**ABSTRACT**

E-Learning is one of most interesting topics in recent years. E-Learning system is not an ordinary system because it requires the integration of many technologies to be adaptive and effective more than other systems do. While superficially e-Learning refers to the usage of Information and Communication Technologies (ICT) in the learning process, e-Learning still means much deeper than ICT in the learning process. E-Learning can not be achieved unless University Management Information Systems (UMIS) and Learning Management Systems (LMS) work together. UMIS includes: Faculty Information System, Student Affairs Management System or Student Information System (SIS), and Library Information System (LIS). LMS includes: Course Management System (CMS), Assessment Management System (AMS), and Digital Library.

Software integration has been widely known as a challenge for system architects. Software architecture is a key factor for system success. Choosing the software architecture to implement is affected mainly by the functional and nonfunctional system requirements. System integration is one of the main nonfunctional requirements that should be fulfilled in e-Learning. Though different software architectures can satisfy functional system requirements, nonfunctional system requirements remained a complex goal to achieve. Service Oriented Architecture (SOA) claimed to satisfy complex and sophisticated systems functional and nonfunctional requirements, especially via adopting Web services as the main SOA enabler. Though software agents can be used as SOA enablers, shortages have arose to prevent so. Mobile News Agent System (MNAS) is a mobile information agent based system proves that mobile information agent technology can not just be used in all information retrieval systems, because under some conditions, it might loose some of its advantages.

This thesis presents a Services based Architecture that applies to UMIS and LMS components and consists mainly of two layers: Interface layer, and Services layer. Interface layer interacts with system users via human interface; that is portals, and with external organization services via machine interface; that is Web services. Services layer contains core system services and has three sub layers: Orchestration, Application Services, and Agents layer. Orchestration layer holds business logic presented by system processes as executable services. Business logic refers to different activities that can include Web services invocations, data manipulation, exception handling, and process termination. Application Services layer contains set of stateless Web services that are capable of performing certain tasks related to system entities.

This thesis highlights an evaluation framework that can be used to evaluate LMSs. Thesis evaluated the extent to which proposed SOA based architecture achieved in satisfying e-Learning functional and non-functional requirements. LMS Evaluation can include three different aspects: information system quality, pedagogical, and managerial characteristics.

Pedagogically, Thesis shows that the proposed SOA based architecture has helped e-Learning to achieve more than one goal. One of the critical limitations of a newly established educational institution is the lack of available well prepared courses. It is more applicable to use widely available courses that might be higher in quality than preparing new courses. Current LMS do not exploit courses shareability. This thesis proposed SOA based CMS as one of LMS components that addressed this shortage, automated discovering and importing of courses maintained and managed by external CMSs. Proposed CMS facilitates integration between different CMSs in order to share resources of educational institutions.

Mobile assessment is one of the M-Learning activities facilitated by proposed SOA based AMS. Mobile assessment refers to the capability of conducting assessments via mobile devices. Mobile assessment relies on external services that are not part of the AMS. Integrating different external systems and services to be virtually part of the educational institution AMS is one of integration challenges that was solved by the proposed SOA based AMS in this thesis.

The capability to integrate the different digital library contents and make it available to different LMS components is a clear example of the proposed SOA based LMS capabilities to integrate different and standalone system components and make them available to each other. Proposed SOA based LMS in this thesis facilitated integration between software agents that play an important role in educational institutions and Web services. Also, integrating legacy systems and newly added systems is facilitated by the architecture presented in this thesis.

Future work includes addressing more and widely system processes that rely on the presented SOA based LMS and the implemented Web services to address agility in education institutions. Business Process Management Systems that rely on proposed SOA based LMS and UMIS is the next step to take.