

## **AC 2007-2466: E-HEALTH (DIGITAL HEALTH) AND SITUATION IN IT/ICT BENEFITS**

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# **E-Health (Digital Health) and Situation in IT/ICT benefits**

## **Abstract**

Today, more and more decision makers are interested in e-health tools as critical components of personal health management and healthcare reform strategies. Decision makers are seeking viable approaches to reduce healthcare costs, improve the quality of care, and increase consumers' ability to manage their own health. Conditions are favorable for a greater investment in consumer-oriented e-health tools. The technology marketplace is dynamic; the public is increasingly turning to information and communication technologies for a better life; healthcare organizations are adopting and offering health information technology; and Government policy is placing great emphasis on both health information technology and personal health management for consumers. Such activities are now part of everyday news.

## **Introduction**

The objectives of this paper are to

- 1) educate the reader about e-Health
- 2) describe the different components of e-Health
- 3) illustrate how e-Health works
- 4) summarize the potential benefits of e-Health
- 5) Detail a plan to increase the probability of a successful e-Health program.
- 6) describe a visionary, yet practical, initial e-Health activity that would benefit developing countries – the online Health Sciences Centre

## **Definition of e-Health**

E-Health can be defined as,

The use of information and communications technology to deliver health services and exchange health information when distance separates the participants<sup>2</sup>

E-Health is a general term that includes many different technologies and telecommunications modalities applied to many different clinical and health education activities. A e-Health system can be divided into four different components:

- 1) technology e.g. workstation and peripherals,
- 2) telecommunications link,
- 3) users e.g. clinicians and patients, and
- 4) policies and procedures. Each of these components is important and must be properly integrated with the others for e-Health to be successful.

## Technology

The technology component of e-Health is the workstations, peripheral devices and software that are used to perform e-Health activities. There are many different workstations used for e-Health including: telephones, videophones, videoconferencing systems, PC-based store and forward systems (S&F) and specialized telemedicine workstations.



Figure 1. Tandberg Health Station III Telemedicine Workstation



Figure 2. American Telecare PC-based e-Health system

Workstations can be used with or without peripheral devices. Peripherals are devices that can be plugged into or connected to a workstation thereby allowing local health professional to capture still images, video, sounds and medical vitals. Most peripherals are medical devices that assist in conducting clinical exams at a distance. Without peripherals, a videoconferencing workstation can still be used for administrative or educational videoconferencing. Some peripheral devices are shown below.



Figures 3a,b,c. AMD peripheral devices (from left to right): a) otoscope, b) electronic stethoscope, c) general exam camera

## **Telecommunications**

The second component of e-Health is the telecommunications link. This is the connection that links the workstations mentioned above. There are many different types of telecommunications links including: the plain old telephone system (POTS), dial-up digital telephone lines such as Integrated Service Digital Networks (ISDN) and Switched – 56 (Sw-56), asynchronous digital subscriber line (ADSL), coaxial cable, dedicated digital networks such as Asynchronous Transfer Mode (ATM) and Frame Relay (FR), microwave, satellite (including Geosynchronous and Low Earth Orbit). The Internet (which is basically a set of protocols) can utilize any of the above mentioned telecommunications modalities. The type of telecommunications modality that is best for your situation depends on what you want to do, what telecommunications are available and what you can afford.

## **People**

A critical part of e-Health that is often overlooked is people. For e-Health to be successful it is necessary to have users, i.e. people who use the technology. It is vital to properly educate, train and support those who have chosen to use the technology. Although some people quickly embrace new technologies, the majority of people do not; rather they have neutral or distrustful feelings towards it. As a result, most individuals need to be educated about e-Health, what it is, how it works and how it is beneficial to them before they will consider using it. If they do choose to use e-Health, they then need to be properly trained. Failure to do so usually leads to users being intimidated by the technology and frustrated when they cannot get it do what they want. Proper training also increases the probability that the user will be able to take full advantage of what the technology can do. Finally, users need to be supported (ideally 24 hours per day x 7 days a week) so that when they do have problems, they can quickly interact with a knowledgeable person who can help them solve the problem.

## **Policies and Procedures**

Before e-Health (in particular medical consultations conducted at a distance) can be conducted, a number of policy issues must be resolved. Examples of policy issues include reimbursement, licensing and liability. Questions that need to be answered are: Who pays for the telecommunications costs? Who pays the clinician to perform a teleconsultation? If the patient and clinician are not in the same province, is the clinician electronically going to the patient or is the patient coming to the clinician? (In most jurisdiction, it has been decided the physician goes to the patient and hence needs to be licensed in the Province / Territory / State where the patient is located). If something goes wrong with the patient due to the advice given during a teleconsultation, who is liable – the clinician, hospital, technology vendor, and / or telecommunications provider? What kind of record is kept of the encounter? Many of these issues have yet to be resolved and standardized in many parts of the world.

Before e-Health can occur routinely, a number of procedures have to be put in place. For example, what information needs to be sent to a specialist before a e-Health

consultation?, how is a patient to be presented to the specialist during a e-Health consultation? who notifies the patient, GP and specialist when and where to go for a e-Health consultation? What type of security measures are to be used during a consultation?

### **Types of e-Health activities**

E-Health activities can be divided into three different types: 1) clinical, 2) educational, and 3) administrative. Examples of clinical activities include using a videoconferencing system to do telepsychiatry, or using a store-and-forward system to send and receive digital pictures of the skin for teledermatology. Examples of educational activities include using a videoconferencing system to connect to another site that is having medical Grand Rounds, or using the Internet to access an online health course. An example of administrative activity is using a videoconferencing system to attend meetings at a distance.

### **How E-Health Works**

Figure 4. depicts how e-Health works. Audio and video (or still images) from one site is captured and processed by the central processing unit (CPU), or by the coder-decoder (codec). Processing involves the digitization and often compression of the information. Next, the information is prepared for transmission and transmitted to the distant site.

If a real-time videoconferencing link (synchronous) has been established between two sites, information is simultaneously sent and received between the two sites. Specifically, at the same time audio and video information is sent from site A, in-coming audio and visual information is received from site B. As long as the telecommunications bandwidth is large enough, this can result in communication that very similar to an in-person encounter. For example, linking two high-end videoconferencing systems with a 384 kbps telecommunications link (equivalent to six telephone lines) provides an encounter that is very similar to sitting across the table from someone and having a conversation. You can see and hear them, but cannot reach out and touch them. If a store-and-forward system is used, the information (usually still images and textual information) is captured and stored in the computer at one site, and then forwarded via the telecommunications link to another site. The information is then held on the receiving computer (or server) until it is convenient for the receiving health professional to review the information. The encounter is very similar to sending an email with multimedia attachments.

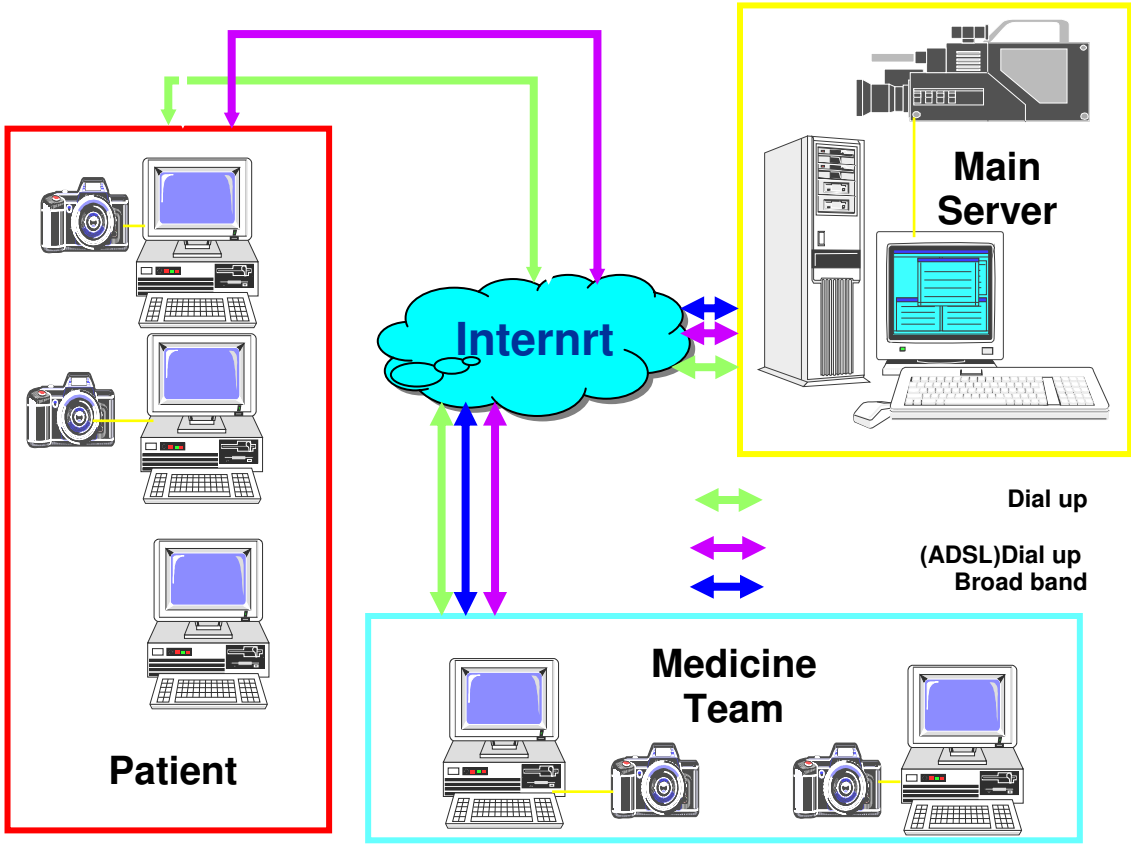
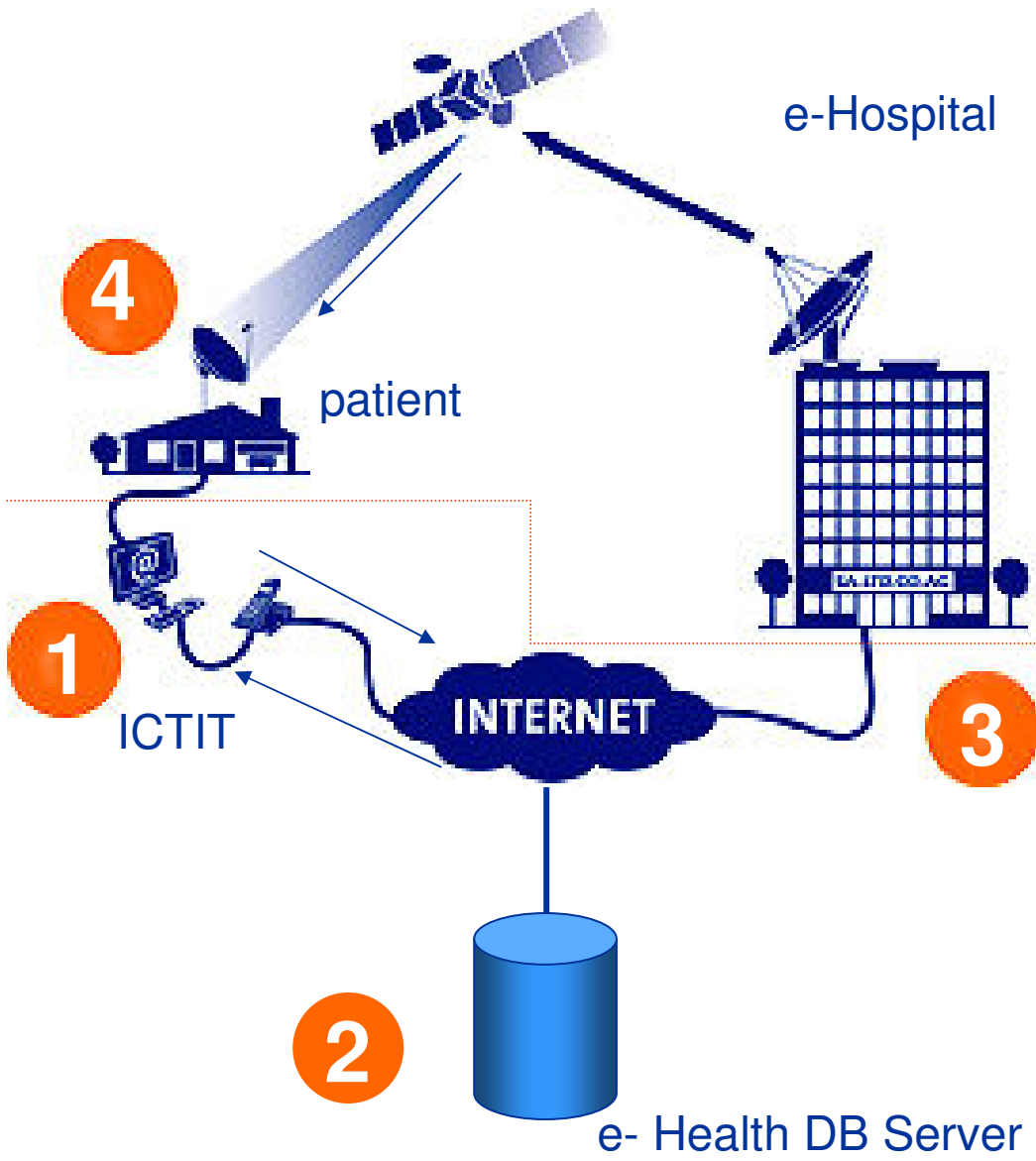


Figure 4. How E-Health Works.



## **Potential Benefits of E-Health**

There are many potential benefits to e-Health. These can be divided into benefits for the patient, remote (sending) health care provider, central (receiving) health care provider and the health care payer (insurer).

### **Benefits - Patient**

- Improved access to medical specialists
- Quicker, more accurate diagnosis and treatment, potentially leading to improved patient outcomes
- Reduced travel
- Decreased stress
- Decreased cost (travel, meals, accommodation, lost work)

### **Benefits – Remote Health Care Provider**

- Improved access to medical specialists
- Increased confidence in management
- Increased opportunities for education (CME at a distance, students can attend classes virtually, can attend conferences virtually)
- Decreased professional isolation
- Virtual meetings
- Collaborative research

### **Benefits – Central Health Care Provider**

- Decreased need to travel - “see patients, not the road”
- Improved screening of patients
- Improved follow-up
- Increased educational opportunities
- Virtual meetings
- Collaborative research
- “Electronic house calls”

### **Benefits - Health Care Payer**

- Decreased overall health care costs (per patient)
  - reduced patient travel costs
  - reduced physician travel costs
  - reduced admissions to hospital or sooner discharges
  - more patients treated at remote site or at home

### **The Plan – How to increase the probability of success<sup>3</sup>**

In order to realize all the potential benefits of e-Health, it has to be designed, implemented and supported properly. Although this article cannot go into depth regarding all the issues that need to be taken into account, the following list highlights the major issues that need to be addressed.

- 1) Establish a team of individuals to create a strategic plan for the design, implementation and evaluation of the e-Health network. This team will oversee and managing the initial rollout of the project (includes everything listed below, plus manage the budget).
- 2) Review the previous e-Health activities that have occurred in your region, country and other similar locations. Learn from their successes and mistakes.
- 3) Conduct a resource inventory. This includes an inventory of any current e-Health technologies and telecommunications that are, or could be supported in your area. It also includes an inventory of people resources, e.g. people who have been involved in e-Health and/ or those who are interested in participating in the future.
- 4) Develop an educational package and disseminate this to all individuals potentially affected by e-Health. This will educate people about e-Health and prepare them to answer questions in the Needs Assessment.
- 5) Develop and conduct a Needs Assessment. This should go to all individuals / sites that could potentially be affected by e-Health. Results from the needs assessment will help direct what clinical, educational and administrative needs have priority. It will also help identify people who are interested in e-Health, e.g. champions.
- 6) Review, establish and formalize relationships with potential sites (referral and remote).
- 7) Review the type of e-Health technology and telecommunications links at all potential sites. Make sure the technology chosen is interoperable with the referral centres.
- 8) Match the needs (identified by the Needs Assessment) to the ability to meet the needs via e-Health (obtained from referral centres). The ability to meet the need includes having health professionals who want to use e-Health technology to meet the need.
- 9) Identify the telecommunications options and work with the vendor(s) to test and implement the preferred option.
- 10) Contract / choose a vendor to install the required IT infrastructure at each of the sites.
- 11) Identify e-Health technology that best meets the needs of the communities, meets the technical requirements (including security) and is compatible with the referral centres. A bridge will be required to facility interoperability between different videoconferencing systems / protocols / multi-site connections.
- 12) If required issue an RFP for the e-Health technology and select appropriate technology.
- 13) Educate and train potential users (including support staff) about the e-Health system and how to use it.
- 14) Educate and train potential technicians how to trouble-shoot and repair the technology.

**Concurrent with the above do the following:**

- a) Review the current policies (or lack of policies) that may affect e-Health both at the remote sites and the referral centres. Begin the process of educating the administrators/managers at the e-Health sites how it may affect current workflow. Begin the process of policy change, if required. Work with administration, clinicians and support staff on the development of new e-Health policies and procedures, and forms. The following issues will need to be addressed: reimbursement, liability, licensing, security (during the session and storage of data), what to record during and after the session.
- b) Initiate and conduct an evaluation. At a minimum this will evaluate the initial e-Health design and implementation, including technical performance and clinical/patient satisfaction. Ideally, on-going evaluation tools should be developed to provide on-going information regarding access, cost, effect on patient outcomes, clinician and patient satisfaction and long-term technical performance.
- c) Develop an on-going education and training program. Usually, the selected vendor will do the initial education and training. However, it is important that an on-going program be developed that will educate and train individuals who are not part of the original rollout. Development of this course may require obtaining additional funds.
- d) Establish a group of individuals who will provide on-going administration, support and lead research, development and evaluation of the e-Health program. This group will assume responsibility for the on-going operations of the e-Health network.
- e) Identify and fund a technical support centre that will continue to repair and maintain the technology after the warranty expires.

**Additional difficulties in setting up e-Health in developing countries**

In addition to all the normal barriers to e-Health, developing countries potentially have a number of unique difficulties, such as:

- Lack of money to purchase the technology or telecommunications
- Limited number of people who know how to operate, install or repair the technology or telecommunications
- Limited access to parts for repair
- Limited access to electricity
- Unstable electrical supply
- Lack of telecommunications infrastructure
- Unreliable telecommunications infrastructure
- Limited or unreliable power supply
- Health care system that may be poorly organized
- Health care system that may be poorly funded
- Limited number of health professionals
- Number of other pressing clinical health care needs

## **Recommendations for E-Health in Developing Countries**

Taking into account the additional difficulties associated with setting up e-Health in developing countries, it would be prudent to utilize e-Health technologies that are relatively inexpensive, robust (do not break down) and are easy to operate and repair. It would also make sense to choose activities that result in a high degree of benefit for as many people as possible – “biggest bang for the buck”. One must also take into account what technology is available and what can be supported. Keep in mind that the technology chosen should be compatible with the technology used by those who will meet your needs. E-Health activities should also operate on low bandwidth telecommunications. Technology should be chosen to meet immediate health care needs.

## **Online Health Science Centre – the Ideal, Initial E-Health Activity**

The ideal, initial e-Health activity should take advantage and build upon what is available in the developed world, yet can be tailored for the needs of developing countries. An example of this type of activity would be an online Health Science Centre (HSC). Individuals and organizations in variety of different countries (both in the developing and developed world) would support the online HSC. The online HSC would be a website that takes advantage of the latest Internet technology, yet is accessible by those in the developing world using older, simpler technologies. It would be designed specifically to respond to the health needs of those in the developing world and the information would be displayed in a low bandwidth friendly manner.

The online HSC would have a number of different components including:

1. Patient information and education
2. Health professional information and education
3. Ability to do patient consultations (store and forward)
4. Act as a clearing house to match needs to those that can meet the need, e.g. a remote clinic in Nepal could indicate that they have a pressing need for penicillin and a drug company in Canada with an excess amount of penicillin could ship it to the clinic.
5. Links to other useful sites

## **Type of information contained on the online HSC website**

Most information on the web site would be in text, with limited images and graphics. This will decrease the amount of information that needs to be downloaded. decrease download times and consequently decrease telecommunications costs. Individuals in developing countries could download the information at their convenience and store it on the hard drive, or CD for future reference. This would decrease the need and cost to continually access the Internet, and it would keep the information locally available.

## **How the information would be distributed**

The information on the online HSC web site could be mirrored on a number of different servers around the world so that high numbers of people could access the information.

### **How the online HSC website would work**

The online HSC web site would be used by the participating developing countries to post a request for: 1) Information / education, 2) Clinical consult, 3) Medical supplies and technology. Participating individuals / organizations would then respond to these requests.

### **Educational content**

The ideal would be for a few people to be responsible for responding to requests for information/education. This would be their primary occupation and they would be appropriately reimbursed for this service. In addition, volunteers from all over the world could also assist. However, volunteer responses would need to be reviewed and possibly edited before being posted. This would be necessary to maintain quality control and to make sure the information to be downloaded is suitable for low-bandwidth downloads.

It is anticipated that volunteers could come from any of the following groups: health care students (nursing, medical etc.), medical residents, health professionals from relief agencies, and health professionals that are retired. Individuals would participate primarily for altruistic reasons, but also the website could be designed so that those in the developed world could only get access to the information after they contributed to it, or paid a certain amount of money. Medical students and residents could contribute papers on specific topics that could then be accessed by their colleagues. The concept is that the research and work done by one person could be posted and made widely available.

Most of the content would be researched and then provided by individuals at organizations in developed countries (relief agencies, NGOs, World Health, universities etc). They would also provide most of the hardware, software, management and money to operate the online HSC. Developing countries would only need the means to access the web site. Eventually, there would be a huge database of information comprising almost all types medical / health conditions. At this point, the individuals coordinating the online HSC would no longer need to find information to post, but they would spend most of their time reviewing and updating the data on the website.

### **Clinical consults**

Patients and health professionals who participate in clinical consults would do so on a voluntary basis. The online HSC would indicate what type of consult was requested. Those who could meet the need would respond. It would be the responsibility of the participating individuals to authenticate the credentials of the participating health professionals. Consequently, it is expected that most clinical consults would be conducted between individuals or organizations that already have an established relationship. The online HSC web site would simply provide the participants with the vehicle through which the consults could take place in a secure fashion.

### **Medical supplies**

The online HSC would indicate what type of medical supplies or technology is needed by an individual or organization. Individuals or organizations that could meet the need would voluntarily respond.

### **Administration of E-Health Activities**

It would be best for the online HSC to be initially coordinated out of a single location by an independent group of individuals (not affiliated with one specific organization or country). This would bring together a critical mass of people, which is important when starting up a new project. These individuals would work full-time on the online HSC and allow it to gain enough momentum to continue on as a sustainable service. A benefit of an independent coordinating group / organization would be an increased likelihood of keeping the online HSC politically neutral. It is likely that this would also broaden its appeal.

### **Support for the online HSC**

The online HSC would be supported by a collaboration of individuals, organizations, foundations, and countries. Start-up funding would probably come from a health foundation. The organization would most likely be non-profit. Individuals working for the online HSC would promote the organization to potential supporters.

### **Conclusion**

Realizing the potential population health benefits of e-health tools requires not only a shift in thinking and strategies but also strong leadership to coordinate marketplace and policy momentum for maximum public benefit. Disparities in access to health information, health care, and technology make it highly unlikely that market forces and fragmented public-sector efforts alone will achieve desired public health goals. Consistent with other Government initiatives, public-sector engagement in partnerships that harness current consumer trends and align the multiple interests of stakeholders is crucial. The way forward for consumer e-health is to use these partnerships and interests to create and sustain a user-centered strategy that results in e-health tools being available on a much wider scale than is currently possible

### **References**

- [1]-Ramin Sadeghi DR Researcher and System Programmer for Iran / Homeopathy Software on e- health paradigm (with Dr. Kamran Jalali dkjalali@yahoo.com)
- [2]. Elford DR. Telemedicine Activities at Memorial University of Newfoundland ; A Historical Review (1975 - 1997). Telemedicine Journal 1998; 4(3):207-224
- [3]. "How to run the world's worst e-Health program" Platform presentation at e-Health 2002. Vancouver, BC (April 23, 2002)
- [4]. Ramin Sadeghi Ph.D. Thesis and Ms.c Thesis 2000-2005  
<http://www.pwut.ac.ir>
- [5]. Ramin Sadeghi Research on Web based Distanced Learning FA Magazine nov.2005- ramin71@gmail.com

<http://www.faa.ir>

[6]. Paul T. Jaeger, Kim. M. Thompson – e-Government around the world: Lessons, Challenges, and Future directions – Florida State Univ. School of Information Studies. Information Use Management and Policy Institute

[7]. Harold C. Relyea, E-Gov: Introduction and Over view – Library of Congress. Congressional Research Service, Washington. USA.