UML Analysis for a Virtual University: A Proposed Model for Saudi Arabia Vuksa

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ABSTRACT
The state of higher education systems worldwide has often been described as being in crisis. A number of change factors impinge on systems such as globalization and revolution of technology connectivity through the Internet, which results in a globalization of information and easy access in anywhere. Virtual Universities exist without temporal/geographical constraints. This paper investigates whether the virtual university would be viable in Saudi Arabia and how to apply frameworks of existing VUs there. Considering the differences and similarities between traditional universities, e-learning and VUs, the study traces notable VU origins in the UK and Europe. The tools, forums and methods in use in these VUs include the Blackboard, Discussion board, online classrooms. Based on a survey of twenty UK institutions of higher education this paper presents a critical discussion what is the proposed model suitable for virtual university in KSA. From the survey of specifically selected higher education institutions in last three months of 2013 it was established that all higher education institutions from conventional lecture theatre approaches are utilising virtual learning environments and are moving towards third generation virtual education. The most popular VLE are Blackboard and Moodle. The main purpose from this paper is to explain our VUKSA components. This view will be illustrated by using the UML language diagrams as use-case diagram, data flow diagram, flowchart, and activity diagram. Virtual university, if properly implemented, would be adequate to support higher education in KSA.

Keywords: Virtual University in Saudi Arabia, VUKSA, UML, Higher education

1. INTRODUCTION
Today, we live in an age of technology; new technology appears all the time. As a result of all the new technological wonders, the world has become one village and people see and talk to each other without curtains because of the advantages these wonders have brought. They have become a powerful influence in shaping our lives. We have come to depend on them for information and entertainment. None is more useful than the Internet for almost instantly providing information about events around the world. Internet technology has become a powerful tool since its advent. The social and functional role of such technology is continually growing and its influence is easily felt in all walks of life. Distance learning is speedily gaining popularity in people’s pursuit of knowledge acquisition. “In 2004, it was estimated that the number of people participating in adult education programmes would rise to 100 million within the next decade” (Schmitt 2004:14, Distance Learning and Universities). Distance learning is a model that allows students to access information without the confines of a classroom. The learner can attend the University of his or her choice and receive the same quality education and attention that the classroom offers. The term distance learning has now extended to include the Virtual University. Virtual Universities are a by-product of Internet usage and are instrumental in higher education today. They reduce the use of many facilities in traditional universities and are one of the outcomes and consequences of a new technology revolution. Virtual university prototype is complex. We use UML as a tool for modelling the virtual university prototype to manage complexity. Constructing a model allows the designer to focus on how the components of system interact. The role of UML is to visualize, specify, construct, and document the artefacts of a software intensive system. We can easily conceptualize components system by identifying domain concepts and relations and generate concept map, Which are includes a set of graphic notation techniques to create visual models of object-oriented software-intensive systems and it’s very important part of developing object-oriented software and the software development process that have proven successful in the modelling of large and complex systems. The UML is a standard that has wide acceptance. In addition, its ability to describe elements and the relations between them makes it potentially applicable much more broadly. This paper describes our experience using UML to describe the software architecture of a system. Therefore, the UML become now generally accepted as the standard methodology and modelling language for developing Object-Oriented Systems

2. AIMS OF THE STUDY
The aims of the study are:
- To define the concept of virtual university;
- To Implement prototype using the UML language diagrams
- Finally, and most pertinently, to help further develop Virtual University systems instead of the traditional educational system and identify the main components of the proposed virtual university model.

3. DEFINITION OF A VIRTUAL UNIVERSITY
The Virtual University is a term used to describe courses flexibly designed to meet individual requirements without lecture halls, classrooms, labs or a campus run by a management office. Ryan et al. (2000:3) describe a virtual university as:
(a) “an institution which is involved as a direct provider of learning opportunities to students and uses information and communication technologies to deliver its programmes and courses and provide tuition support; and (b) An organisation that has been created through alliances/partnerships to facilitate teaching and learning to occur without itself being involved as a direct provider of instructions”.

290
Cornford and Pollack (2003) state that "the online or virtual university has emerged as a potent vision for the future of higher education, utilising new information and communication technologies (ICTs) to radically restructure higher educational provision and to re-equip the university for its new environment. What is generally envisaged in this scenario is a university without walls, a virtual institution consisting of little more than global connections of potential students (recruitment), learners and teachers (students and staff), employers (the careers' function), and alumni, in terms of teaching and learning, and researchers, and research users, in terms of the institution's research mission, all held together by ICT applications."

Tiffin and Rajasingham (2003) hold that there is a paradigmatic structure for all Universities, just as there is for any society or community. In many respects then, drawing on Tiffin and Rajasingham (2003:17) "a university is a learning society or community of practice with research-oriented goals. If the university is a spatio-temporal field where people, study the application of knowledge to problems at an advanced level, (and) what constitutes the society, knowledge and problems and who are the teachers, students and researchers and how the quest for knowledge is pursued depend upon the episteme within which the university exists", then the virtual university is no different in terms of goals and practices but only in the management and structure in which the process takes place.

4. CONCEPT OF VIRTUAL UNIVERSITY
The concept of virtual university, now so ubiquitous, is in fact only around eight years old in its current usage. By the phrase virtual university, we (and most people) mean a university which carries out much of its teaching, perhaps all of it, at a distance from the learner. Distance learning as a concept has very early origins. It started at a higher education university level when the University of Queensland, Australia, began to extend degree courses through distance learning options to its students. (Harry and Magnus 1993). But the very first of its kind at any level in Europe, introducing course material and teaching input through correspondence was, in fact, in England in the mid-19th century. Early methods of distance learning naturally used the postal system in their countries to make available higher education to those students who were unable to or unwilling for some reason to attend conventional classroom-type teaching courses. (Rowntree, 1992:8) indicates that, "The basic idea- in the form of correspondence education had been around for some time. Isaac Pitman started to teach shorthand by post in 1840 and in 1856, language teaching by correspondence started in Germany. During the second half of the 19th century, correspondence education became well-established in the USA and Europe". The introduction of Educational Radio in the 1920s and the advent of television in the 1940s created important new forms of communication for use in distance learning.

In the 1980s and 90s teleconferencing entred the scene. Computer conferencing greatly bolstered distance learning because with the communication network it afforded, large numbers of people gained access to educational facilities. Greater reliability and advancement in telephony in the early 20th century increased the potential and availability of distance learning options and the efficacy of such methods also improved. The demand for information and education expanded and spilled out of the four walls of conventional universities. But telephone systems were not yet popular. It was only with the advent of teleconferencing technologies which made it possible for teachers to talk with, hear as well as see their students in real time – and, with no delays in transmissions, regardless of location, that telephony in distance learning came to stay.

After the 1980s and teleconferencing, computer conferencing finally joined the fray and then enhanced distance learning ventures and courses. With the endless communication possibilities such networking offered, larger numbers of people had potential access to these facilities. Today, most institutions around the world currently offer distance learning content (Mann and Robinson, 1987).

The Internet was the result of some visionary thinking by people in the early 1960s. The possibilities that allowing computers to share information opened up in research and development in scientific and military fields were very exciting and also heretofore relatively uncharted territory. Most historians agree that the Internet originated in the United States of America (Ackermann and Ernest 1999) when the Advanced Research Projects Agency (ARPA) started a network called ARPANET in 1969. The Internet was derived from military-based research to produce a professional and social and communication network that would not break down, even in difficult conditions such as total isolation or emergency situations. The idea was that all computers or 'terminals' on the particular network would share total information and therefore also the responsibility for ensuring effective vital communication. This is evidenced in that, based on the same model, no single computer on the Internet is more important nor assumes a controlling or moderator position. During the 1970s and 1980s, other institutions began using this Internet protocol to connect their networks, and the attempts continued to expand globally.

Al-Harthi (2005) categorises the evolution of distance education in the Arab or Middle-Eastern world into three ‘generations’. The generations are interlinked with the history of the information revolution. The first generation used correspondence studies, such as the kind explained above, with postal systems and teaching input from a distance; the second was “a total system approach” (2005:4), involving an entire academic body operating on the distance learning principles, such as open universities; and the third generation in its pre-natal but distinct stages in the Arab world is through electronic media, even in “traditional universities which until now mainly use such technologies to supplement face-to-face courses” (Al-Harthi,2005:4). Some interesting points are noted in this categorisation. In the second generation, the broadcasting media were used popularly. In the third, distance learning is used as a substitute for face-to-face interaction and is actually now preferred in some areas in light of its own contribution. Distance learning has therefore come a long way. Helen Jonstone (1995) refers in her article to “the GNA's "Virtual School of Natural Science" when appeared in 1994 as co-sponsor of a business course. It put courses online on its website; registration for courses was by email, and course materials were provided on a series of Web pages, with "hypertext" links from those pages to other relevant resources on the Net. Discussion of courses took place by identifying problems and keeping in touch with other students and lecturers using the chatting system which was called (BioMOO)."
In 1995, the first virtual university with a full learning community and a pioneer in Web-based education appeared in California, USA under the name, quite simply, of Virtual University (http://www.vu.org). In 1999, The Wall Street Journal announced that Harcourt General was going to join the bandwagon and start an Internet University. It would be “the first major publishing house to offer accredited college degrees, pending approval from the ’New England Association of Schools and Colleges” (Schmitt 2000: 12).

In 2001, on the 18th of January to be precise, another national VU venture commenced. In Finland, a virtual university was set up using the latest technologically advanced infrastructure. Not much later, the Australian Opposition leader announced the intention of setting up the University of Australia Online (UAO). The idea of a virtual learning environment to the extent of an entirely self-standing university was catching fire. The University of Australia Online was a separate entity, much like the open universities in the UK and other parts of Europe, while the Finnish University was a network of all existing Finnish Universities combined into an online presence (Tuovinen, 2001).

In his article (The Distributed Virtual University), Naslund (2000:1) “discussed the quality provided by a distributed university and contended that European institutions of higher education (particularly in continental Europe) were clearly lagging behind their US and Australian counterparts with regard to ICT supported open and distance learning, especially when it came to collaboration between institutions”. The aspect of collaboration between universities is one of the most important functions of a virtual university. It combines the resources and intellectual skills between all the sharing universities into a pool in the same style as pioneered by MIT and Cambridge in 1999. But Naslund (2000) was quick to also point out that all European Universities were rapidly building up their ICT facilities and introducing distance learning options. However, the virtual university systems and virtual campuses were taking longer to come about. Today, there are a few virtual university co-operative initiatives in Europe, most of these within the same nation or political region, and commissioned by the government. Examples of such initiatives are The Virtuelle Hochschule Bayern, the Open University in Finland, and the very new e-University initiative in the UK. Naslund’s (2000) article’s focus, as the title suggests, is the distributed e-University across region and political or geographical boundaries. The EUNITE initiative is described in length and the seven participating universities, at the time of writing, were universities in Aalborg (Denmark), Granada (Spain), Leuven (Belgium), Lund (Sweden) and Twente (The Netherlands), as well as Helsinki University of Technology (Finland), and the German Fernuniversität Hagen.

There are several obvious advantages to this distributed system, the first being the sharing of resources as already pointed out. However, increased internationalism and cross-cultural communication also enhances the discipline of any specific field of study that the student undertakes. Even without travel, which many students may not be able to afford financially or otherwise, the possibilities of exchange study are open to participants. Such distributed university systems also expand options for student’s already on open and distance learning courses, as there is now a bank of all courses and programmes available to students through these different universities. Their combination therefore makes the distributed virtual university well able to stand on its own. Secondary, there is the added advantage of continuing professionals able to access the courses with accreditation with the support of employers.

5. RESEARCH METHOD
The research methods employed to collect, analyse and present research data. The research used published works thus textbooks, journals and websites because published work would have been professionally reviewed and therefore provide more accurate information. Questionnaire was used to collect data on the structures currently being used to support virtual learning environments, benefits and challenges of virtualising higher education. The questionnaire results have presented perspective real benefits and challenges of virtual learning environments from organisation actually using different blackboard and module. From the questionnaire came suggestions which are built into the proposed model.

5.1 Questionnaire Results
This researcher collected data by means of a questionnaire from twenty higher learning institutions that are providing close to virtual education in the form of e-learning. The questionnaire was administered once to a group of institution randomly selected.

![Sample Composition](image)

Figure 1 Sample Composition
The sample size of twenty as shown on the diagram above consisted of ten universities of which one is in America and Africa, three in Kingdom of Saudi Arabia and five in United Kingdom, six colleges of further education and four private post compulsory education colleges all in UK. The responses received at close of the survey consisted of seven universities, translating to 70% success rate, five colleges of further education translating to 83% and all four private post compulsory education colleges. Therefore the overall success rate is 80% as shown on the diagram below. The questionnaire comprised of nine questions forming three themes; types of VLE, devices which could be connected to a network and system functionality. The results from 16% valid responses indicated that different types of VLE are being used and the responses are; Model 31% and Blackboard 69% which translate to the diagram shown below.

On the aspect of how long it takes for a prospective new system user to learn the system, all responses indicated that it takes less than one week, which in this researcher’s opinion is a reasonable time. Then on the aspect of functionality and benefits the responses are as presented and the most universities used virtual Blackboard is one of the best methods used in many universities for e-learning. The blackboard offers a communication tool which enables both students and lecturers to communicate easily using this tool; the lecturer begins uploading his lecture notes after logging onto the system using his unique user name and password. Also the modules sections will provide students with notes, and assignments on the subjects which are studying. The lecturers will be able to post messages and announcements on the Blackboard to their students. The interactive Blackboard is also very similar to a real board used in the classroom but online. So that the lecturer can draw and write whatever he would like to explain on this screen using the keyboard, mouse or e-pen and from the other side all of this information will appear for other students whom attend this lecture. The lecturer can use voice also to explain the lesson beside this Blackboard. However, also from analysing collected data the most universities are used the online classroom and libraries to introduce online classrooms for science and advanced technology subjects. The difference here is that the students as well as the lecturer have an online presence and the students as a community are valid online. Apart from the questions allowed by Blackboard/Whiteboard facilities, the online classroom facilitates group discussions and allows student-student interaction as well as student-lecturer. The lecturer can also be specific to students. A classroom however must be scheduled to run at a scheduled time so that all students in whichever part of the world they normally reside would be required to attend it together.

6. VIRTUAL UNIVERSITY MODELS

Stein (2000:3) analyses the forces that drive the operation of a virtual university as follows:

A virtual university is an organisation, that is, a public or private institution with the right to certify learning outcomes. The operation of an organisation may reflect beliefs and values of certain perspectives. This does not refer to a theoretical statement, but to a concrete and observable behaviour, from which this perspective might be inferred. In some universities, it seems most important that the actors of the instruction process and students have media in use, which would indicate a technological perspective. In other universities, the most important thing is that the employed methodology leads to significant learning outcomes, which would indicate a pedagogical perspective. A third perspective would be economic, the question if the institution makes a profit or at least does not generate debt. This perspective determines how the operation of the institution is administered and how success is evaluated (2000:3). It appears that all three perspectives should be taken into consideration in the setting up of an ideal virtual university in Saudi Arabia. In general, the VU structure should respect many issues related to the nature of the society where it will operate. In this part we will draw out the elements that make up a prototypical Virtual Level University that could be applied in Saudi Arabia.

6.1 Proposed model of VUKSA

In the proposed model, the Virtual University of Saudi Arabia is an improved version of a third-generation virtual university, which has no physical buildings except small offices housing computers and a very small, highly skilled staff. Supported by the power of internet technology, cloud computing and SOA, this is a model of a real university in the virtual space and offers all its services to its learners in an integrated and entirely paperless way, through the Internet. Its services include online learning materials of different types, specialized virtual centres for the development of educational courses, library and administrative functions, an interactive environment for synchronous and asynchronous communications and online collaboration.

Saudi society is in need of a virtual university and the success of e-learning is quite realistic. As a private university, VUSA will start by granting undergraduate degrees in specific specialties, before broadening its scope. Therefore its initial organizational structure will be simple. However, it will involve the selection of narrow criteria to establish a new private
virtual university of reasonable size and high reputation, which will be convenient and cheap, but of high quality, to encourage lifelong learning. The necessary basic structure of VUSA requires the implementation of structures and procedures appropriate to a university of the relevant size, due to the virtual nature of the university. The setting up of an ideal VU in Saudi Arabia can be divided into three main areas, involving administrators, lecturers and students.

The admin area will have tools and utilities to help VUKSA's employees to carry out their main duties, as in a real-world university, but in this case they will do it online and will deal with students without seeing them. The needs and actions of employees in this virtual environment will differ from one employee to another, depending on their duties, tasks, job descriptions and interactions with students.

The lecturers' area will contain all the tools which academic staff members require to teach courses online and to interact with students using chat, email or interactive boards, to construct and correct online exams, and to put their lecture notes and reading lists on the Web for students to browse. It will also contain a library. Course outlines are commonly published on departmental websites, while libraries have Web interfaces for searching, checking availability and reserving books. Lecturers must also provide meaningful intrinsic feedback on the actions that relate to the nature of the task or goal.

There are now many more opportunities for higher education, and several fellowships and scholarships have come into being. It is also possible to contract lecturers or researchers from various parts of the country who would like to work part-time for a VU for a specified number of hours each week.

The students’ area would be the main virtual space for students enrolled in the University. It would provide an environment or interactive area where they could access their courses, assignments, email, the virtual blackboard tools and facilities, such as Blackboard and Web-Learn, online tutorials and the library, as well as tools to interact with teachers and with student welfare and administration staff. Figure 3 depicts the proposed model.

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**Figure 3: Model of VUSA**

6.2 UML diagrams
Unified Modelling Language (UML) is a standard language for constructing, visualizing, specifying and documenting the artefacts of software systems, including a set of graphic notation techniques to create visual models of object-oriented software-intensive systems. It is a very important part of developing object-oriented software and this software development process has proven successful in the modelling of large and complex systems. UML has been preferred because it is an object-oriented modelling language that defines structural diagrams, which describe the static relationships between components.

6.2.2 Component diagram
The component diagram in Figure 4 shows that the system consists of four top-level components: student's panel, lecturer's panel, administration panel and database.
The database component is responsible for storing and managing user data, where the users are administrators, lecturers and students. It saves and provides data on request by the interface. The interface plays the role of a middleman, but is actually more than this, as it allows the components connected to it to interact with the database. The administrators can access the admin panel to manage the system. The panel helps them to perform administrative tasks including management of users, i.e. students, lecturers and other administrators. The admin panel interacts with the interface for database access and the interface responds to the request or interacts with database components on the server to fulfil administrators’ requests. Lecturers can also interact with the system via the lecturer panel, to add new assignments, upload documents for course materials, review student assignment and submit results. The lecturer panel accesses the database in the same way as the admin panel.

Students interact directly with the student panel, allowing them to perform student-related tasks, such as submitting an assignment, seeing feedback from lecturers on the work done and accessing course materials. The student panel accesses the database in the same way as the other two panels. Students and lecturers can also benefit from the library through a Web service built into the system, which can be also used by other university systems and added to their systems; thus our system will have a service-oriented architecture, as we are adding a WS to it. It will provide books, articles, journals, etc to the library and users will be able to search for anything in the system and view or download the books to their systems. If they want to reserve or borrow a book, they can do so by visiting the library.

6.2.3 Flowcharts

A flowchart is a diagram that represents an algorithm or process, illustrates a solution to a given problem or is used in analysing, designing, documenting or managing a process or program in various fields. Figures 5, 6 and 7 are flowcharts for VUSA administrators, lecturers and students respectively.
In Figure 5, the main tasks of an admin user are seen to cover the management of the system. An admin user can manage the whole website and system by adding, modifying and deleting records and can also assign modules to students and to lecturers. The main tasks of the lecturer illustrated in Figure 6 include the management modules and uploading course material to the website. The students can then download course material. Lecturers can also create assignments and award marks to them. They can chat with other lecturers and students through discussion boards.

Students, as depicted in Figure 7, can view their modules and enrol in them. Within these modules, students can submit assignments and view their marks. They can also use the chat facility to discuss problems with other students and
lecturers. Finally, they can attend and view videos of conferences presented by lecturers within the various modules. In this way, they can learn more about each module.

Students can also chat to other students and lecturers for discussing their problems. Students can attend virtual classroom and view videos of conferences by the lecturers for different modules. In this way they can learn more for the module. The system provides a tool to build educational content in the form of educational components are stored according to standard SCORM and AICC, this tool provides templates for the forms of educational and page through which is put educational content of the lessons supported by multimedia in an easy and simple. The student can search the contents of the decision, and the development of stop signs and comments of the content. The system provides status information to be public and educational content to link educational activities with the decision (discussion forums, tests, and educational links.)

6.2.4 Use case diagrams
Cockburn (2000:1) describes use cases by stating that they ‘capture a contract between the stakeholders of a system about its behaviour’, adding that they describe the system’s behaviour under various conditions as the system responds to a request from a stakeholder. Welling and Thomson (2005) agree with Fowler (2004) in describing the use case as a technique for capturing a system’s functional requirements. Cockburn (2000), Fowler (2004) and Welling and Thomson (2005) agree that there is no one way of writing use cases; different formats work well in different cases. The most important aspect of use case modelling is that users of the system and the tasks they undertake within the system should be identified (Stevens and Pooley, 2000). Fowler (2004:99) adds that ‘use cases work by describing the typical interaction between the users of the system and the system itself, providing a narrative of how a system is used ... a set of scenarios tied by a common user goal’. This subsection thus illustrates the set of scenarios tied by the common goal of running a virtual university in Figures 8, 9, 10 and 11, representing respectively use case diagrams for administrators, lecturers, students and the library.

Fowler (2004) explains that in use cases, users are referred to as actors, each playing a particular role with respect to the system. The actors in VUSA are students, assessors and administrators.
Figure 8 illustrates the two main functionalities of administrators. The first is administration of the full site, involving these functions: manage administrators (add, update, delete), manage lecturers (add, update, delete), manage modules (add, update, delete), manage students (add, update, delete) and assign modules to lecturers/students (add, update, delete). The second functionality is managing user accounts and updating details such as changed passwords.

Figure 9 shows the functionalities of lecturers, limited to management of parts of the site: manage discussion boards, chat with lecturers and students through discussion boards, manage assignments, assign marks to students’ assignments and manage course material. Lecturers can upload course files, presentation slides, etc. and access the library to view or download books and other documents from the library system. Figure 10 shows that students are the main users of the system, who interact with it via many functionalities: they can manage their accounts to update profiles and change
passwords, view the results of assignments they have submitted, view modules, enrol on modules, view, download and read course materials, view assignments, submit assignments after completion, check for plagiarism, attend conferences, view videos of the classes in modules on which they are enrolled, view discussion boards, chat and communicate with other students and lecturers, and access the library to view or download books, journal articles and other documents.

6.2.6 Class diagram
The class diagram of VUSA presented here as Figure 11 was designed and developed following the definition and recommendations of Fowler (2004), who asserts that a class diagram should describe the types of objects in the system and the various kinds of static relationships that exist among them. Fowler (2004:35) adds that it should ‘also show the properties and operations of a class and the constraints that apply to the way the objects are connected.’ UML presents class diagrams in the form of boxes divided into three compartments: the class name in bold, its attributes and its operations. Properties represent structural features of the class which correspond to fields. In addition to specific components of the class, class diagrams also show associations, in the form of a solid line between two classes directed from the source class to the target class. Associations correspond to verbs expressing the relationship between classes. In interpreting class relationships, the name of the property goes at the target end of the association, together with its multiplicity (Fowler, 2004; Stevens and Pooley, 2000).
7. CONCLUSION
Based on the models presented, we believe that the methodology developed and used can be considered a foundation for a proposed model of virtual university in Saudi Arabia. The primary aim of this paper has been to investigate the feasibility and practicality of applying a tested structured plan for virtual universities systems in Saudi Arabia. Therefore, several objectives have been established with the purpose of gaining a thorough understanding of a variety of aspects concerning this issue. Using UML which are helps on explore potential designs, and validate the architectural design of the software and supporting tool for the project and design process through proposed a virtual university model with components that must work in harmony in order to come up with a model that can widen learning opportunities for those who otherwise have no access to or can’t attend conventional universities for whatever reason. In my opinion the best possible solutions is a third generation virtual university, which is a safe and secure web based educational system. It provides online education to all people regardless of their gender, religion, age, geographical position and or time of the day. In addition it’s a very useful environment and a great solution for those students who are unable to continue because of disability or because of the high fees of traditional universities. It is now time for higher education to fully embrace the new technology and establish a new type of education, that is, the virtual university and e-learning.

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