Abstract: We are familiar with the term Web Engineering, but not quit so with Web Architecting. The activities of Web Architecting precede all other activities in a project. Working trend and working habit are tending toward more mobility. Small and light weight computing devices will out sale stationary units by the year 2013. We-based application and Web-based services are used to deploy ‘Software as a Service’ of Cloud Computing. The Web is becoming more important than ever.

Key–Words: Mobility, ICT architecture, Web technologies, Web architecting, Project planning, Managerial and Technological Competency curve

1 Introduction

The process, so called, architecting the web has never been as important as it is now. There is a prominent shift in development efforts forming desktop software applications toward Web-based applications all across ICT (Information Communication Technology) industries ranging from big enterprises to governments and educational sectors. The main reason behind this shift is mobility of workforces and dispersion of applications users across geographical locations and time zones.

The Web, form the time of its inception 30 years ago (1980) [6], has been based upon the principles of open, distributive control and responsibility, collaborative freedom and mobility. It is no surprise that the Web is a success since the principles underlining its design, development and deployment are all inherently basic humanitarian principles.

The trend in the consumer personal computing units sale shows a clear tendency toward mobility. Mobile units sale is overtaking the stationary units. The Web is providing, supporting and encouraging work habits and nonetheless play at anytime and at anyplace. This is what the consumers want and what the technology provides. Mobile units are becoming more portable, powerful, useable, accessible and affordable.

In the last two decades, any interested party can observe the rapid development in the software for both server and client side of the Web technologies. Diverse development tools and deployment platforms and frameworks on the server side, complimented by and many powerful Web browsers on the client side are supporting the Web businesses of today. Many Web applications are tailor made for mobile units for greater spreading and business present to todays mobile users.

Seemingly, different choices and combinations can be easily made in order to deploy a Web site for specific services or businesses. It is easier initially to get trapped into a bad choice giving a sub-optimal solution then to make a good choice from the very beginning, since the choices are not based only on technological but also economical, social and psychological reasoning. More often than not, non-functional constrains dictate the decisions to be made more then the purely functional constrains.

There are many more intangible than tangible attributes governing and controlling a working success to a Web application. Some of these intangible attributes can only be measured indirectly after the Web application is set into production. Flexibility and agility in code maintenances to both regarding presentation and process are important to the Web application success and useable lifespan.

Architects in the business of ICT are a breed of individuals newly emerged to fill the gap in the
area of responsibility between managements and engineering, strategic requirements and functional deployment, user expectations and real outage limitations. In other words, the architects make the difficult choices in view of making a future Web system that will satisfy all known and unknown requirements put forward by managers, developers, engineers and users.

Architects are those that must have knowledge in both the vertical and horizontal aspects of a proposed system. Architects need to make plans on unclear and shifting specifications toward some profitable goals from some future deployments within some unknown future environments and usages. While engineers are concerned on the physical and material constrains, architects on the other end of the scale are more concerned on the business and social constrains. However both architects and engineers need to be concerned on the economic and ecological aspects of the ongoing Web projects. Moreover, the system being implemented must conform to the ecosystem of the whole organization and the deployment arena which in our case the World Wide Web.

2 Technological Changes

ICT landscape is changing at a rapid rate. From mainframe computing with the UNIVAC 1107 in the early 1960 to personal computers with the Altair, IBM, Apple and Commodore in the middle and late 1970 [4]. Computing moved from being stand-alone and data-centric to more distributive and network-centric. In the last two decades, starting around the beginning of 1990, the behaviors of computer users are moving from stationary toward mobility.

The large-scale consumers Smartphone sale started at around 1997 by Ericsson GS88. Technological changes drive social changes and social changes in themselves drive technological changes in an ever-tightening feedback loops.

In 2009, 174 millions units of Smartphones were sold worldwide. According to forecast conducted by Forrester Research [2] the sale of tablet PC (Personal Computer) units will overtake mobile PC units sales by 2012, and desktop PC units sale by 2013. Clearly, these provide a strong indication toward more mobility of ICT users in the future.

3 Web Technologies

![Software Tools for Web Developments](image)

Figure 2: Software Tools for Web Developments

The best way to present the Web Technologies used to deploy a Web-based system is to summarize their relationships and dependencies in the technology stack diagram. Each row in Figure 2 shows different type of software technologies with examples of some of the different choices of tools. These technologies are arranged from bottom to top in the following order: 1) Internet routing, 2) Internet naming services, 3) Database servers, 4) Web servers, 5) Web framework, and 6) Programming languages.

The Web-based systems owe their existence to three technological innovations of our modern time; 1) the Internet, 2) the relational database management systems (RDBMS), and 3) the World Wide Web.

The Internet provides an open technological framework in which a computer can communicate with other computers over large distances across organizational and national boundaries spanning the whole globe. A database can provide a persistence data
storage with relational structures for easy information search and retrieval. The Web became popular due to the simplicity in its concept, design and implementation. The Web is modeled on client-server network architecture with stateless request-response mode of communication. The Web is built to provide easy and accessible tools for network programming.

These three technological innovations changed the way computer applications are perceived; 1) from a single user, single machine to multiple users and multiple machines, 2) from a stand alone application to collaborative applications, and 3) from a close private system to an open shared systems.

4 ICT Architecture

Architecturally speaking, ICT architecture is composed of two main branches i.e. 1) hardware and 2) software, which are deployed in concert to provide the modern society with the processing power for both information and communication. Therefore, the field of ICT architecture is necessarily a very wide area of study with many sub-branches emanating from both of the two main branches. The working environments and the responsibilities if ICT architects are often in the gray zones of overlapping areas situated at the borders between business strategy i.e. regulatory and management on one hand and between technology i.e. design and engineering on the other hands.

An ICT-based system regardless of size is a complex combination of both hardware and software components specifically designed and built to meet a set of predefined economic goals bounded by a set of social, legislations, managerial, technological and engineering constrains. Due to this complexity, according to [3] the primary roles of an architect is to solve two problems i.e. 1) intellectual intractability, 2) management intractability, and in addition to these two, we can add another, namely 3) operational intractability.

Intellectual intractability means making the simple sense of the interrelationships of all the components involve, their purposes and dependencies. A proposed system is made intellectually manageable by; 1) using high level abstractions that hide unnecessary technical details, 2) providing unifying and simplifying concepts, 3) logically decomposing the system into sub-system or layers. The proposed system needs to be designed within the constraints of user requirements, organizational structure and technological infrastructure in conformation to state legislations and organizational policies.

Management intractability means making the development process of the system manageable by using a set of management models and tools that provide; 1) efficiency, 2) flexibility, 3) measurable control mechanism, and 4) meeting the target requirements. Managerial complexities in a project management are mainly due to two important but conflicting interests; 1) maximize product goals, and 2) minimize resource used. During development phase the two main resource types are; 1) Financial resources, and 2) Intellectual resources. These necessitate some installment for division of labour and responsibilities with the help of management tools and best practice such as; 1) Prince2 [1], and 2) Scrum [5].

Operational intractability is making logical and realistic predictions on how the system will be used and its operational environments in relation to expected futures changes such as; 1) Technological changes, and 2) Market changes. Major issues concerning operation are; 1) Usability, 2) Adaptability, 3) Continuity, and 4) Sustainability. Questions concerning operation need to be addressed at this early stage since the success of the proposed system depends very much on the readiness of the organization to support its deployment. One main issue that needs to be especially addressed is a system manual regarding both user manual and operational manual. Plans need to be devised in order to support system agility in relation to releases. User support and user education are another issues in need of special attention in order to provide system usability.

5 Web Architecting

We are somewhat familiar with the term Web Engineering, but not so with Web Architecting. The reason could be that the division in responsibilities between engineers and architects are not as clear in ICT as in any traditional building and construction businesses. Software architects are in the business of constructing programs while building and construction architects are concerned with the construction of physical objects.

Traditionally a software house will produce softwares as products to be sold to consumers. Softwares are bought and owned by the users. A new trend computing is emerging mainly due to the demands of mobile users, namely cloud computing, where software are bought as a service also known as SaaS (Soft-
ware as a Service) [7]. In cloud computing all softwares, applications, and data are stored and managed by some service providers reachable through some well known URLs (Uniform Resource Locator) accessible by the users located anywhere in the world at any time of the day and the only necessary condition is connections to the Internet. A SaaS is typically deployed as a combination of Web-based applications and Web-based services.

Web architecture is a subset if Software architecture. Albeit a subset, Web-based systems are as complex as any standalone software system, and in some cases can be more complex as demonstrated by some of the Web-based systems of today. The job of Software architects and Web architects are similar, the different being that Web applications development and deployment works a different and wider field of concern and influence then a piece of standalone program. Obviously, the more influence a system has upon its operating environment, the more the environment influences its inception, operation, lifecycle and lifespan. Another crucial different between a software projects and a Web project is that the goal of software project is a software product while a Web project aims at providing a Web service.

In field of Web architecture, the Web architects ask the horizontal what and why questions, while the Web engineers ask the vertical where and how questions. A Web architect is more a role than a specific person. Taken as a role, a Web architect is a group of people with the necessary expertise and competency for a specific Web project as shown in Figure 3. The group memberships are not necessarily static. Group members can change as the work progresses from requirements planning to deployment staging.

The graph of Figure 4 shows a competency curve related to a project work in relation to activities network shown in Figure 3. The inverted S-curve gives some indication of competence levels where we have; 1) managerial (Y-axis), and 2) technological (X-axis) at different stages; 1) Initial Requirements Study, 2) Requirements Planning, and 3) Development & Deployment, within a project and with different type of activities; 1) Web architecting, 2) Web designing, 3) Web engineering, and 4) Web deploying.

This model captures the essential relationships between competency level requirement of different roles; 1) architects, 2) designer, and 3) engineers at different stages of the project, as well as the shape of the competency curve for this particular project. Three basic observations can be easily seen from Figure 4 namely; 1) managerial competency is decreasing while technological competency is increasing as the project progressing from initial stage to the final stage, 2) the architect group starts their work at early stage of Initial Requirements Study and ends their work at the later stage of Requirements Planning, and 3) there is a significant drop of managerial involvement some where at the later stage of Requirements Planning.

The model shown in Figure 4 is simplistic and intuitive. Typically, at a project start, more managerial competent persons are needed while managerial expertise are no longer important at the later stage and at this period the group members are predominately technological experts.

The model divides the project lifespan into three equally spaced periods, while this makes the model easy to understand but by no mean necessary. One can have more than three stages and they need not be
equally spaced. The same goes with the shape of the competency curve. Different stages and shape curves are possible to describe different scenarios. Actual competency curve models can be drawn from actual memberships data from earlier projects.

In our professional view, Web architecting should be done by a group of people. Group memberships are not static but changing in relation to the nature and stages of a project. A single person cannot have all the necessary competency to cover all knowledge requirements. It is a false assumption that a person with a work title of an architect can solve the problems posed by Web architecting singlehandedly. In our experience, Web architecting is best done by group of people. In any case, a person hired as an architect must have enough basic competency that spans the entire spectrum of knowledge of an enterprise from business to technical.

The work of Web architecting is to produce reports that communicate top-down requirements from business managers point of view and to communicate bottom-up technical constraints from designers and developer to the upper management. Web architecting is the bridge that closes the knowledge gap between two important groups of an organization.

6 Conclusions

Working habits of information-based workers are changing. The current and most probably the future trend is mobility. Touch screen internet tablets and smartphone would be the future tools of choice. These small and light devices will have theirs programs, application and data store elsewhere in the Internet clouds.

In this respect, the Web plays a major role in providing mobiles user with critical business data, applications and services. In fact, the Web makes it possible for the internet workers to be free from specific geographical locations and timezones.

Web architect has the important responsibility of ensuring success of a Web project by; 1) translating vague high level requirements into concrete implementable actions, 2) making effective resource planning within the constraints of financial and intellectual capitals, and 3) making reasonable deployment planning that will satisfy the service-level requirements.

Service-level requirements are difficult to quantify during the project planning phase, the Web architect can only plan from a guiding intangible values and attributes of; 1) usability, 2) performance, 3) scalability, 4) reliability, 5) availability, 6) extensibility, 7) maintainability, 8) manageability, and 9) trustworthiness and security. In the planning stage, these attributes can only be used as guide lines for drawing up the operational constraints and goals required. They can only be quantified after the system is deployed and some direct or indirect measurements pertinent to these attributes are taken during real deployment. To meet the requirements, the production system needs to be changed and tuned. If this is not possible, service-level requirements need to be readjusted to conform to the operational environment.

In addition to these service-level requirements, the Web architect must first and foremost satisfy business and organizational requirements. The reasons for existence of any Web system are to support organizational needs. In order to do this a shift in focus has to be done in which Web architecting activities in any new project works are given more effort, attention and seriousness.

References: