in Iran. Many of these messages were politically motivated and caused the hardliners to shutdown the entire mobile network for a few days starting from June 11, 2009, which was the day before the election in Iran [31, 32]. The above examples show the intensity of ICT usage in Iran, confirming the results of the regression, as well as our DEA analysis based on data collected from sources such as ITU, The World Bank and UNDP.

The results of this study indicates also, that, despite intensive efforts by the Iranian authorities in filtering Internet contents, the digital community of Iran was able to bypass the imposed filtering through various methods, including the use of proxies, VPN and anti-filtering software available on the Net.

VI. CONCLUSION

ICTs changed the nature of interaction among individuals, civil society, democratic institutes and business activities. In particular, many individuals and protest movements were organized by utilizing ICTs in their campaigns. As we have seen in recent popular unrests in Middle East and North Africa, ICTs provide the means for building the capacity to participate in democratic discourse, and mobilize masses for radical social change in constitutional and legal arrangements.

Since the introduction of Internet in Middle East in 1995, the digital communities in the region were able to effectively use the new technology for not only as a means of communication and interaction among people, but also to organize social-political events. Despite governmental control and filtering the content of Internet including the block of blogs, critical websites, Facebook, Twitter and email systems, the digital communities in the Middle East were able to use advanced anti-filtering tools and software, as well as proxies, to bypass the imposed restrictions on the Net and participate in discourse with digital societies across the globe. By using the theory of new media communication coupled with empirical analysis of archival data, this study tried to investigate the intensity of ICT information usage in the Middle East in order to better understand the nature of communication discourse in the region and their mobilization impacts on recent public unrests. The results showed that citizens who are actively engaged in digital communities and use ICT tools and services more efficiently are more likely to participate in public discourse and mobilization.

REFERENCES

- [1] B. Loader, "Cyberspace Divide", London: Routledge, 1998.
- [2] P. Foley, X. Alfonso, and, M. Al Sakka, (2006) "Information sharing for social inclusion in England: A review of activities, barriers and future directions", *Journal of Information, Communication and Ethics in Society*, vol. 4, no. 4, 2006, pp. 191-203
- [3] P. Norris, "Who Surfs? New Technology, old voters and virtual democracy in the 1996 and 1998 US elections", in: E. Kamarck, (ed.) "Democracy.com?", Cambridge: Hollis, 1999.
- [4] D. Ott and M. Rosser, "The electronic republic? The role of the Internet in promoting democracy in Africa", *Democratization*, vol. 7, no. 1, 2000, pp. 137-155.
- [5] A. Jones, "Wired world: Communications technology, governance and the democratic uprising" in: F. Webster (ed.), *Culture and politics of the information age*, London: Routledge, pp. 145-163, 2001.
- [6] S. Suarez, S. "Mobile democracy: Text messages, voter turnout, and the 2004 Spanish general election", prepared for Annual Meeting of the American Political Science Association, September 1-4, 2005.
- [7] J. Katz, "The Digital Citizen", *Wired*, vol 5, no. 12, pp. 86-82, 1997.
- [8] D. G. Lenihan, "Realigning Governance: From E-Government to E-Democracy", OECD Discussion Paper, for the Public Sector Management division's E-Government Working Group, Centre for Collaborative Government, April 2002, <http://kta.on.ca/pdf/cg6.pdf> [retrieved: June, 2007]
- [9] S. Clift, "E-Democracy, E-Governance and Public Net-Work", 2003, available: <http://www.publicus.net/articles/edempubnetwork.html> [retrieved: April, 2007]
- [10] R. Hirschheim, and H. K. Klein, "Realizing Emancipatory Principles in Information Systems development: The case for ETHICS", *MIS Quarterly*, vol. 18, no. 1, 1994, pp. 83-109.

- [11] C. B. Stahl, "Empowerment through ICT: A critical discourse analysis of the Egyptian ICT policy", *Social Dimensions of Information and Communication Technology Policy* IFIP International Federation for Information Processing, 282, 2008, pp. 161-177.
- [12] A. Cigler and L. Burdett, "Interest Group Politics", 5th edition, Washington: Congressional Quarterly Press, 1998.
- [13] B. J. Oates, B. J. "The potential contribution of ICTs to the political process", *Electronic Journal of e-Government*, vol. 1, no. 1, 2003, pp. 33-42.
- [14] F. Shirazi, "The Emancipatory Role of Information and Communication Technology: A Case Study of Internet Content Filtering within Iran", *Journal of Information, Communication & Ethics in Society*, vol. 8, no. 1, 2010, pp. 57-84.
- [15] M. Castells, "The Rise of the Network Society", 2nd edition, Oxford: Blackwell, 2000.
- [16] M. Castells, "Communication, Power and Counter-power in the Network Society", *International Journal of Communication*, vol. 1, 2007, pp. 238-266.
- [17] A. L. Lievrouw, (2001). *New media and the 'pluralization of life-worlds': A role for information in social differentiation*, *New media & Society*, vol. 3, no. 1, 2001, pp. 7-28.
- [18] M. Marsili, F. Vega-Redondo, and F. Slanina, "The rise and fall of a networked society: a formal model", *Proc. Natl Acad. Sci. USA*, vol. 101, 2004, pp. 1439-1442.
- [19] T. O'Reilly, "What is Web 2.0: Design patterns and business models for the next generation of software", *Communication & Strategies*, vol. 65, no. 1, 2007, pp. 17-37.
- [20] A. Chadwick, "Web 2.0: New Challenges for the Study of E-Democracy in an Era of Informational Exuberance", *I/S: A Journal of Law and Policy for the Information Society*, vol. 5, no. 1, 2009, pp. 9-42.
- [21] S. Wattal, D. Schuff, M. Mandviwalla, and B.C. Willams, "Web 2.0 and politics: the 2008 U.S. presidential election and an E-politics research agenda", *MIS Quarterly*, vol. 34, no. 4, 2010, pp. 669-688.
- [22] ITU-Orbicom, "From The Digital Divide To Digital Opportunities: Measuring Infostates for Development", Montreal: Claude-Yves Charron, 2005.
- [23] ITU, "Measuring The Information Society 2007: ICT Opportunity Index and World Telecommunication/ICT Indicators", Geneva: ITU Publication, 2007.
- [24] World Bank, *World Bank Development Indicators (WDI) CD-ROM*, 2007.
- [25] S. Perelman and T. Serebrisky, "Measuring the Technical Efficiency of Airports in Latin America", *Policy Research Working Paper 5339*, The World Bank, Latin America and the Caribbean Region Sustainable Development Department, June 2010.
- [26] W. Greene, "Reconsidering heterogeneity in panel data estimators of the stochastic frontier model", *Journal of Econometrics*, vol. 126, no 2, 2005, pp. 269-303.
- [27] C. Vercellis, "Business Intelligence: Data Mining and Optimization for Decision Making", London: John Wiley & Sons, Ltd, 2009
- [28] E. Karahanna, D. W. Straub, N. L. Chervany, "Information Technology adoption across time: A cross-sectional comparison of pre-adoption and post-adoption beliefs", *MIS Quarterly*, vol. 23, no. 2, 1999, pp. 183-213.
- [29] V. Venkatesh, M. G. Morris, G. B. Davis, F. D. Davis, *User acceptance of Information Technology: Toward a unified view*, *MIS Quarterly*, vol. 27, no. 3, 2003, pp. 425-478.
- [30] N. Thurman, *Forums for citizen journalists? Adoption of user generated content initiatives by online news media*, *New Media & Society*, vol. 10, no. 1, 2008, pp. 1-30.
- [31] A., Aramesh, "Iran Filters and Jams Internet to Combat the Opposition", 2008, available: <http://www.insideiran.org/critical-comments/iran-filters-and-jams-internet-to-combat-the-opposition/> [retrieved: December, 2010].
- [32] G. Esfandiari, "Misreading Tehran: The Twitter Devolution", 2010, available: http://www.foreignpolicy.com/articles/2010/06/07/the_twitter_revolution_hat_wasnt [retrieved: August, 2010].