Utilization of e-Learning Tools, Virtual Machines, & Open Source Software to Enhance Graduate Systems Engineering Programs

Maurice Dawson
Darrell Burrell
William Emanuel, Morgan State University

Available at: https://works.bepress.com/maurice_dawson/15/
Utilization of e-Learning Tools, Virtual Machines, & Open Source Software to Enhance Graduate Systems Engineering Programs

Dr. Maurice Eugene Dawson Jr.
School of Engineering
Morgan State University
United States
dr.mauricedawson@yahoo.com

Dr. Darrell Norman Burrell
School of Business
Virginia International University
United States
darrell.burrell@yahoo.com

Mr. William Emanuel
School of Engineering
Morgan State University
United States
emanuel@peopleofcolor1.com

Abstract: This paper is a report on the findings of a study conducted on a graduate systems engineering course at an urban university in a group learning environment. The course, IEGR 501 Introduction to Advanced Systems Engineering, was a sixteen week course which took students with backgrounds in Industrial Engineering, Electrical Engineering, and Mechanical Engineering and prepared them to understand the systems engineering subject matter more. As the future of education becomes more and more virtual it becomes essential that universities take full advantage of the available tools at their disposal. In the book Technology’s Promise: Expert Knowledge on the Transformation of Business and Society written by W. E. Halah mentioned is the shift of societies online. As education is one of these societies it is essential we fully integrate e-learning into engineering curriculum. The purpose of this paper is to present an argument and discussion on the subject concerning the utilization of e-learning tools, Virtual Machines (VMs), and Open Source Software (OSS) to enhance graduate systems engineering program. As discovered in this particular course many of the students did not have a strong background in OSS thus this allowed a portion of the course to be taught using Linux distributions in VMs. This paper shall also highlight specific the entire systems engineering lifecycle and where the injection of these tools have taken place. As systems engineering is an interdisciplinary field of engineering that focuses on how complex projects should be designed and managed over the life cycle of the project it is essential that professor instruct in that manner as well. Due to the recent economic events in the United States (U.S.) and other countries many projects must find ways to reduce cost without reducing scope thus OSS is the solution. As the times continually change the curriculum and tools utilized must change at the same time.


Introduction

This evaluated course, IEGR 501 Introduction to Advanced Systems Engineering, introduces students to a logical approach to design, realizing, operating, managing and disposal of a system. The key principles are taken from the NASA’s Systems Engineering Handbook and the International Council of Systems Engineers Handbook, v3.1. Also this course covers the identification and analysis of business processes and systems. The focus is on current approaches for business management of systems and processes. This course is designed to cover the traditional systems development life cycle (SDLC), although alternative methodologies are also discussed. Focus on the earlier
phases of the SDLC, from information systems planning through the specification of structured system requirements in functional form (i.e., logical system design) and concentrate on the methods, techniques, and tools used to determine information requirements and to document their requirements in a thorough and unambiguous form. Emphasis is placed on best practices that support business processes. At the conclusion of this course, successful students should be able to the following tasks:

1. Define the systems engineer’s role and responsibilities in a typical organization.
2. Ability to explain the phases of the systems development life-cycle (SDLC) and the major deliverables in each
3. Understand key industry SE standards
4. Knowledge of CASE tools including DOORS and CORE
5. Be able to analyze and understand business processes
6. Work in a SE team, from both customer and developer perspectives
7. Understand the relation between the Department of Defense (DoD) and the commercial sector as it relates to systems engineering

Research Objectives

The objective of this research is to identify additional technology that is needed for success in a graduate engineering systems engineering course. This shall be done using a case study based upon course participation from approximately 14 students.

Discussion

As many of the students in the class were disciplined engineers none fully understand the roles and responsibilities of a systems engineer. Furthermore, the breadth of knowledge needed to fully understand the SDLC was not fully understood. In an effort to bridge this education gap and grasp additional technologies Open Source Software (OSS), Second Life, and Virtual Machines (VMs) were utilized. OSS is a term that describes practices in production and development that gives access to an end product’s source code. OSS was selected as these products provide source material, documentation, and the blueprints for design at no cost. This was essential as in many government-run programs the driving cost is software. One of the recent trends is to replace software deemed not cost effective with OSS and secure it using static code analysis.

Figure 1: VMware Centos Operating System

In Figure 1: VMware Centos Operating Systems displayed is a VM with Centos as the Operating System (OS). This is one of the OSSs used to teach the engineering students how to utilize freely available tools to manage the SDLC.
The open source project planner tool allowed the students to understand how to develop project charts, track resources, and manage tasks. This tool allowed for the students to have the ability to manipulate software that provided similar capability to Microsoft Project.

**Second Life**

Second Life (SL) is a virtual world created by Linden Lab. There is an associated free client program known as the viewer which allows the users, known as residents, to interact with other individuals through avatars. Students created avatars which were representative of their personality and how they best felt to interact with other residents. This course allowed students to develop virtual objects with limited knowledge of the Linden Scripting Language. As the Linden Scripting Language has syntax familiar with the C programming language the students were able to jump right into developing scripts. Figure 2: Example Linden Scripting Language is an example of the Linden Scripting Language that would be utilized to have an object interact with an avatar that touches it.

```
default
{
    state_entry()
    {
        llSay(0, "Hello, IEGR 501 Graduate Class!");
    }

    touch_start(integer total_number)
    {
        llSay(0, "Touched.");
        llSay(0, "Touched.");
    }
}
```

The one great advantage that SL provided was the ability to share information such as presentations through viewers. The other great item was that individuals can talk directly to one another or to the entire group. When individuals were unable to be present they could participate in scripting, systems design, and course discussion all through SL. Figure 3: IEGR Second Life Class displays how a typical class session looked.

**Optimizing User Participation in the Systems Engineering Process**
A widely held principle in the field of systems engineering is that the success of a system is directly proportional to the extent of user participation in developing the system. The results of this are that when an end user has a higher level of perceived meaningfulness task this would positively impact subjects’ attitude and performance. The other result is that when the user has a perception of control and procedural justice then the user’s outcome is satisfaction and their performance increases for the subjects as one increase the user’s mode of participation. Perception of user control with procedural justice yields an outcome that increases the performance of a project as the user is given more opportunity to voice their opinion. It is interesting when the users are given the choice to establish boundaries in the decision making process there are increasing gains in user participation attitudes and performance. When the users task meaningfulness is increased then procedural justice and control task commitment and performance also increases. The user participation positively influenced perceived control even though none of the users received their preference. Perceived control influenced perceptions of procedural justice. The direct path from decision control to outcome satisfaction reinforces the fundamental importance of perceived control. Path analysis demonstrates a direct effect of task meaningfulness on performance. Meaningful task evoke feelings of inclusion and increase perceptions of control (Hunton and Price, 1997).

As we note that user participation is essential in the systems engineering process then it is important to provide a method of prototyping technology. Using virtual tools allows items such as Graphic User Interfaces (GUIs) to be demonstrated in a three dimensional representation. As many of the OSS tools are freely available this allows for a system to be modified cheaply however the GNU General Public License must be adhered to.

**Conclusion**

As we concluded the case study it was deemed that there were no additional tools needed for success in a graduate engineering systems engineering course. As we discussed only SL, VMware, and OSS in a general form these tools combined provided an environment where the students could do a fully systems engineering design to include testing it in an environment that could represent a live test. The OSS provided students the ability to download free programming tools, office tools, and more at no cost but with extensive functionality. VMware provided students the ability to test a OSS in a sand box environment. Students who had backgrounds in other engineering disciplines were able to transition with greater ease into systems engineering utilizing the tools as they provided a method to better ingrate different types of technological tools. All students were satisfied with the content of the course and the toolsets provided to them by the end of the class.

**References**


