The CAEMP Methodology Applied to the Design and Implantation of an e-Health Environment

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Abstract In this paper we present the CAEMP Methodology, (Capacity, Abilities and Efficiency Maturity Process) in the context of e-Health environments. This methodology gives a roadmap for the redesign and integration of a company's technology, human resources and processes supported by ICT. This methodology is composed of five steps and four levels of applications development and integration. It takes into account human as well as organizational factors. In order to validate our methodology, we compare it to others and perform a SWOT analysis.

Keywords: e-health, information technology, processes, human resources, knowledge management.

1 Introduction: E-health and the Information Society

The information society is an initiative that through the use of Information and Communications Technology (ICT) allows the community to have access to information and services in areas such as economy, education, government, science and health. This access is achieved mainly through the Internet, which also implies that communities not only will have access to information and services but also will enhance the interactions between society's constituents [1].

The Information Society will improve the quality of life in general because it has the following advantages:

1. Eliminates space and time barriers.
2. Reduces costs and allows the resulting services to be replicated and thoroughly spread.
3. Widens the reach of the benefits of high quality services even to those that by reason of their geographic isolation, their family/social situation or other economic constraints cannot have access to them.
4. Improves process efficiency in such a way that services can be delivered in a shorter amount of time.

5. Improves effectiveness by deploying services that solve real-life social, education, economic and political problems while addressing a society's concerns and information gaps over a longer period of time.
6. Improves transparency and feedback on resource allocation, effectiveness, efficiency and progress.
7. In general promotes the use of technology and wider communication in the community.

Specifically, Internet and ICT will help us avoid the everyday problems in health centers: bureaucracy, inefficiency, paper work, waiting lines, and others [2]. In the information society, ICT and Internet will help to automate these processes to make them more efficient, achieve the use of fewer resources (time, equipment, cost, employees, etc.) and create a technology based health environment that is accessible to all members of society.

2 E-Health and Telemedicine

E-health is the combined use of electronic communications and IT in the health sector, both at the local site and at distant locations for clinical, educational and administrative purposes [3].

E/health can also be define as the application of Internet and other related technologies in the healthcare industry to improve the access, efficiency, effectiveness, and quality of clinical and business processes utilized by healthcare organizations, practitioners, patients, and consumers to improve the health status of patients [4] [5] [6].

Telemedicine is another widely used term when referring to the use of remote medical services. Telemedicine is the use of information and telecommunication technologies to provide medical information and services remotely [7]. The telemedicine applications that can be implemented in an e-health environment are very diverse. In 61% of the cases telemedicine systems are used to transmit images and the other two most important applications are tele-consulting and transmission of medical information [9].

Telemedicine tends to refer to a specific health service delivered thorough a specific data transmission channel, while e-health is a broader term that implies the use of technology to the provision of healthcare [8].The former focuses on technology applied to clinical process, whereas the latter focuses on technology applied to business processes.

3 Current Situation of e-Health

Despite the growing number of e-health websites, hospitals and health provider organizations tend to use static websites that supply information, but have not made major investments in interactive technologies to engage patients in the e-health marketplace [2].

The health-care industry has long lagged behind other industries in deploying business technologies until well after they've gone mainstream in many other industries [10].

High costs and rapidly changing technologies are most likely to blame for the relatively slow adoption of advanced technologies among hospitals and health provider organizations [2].

Among the several challenges to implement an e-health environment, the most important are [11]:

- The healthcare industry is extraordinarily complex and turbulent, with rapidly changing business models.
- Healthcare industry has made relatively little investment and has gained relatively little experience with the use of advance information technologies as a basic business tool.
- The ability or the industry to achieve large-scale efficiencies is restrained by legal and regulatory barriers and a deeply conservative medical culture.
- Most healthcare services must be delivered in person.

Building an e-health environment isn't an easy task as there are not many guidelines or methodologies that can help develop a robust and efficient e-health environment.

Many sources provide their success stories and best practices in developing an e-health environment; nevertheless, a methodology is needed to develop an effective e-health environment taking into account every step needed and all the implications and requirement that need to be accomplished.

4 CAEMP Methodology

As shown in Fig. 1, the CAEMP methodology consists of five stages which are described bellow.

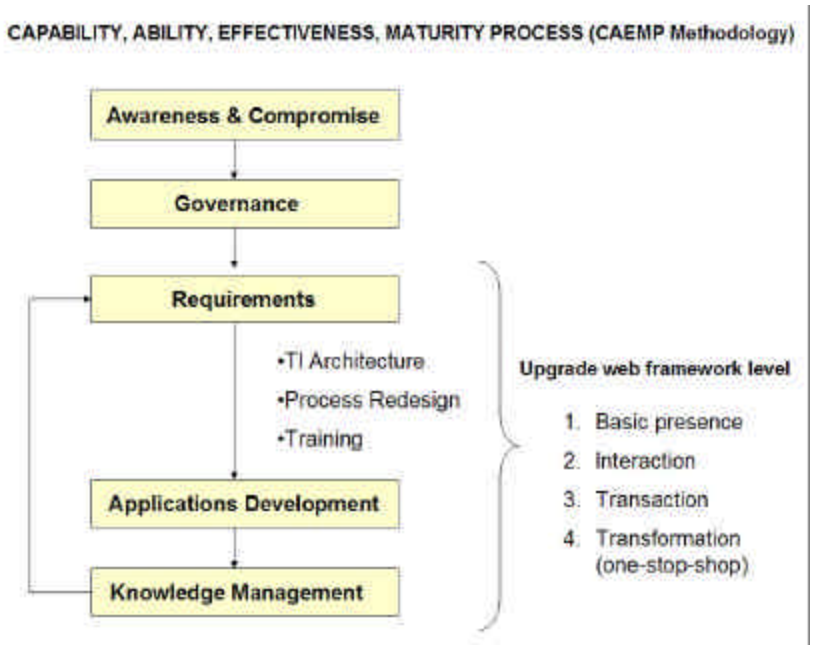

Fig. 1. The processes of the healthcare center must pass through the methodology in order to eventually craft an adequate e-health environment.

The processes already transformed can go back to the requirements stage to achieve another improvement. With this procedure we assure the maturity of the processes and we can eventually upgrade the web framework, from a basic presence, to a one-stop-shop.

4.1 Stage1 – Awareness and Compromise

In this early stage we have knowledge about the benefits of implementing an e-health environment, and there is a compromise to achieve improvement through an organizational change. Some of the implications are:

We need to define the person or persons responsible for developing the strategies and initiatives regarding the e-health environment. In 40% of the health organizations, the CIO or director of IT is the responsible for developing Internet strategies [12]. Other options are using a cross-functional team, that effectively balance IT and business skills, and outsourcing, which can also enhance the skills and diversify the points of view [13].

A business strategy requires the alignment of technologies and standards, new business processes and the adoption of external business models and processes. A successful strategy will provide efficiency, cost controls and improved service and

health quality that are necessary to compete effectively [14]. All subsequent efforts must be aligned with the strategy, which is the vision of the healthcare organization.

Nevertheless, those strategies must take into account the interests and concerns of all stake holders. Since organizational change will take place throughout the entire organization, it is not possible for one single person or group to make them all happen. Change will be effectuated by every area and department within the organization. Therefore, explicit compromises over time scales, investment of resources, priorities and performance measures (and a method for measuring) must be established) must be reached. This is crystallized through different inter-department councils. One council should be integrated with the heads of all mayor areas of the organization, whereas another council must consist of all responsible for IT management. Other councils can be organized, such as human resources but not many more, since a complicated structure will slow down the response time of the organization.

Other considerations that must be taking into account are:

- Focus on the core processes that give the organization a competitive advantage.
- Promote the benefits and use of an e-health portal.
- Know the customer requirements and develop solutions that can be better accepted.
- Be aware of the best practices developed in other countries.
- Develop risk and financial analysis that can help to develop a more appropriate strategy.

4.2 Stage 2 – Governance: The E-Health Management Office

It is necessary to control the transformation towards e-health; therefore, an e-health management office must be established to ensure coordination, integration and to monitor delivery of all e-health initiatives [4]. This office has the responsibility of coordinating the maturity process and to continually reinvent the organization. In essence, is a organizational change management and quality control management office.

As mentioned before, when controlling the transformation towards e-health it is necessary to have relevant indicators. With a proper analysis, these indicators can show if any improvement has been made to a process, and the type of indicator can be very diverse: time for completion, error rate, cost, user satisfaction, etc. This e-health office has the responsibility of measuring and giving relevance to those indicators.

Quality assurance is implied in the governance stage. Therefore it is necessary to have adequate indicators to evaluate the transformation towards ehealth and an effective control over the processes.

The e-health management office must establish the necessary prerequisites in order to succeed. It must calculate the necessary resources and plan the time table for

organizational change and resource investment. It determines roles and responsibilities and must also document the entire process.

In order to be effective, this management office must have the proper authority. Responsibility requires authority. This authority will emanate form the compromises reached in the previous stage sanctioned by the high-level committees that established them. But also, the management office requires a set of incentives that will motivate the participation of low-level actors. Such incentives can be the allocation of resources such as men, equipment, facilities and money. But incentives need not be financially expensive. For example, different types of recognition such as certificates, diplomas, awards and even barbecues inviting high-level management and low-level actors that have completed or even gone beyond initial goals can be effective. Also, transparency, such as the publication of resources allocation, award recipients and reports on e-health advancement by departments, areas and even individual will also motivate people to participate.

In other word, the main challenge of the e-health management office is to create a culture and atmosphere of continuous improvement and health competition within the organization.

4.3 Stage 3 – Requirements

While transforming towards e-health, it is necessary to create new applications and systems working in an appropriate technological architecture. These and other important requirements, such as human resources and process redesign, are described below. Also we will see how the terms capacity, abilities and efficiency fit in the methodology.

4.3.1 Technological Architecture (Capacity)

In simple terms, an Enterprise Architecture (EA) identifies the main components of the organization or a sub-set of it (such as its information systems), and the ways in which these components work together in order to achieve defined business objectives. Appropriate architectures for the enterprise and its information systems can facilitate the changes required to progress the e-Health agenda; lack of attention to enterprise architectures can inhibit change, and inappropriate architectures can become barriers to progress. With the increasing emphasis in the public services on joined-up working and the efficient use of resources, designing the right IT architecture for the enterprise and its information systems is becoming increasingly important.

Although an Enterprise IT Architecture must be created by establishing a return of investment base-line, just like any other business activity, it has also the following advantages [21]:

- Use economy of scales to reduce the cost of execution.

- Provide effective, efficient and timely support for business processes - including achieving fast time to market or operation for new business endeavors.
- Facilitate interoperability between separately developed application systems - both within and outside the enterprise.
- Ensure suitable flexibility of the ICT infrastructure to accommodate unforeseen new or changed business requirements, organizational change, changing market conditions (including new channels to market), etc.
- Facilitate (or at least not unduly constrain) necessary business process reengineering.
- Ensure maximum longevity/reuse of infrastructural components (and hence maximum ROI)
- Reduce the need for radical change in terms of ICT infrastructure, services, applications, management, etc.
- Maximize opportunities for exploitation of corporate information assets (such as for customer relationship management or improved decision-making).
- Ensure the survivability of information/data and other assets and dependence on certain technologies or service provider.
- Ensure suitable support to users, whether internal or customers, including appropriate availability and ease of use.

Two major technology barriers to health plan automation are current applications and lack of standards [14]. Although health plans have been slow to adopt standards, they are increasingly recognizing that standards are necessary to achieve dramatic reductions in the time required to create and maintain electronic collaboration [15]. Health insurance portability and accountability act (HIPPA) standards, internet technologies, next-generation applications designs (exploiting service-oriented architectures and XML) and integration standards are creating the technology platform for a more automated health plan [14].

As shown in Fig. 2, an EA has several components: applications, data dictionaries, information structure and hierarchies, communication channels, protocols, technologies, etc.

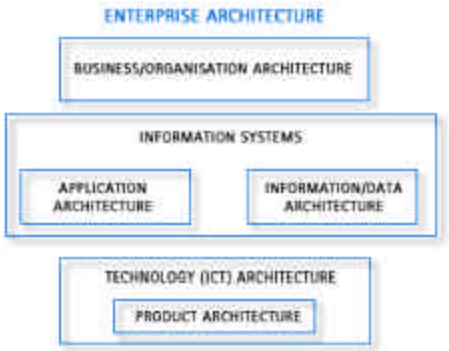

Fig. 2. Enterprise Architecture components

Due to the enormous quantity of information that can be generated, the data management must relay on modern data storage systems that are able to handle uo to terabytes of information, which is most of the time confidential, with security, flexibility, scalability, availability and reliability. Security as a concern stands out because data managed in an e-health environment is very sensible: patient information, prescriptions, financial data, etc. There must be an adequate security plan covering the physical, the administrative and the technical issues that can be involved.

The computing infrastructure must be robust, proficient, and must be connected with a proper broadband access technology (ADSL, Coaxial cable, satellite or optic fiber, depending on the requirements and the budget of the healthcare center). Open source technology and products, if correctly integrated into de EA, can help reduce costs associated with technology absorption and can reduce dependability on solution providers.

4.3.2 Process Reengineering (Efficiency)

In order to improve the processes of the healthcare center, the organization must be reinvented; breaking rules, myths, paradigms and using ICT will lead us to a fully integrated and automated e-health environment. But specifically, administrative and operative processes must be redesigned in order to make them susceptible to integration and automation. It is in fact in this area that an e-health program can show that it is much more than just technology modernization. That it is about improvement, efficiency and efficacy. In short, that it is about reform.

Some considerations that need to be taken into account when reinventing the organization are: eliminate bureaucracy, eliminate duplicity, reduce times, test for errors, more efficient use of the resources, standardization, alliance with providers and clients. Using these advices we can have a more efficient, effective and adaptive organization.

But achieving such organizational change is not easy. Thus several methodologies have been used that specifically address the issue such as ISO-9000, ITIL, COBIT, CMM and others [16]. But the most widely used for health related projects seems to be Six-Sigma [17][18, pp. 3].

4.3.3 Training (Abilities)

Many current employees of healthcare organizations will disagree on this reengineering; this internal rejection is an obvious step in a transformation process because of fear of change.

It is necessary to establish a training plan to inform the benefits of an e-health environment. The potential users of the e-health environment will learn to use the tools and interfaces required and after a learning curve they will perform their activities in a more simplifying way.

There must be a training plan developed for every different user group of the organization and always looking toward the adoption of professional certifications. With this incentive, users can participate more actively in the training procedures knowing that they will acquire a competitive advantage and can perform a better job.

This training program can absorb a large percentage of the planned resources and time schedule. Therefore, especially if a large body of participants must be trained, e-learning technology can be used in order to make the training program more effective and efficient. Since the production of training programs, digital contents, learning activities, evaluation procedures and the acquisition of new technology related to e-learning can incur in heavy costs, this will be again a decision based on calculating gains against costs, or ROI.

4.4 Stage 4 – Applications Development

Web functions are becoming an important strategy when deploying an e-health environment, and in most cases, XML programming it used in the design of this service oriented architecture.

After 2004, 90 percent of healthcare centers (in the United States) will have executed at least one Web-based service intended to improve revenue cycle management, extend customer service and marketing functions, or reduce operating costs [19].

Administrative applications help automate many inefficient processes. Tools like ERP (Enterprise resource planning) and CRM (Customer relationship management) are expected to be the new trends in Information Technologies used in healthcare organizations [10]. According to industry analysts, almost two-thirds of customer relationship management projects fail. Another report estimates that between 60 and 90 percent of enterprise resource planning implementations don't achieve their goals [13], therefore, an adequate implanting plan is needed in order to achieve success when using these administrative tools.

CMC applications (Computer Mediated Communication) are important tools in an e-health environment. There is a wide diversity in applications used for collaborative work, like e-mail, chat, discussion forums, and more recently, videoconferences.

Some organizations use proprietary applications developed inside the organization and others use outsourcing for these matters, but what is the best option? Davis [12] assures that the best option is to look for a combined philosophy, achieving the integration of proprietary software and commercial software (or open source software).

4.5 Stage 5 – Knowledge Management

As organizations are continuously evolving, there is a significant shift of importance from information-based systems, mainly dedicated to the management of operational data, towards new systems that are based on more aggregated information and knowledge necessary for monitoring and controlling business processes and for strategic decision making [20].

In this last stage, the new processes can be easily controlled and the information used is the more relevant in order to make decisions and define the best strategies.

The processes that were redesigned are now totally integrated with the legacy processes that were already in use. If this integration can be accomplished and improvements in process performance are perceived, then the methodology has been successfully accomplished. Otherwise we need to go back to stage 3 in order to redesign the process and try to achieve a better performance and maturity.

The most important task of the knowledge management phase, is to insure that every organizational process, including organizational change and invention, is a deterministic event. That is to say, that every time that a process is initiated it does not behave as it was the first time it has been executed. That all enterprise processes are people independent, meaning that the knowledge stored in the minds of its most experienced workers is appropriately integrated into the organization.

5 Levels of E-health

Davis [12] describes the strategic web framework in which e-heath developers are evolving. The levels involved are:

- Level 1, **Basic presence** – Creating a web portal with information about the organization and services provided.
- Level 2, **Interaction** – User personalization is provided and basic health assessments can be performed. Now we have dynamic content information.
- Level 3, **Transaction** – Use of advance tools like XML to develop active web services and implement an e-health environment with customer self-service. Allow the storage of previous sessions information, the flow of information between the organizations departments.
- Level 4, **Transformation and Integration** – In the final level, customers and business processes are integrated; this level is also called one-stop-shop, an environment that provides a range of access mechanisms and channels that meet the requirements of users when, where and how they want it [20]. Whereas in the previous level there is flow of information between departments, it is done in a patchwork way, relying in just a few processes and items of information. In this level, the flow of information is done through organization-wide information flow standards and all processes are automated.

Getting to the top levels of the framework will require a significant commitment of capital and effort, change in organizational culture and attitudes, and a better understanding of the needs and desires of the target audience [2].

According to the time tables suggested by Davis, health organizations must be in the transformation or transaction level, nevertheless the majority of the organizations that have initiated the process only reach level 1, and some pioneers in the use of advanced ICT are in level 2.

6 Other Methodologies

During the research for this paper, we found a couple or methodologies that seek similar goals:

6.1 "La Gestión por Procesos" (Management Using Processes).

2002 Toledo, Spain.
http://www.chospab.es/calidad/archivos/Documentos/Gestiondeprocesos.pdf

This model is about the organizational change that is needed in a health center to move towards a work philosophy focused on process management.

There are a variety of issues involved and the author assures resource usage optimization and an improvement in the quality of the services provided.

In this model we can see a strong focus on users and clients. There is compatibility with other models, like ISO, and the author provides a variety of well know methodologies that can be used in all stages of his model.

6.2 Getting to e-Health: The Opportunities for Using IT in the Health Care Industry.

ITAA (Information Technology Association of America).
http://www.itaa.org/isec/ehealth/ehealthfinal.pdf

This is a model focused on the use of ICT to achieve benefits in the performance of health organizations, and provides very interesting statistical facts.

A lot of implications are defined, like the creation of comities, limitations, security, regulations, etc. and offers a detailed study of the health industry in the US.

The author provides a series of solutions that can help to solve diverse problems that arise in an e-health environment and shows ten real stories of best practices in different health organizations in the US. Also offers an extensive directory of key players that support all e-health efforts, creating an organization network in this area.

7 SWOT Analysis

After reviewing similar methodologies we can define a SWOT analysis to the CAEMP methodology in order to start the validation process.

SWOT stands for: strengths, weakness, opportunities and threats, and though it's a very subjective analysis it can provide a general view of the internal and external environment in which the CAEMP methodology can participate.

7.1 External Factors

7.1.1 External Threats

- E-health is a very complex environment that is constantly changing.
- Constant changes in the arena in which e-health is evolving.
- Similar models or methodologies have been implemented with success.
- Strong investment is required (time, money, training, technology, etc.) in order to implement a methodology that requires big changes in the organization.

7.1.2 External Opportunities

- There are many efforts related to e-health all over the world.
- Notwithstanding the availability of other methodologies, not all e-health projects have been successful, this signaling the need for further methodology improvement.
- Countries are aware of the importance of investing in ICT.
- New participants in the e-health sector can adopt the CAEMP methodology for their organizational change since it is holistic and not technology or process centered.

7.2 Internal Factors

7.2.1 Internal Weakness

- Other models offer more specific solutions and suggest the use of other models that can complement them.
- CAEMP lacks of statistics on the current status of the health industry that can help justify the use of this methodology.

7.2.2 Internal Strengths

- CAEMP talks about many diverse topics without loosing focus.
- Users of the methodology can have a more wide vision of all the implications of building an e-health environment.
- It is evolving, progressively addressing more specifics as it is being adopted.
- It originated in other e-society projects, such as e-learning, where it has been successfully applied. Thus it has collected a fair amount of best practices and experiences that can be easily adapted to the health industry [22].

8 Conclusions

The CAEMP methodology is a tool that can help in the process of designing and implementing an e-health environment. CAEMP is based on the use of ICT and a holistic approach to organizational change. It differs from other methodologies in that it balances the three main supports of modern ICT projects: technology, human resources and enterprise business processes. It also establishes the advantages of knowledge management, of a quality control office and of constructing the necessary scaffolding for success, such as high and low level committees, incentives and compromises with all stake holders.

The CAEMP methodology talks about a wide variety of topics that can be involved in the design and implementation on an e-health environment, and is supported with the information of previous and related research and applications in other fields of the information society.

Even though CAEMP is focused on the health sector, it can be a generic tool that can help other industries to achieve more efficient processes with the support of ICT.

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