System Analysis of An Assurance of Learning System

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Abstract

A systems analysis is performed for an assurance of learning data warehouse for the Cameron School of Business at UNC Wilmington. The systems analysis proved to be a powerful tool for documenting the existing process, specifying the proposed data warehouse, and accreditation documentation purposes.

Keywords: assurance of learning, systems analysis, assessment

1. INTRODUCTION

Assessing program learning outcomes over time can give great insight into how changes in the curriculum or educational environment affect learning outcomes. However, the task of gathering data for assessment, storing that data across time, and transforming that data into accurate, relevant, useful data is generally underestimated.

Assessment data comes from various systems and mechanisms (hand-score rubrics, external assessment systems, internal assessment systems, etc.), and the data is stored over time. Data arrives in many formats, e.g., handwritten forms, spreadsheets, csv files, etc. The data must be converted into a consistent format, aggregated, formatted for current reporting needs, and store safely for future reporting purposes. Manual management of the data, for instance, with spreadsheets, is error prone, inconsistent, and expensive. Because data is gathered periodically (each term, for example), the way the data is gathered can change, and the way the manual data management is performed each time can change.

Some learning objectives are, by their nature, difficult to crisply assess, e.g., leadership, awareness of diversity, teamwork. Gathering clear, actionable information for these type of learning outcomes is very difficult. In situations where sampling is used, it can be very difficult to analyze with statistical rigor and accuracy.

With these challenges, changes over time to the *assessment process* can be more visible in the data than changes in the curriculum or educational environment. Consider a small change to rubric data entry. In Term 1, rubrics with any missing data are thrown out. In Term 2, rubrics with any missing data are kept, but only the usable data is entered. This change in the data management process can generate a more pronounced change in the learning outcome measure than a change in curriculum.

The general form of an information system that addresses many of these challenges is a Data Warehouse. Data Warehouses extract (or accept) data from a variety of sources, storing them in a common format. Incoming data passes through an Extract-Transform-Load (ETL) process to produce a common, consistent format for the Data Warehouse data, regardless of its source. The necessary reports can be defined against a common data format, and saved to be reused over time.

The Data Warehouse model ensures that the data management and reporting are consistently performed over time, because the ETL and Reports are explicitly defined and created. The end result is more accurate information for decision making.

In the 2008-2009 academic year, a graduate student in the Computer Science and Information Systems masters program at UNCW, Sarah Peck, undertook a systems analysis the Cameron School of Business's (CSB) Assurance of Learning (AOL) process. The goal was to understand and document the current process, and specify a desired data warehouse system for Assurance of Learning.

This paper presents the system analysis that was performed. The systems analysis proved to be a powerful tool in both technical and human aspects of the process. The design documents were used not only as the plan for implementing the AOL Data Warehouse, but also for accreditation reporting purposes. The next section gives a brief background of the learning goals for the Cameron School of Business, and how those learning goals were to be assessed. Then, the systems analysis techniques used are presented, in the context of these learning goals. Finally, we discuss the benefits of this type of analysis in the assessment context.

Background

The Cameron School of Business had previously established the following learning goals for the undergraduate Bachelor of Science in Business Administration program:

Learning Goal 1:

Our students will be able to integrate discipline-specific knowledge across functional areas and utilize leadership and team skills to accomplish group tasks.

Learning Goal 2:

Our students will demonstrate critical thinking and problem solving skills through problem identification, analysis and synthesis of data, evaluation of alternatives, and defense of a solution.

Learning Goal 3:

Our students will be able to conceptualize a complex issue into a coherent written

statement and oral presentation, demonstrated with the effective use of technology.

Learning Goal 4:

Our students will understand the importance of social responsibility, diversity, ethics and legal issues.

Learning Goal 5:

Our students will demonstrate an understanding of global business practices that embraces the opportunities of multicultural, diverse environments, as they relate to local, national, and global operations.

The core course content was to be assessed by answering MC/TF questions via an in-house online testing tool. Written communication was to be assessed by a third party online writing assessment service. The remaining assessments were performed by a variety of rubrics completed by a variety of raters.

2. SYSTEMS ANALYSIS

Stakeholder Interviews

For this project a small sample of the stakeholders were interviewed to discover their needs, wants, and concerns regarding the AOL Program. The selected stakeholders interviewed were:

- AOL Committee Chair
- The administrative assistant responsible for data management and reporting
- The Dean of the Cameron School of Business
- A CSB Faculty member

Each stakeholder was interviewed in their office with a time limit of one hour. Questions for the interviews were prepared and agreed upon by the Capstone Committee prior to the actual interviews. Questions included:

- What are your objectives for AOL?
- Who uses the AOL system?
- What are the criteria for the AOL System?
- What types of reports need to be generated?
- How are the reports used?
- How often are assessments performed?
- Are there any constraints?
- What are the requirements for accreditation?
- Are there any issues with the current system?
- How much of your time does AOL take each term?

Unsurprisingly, each of the stakeholders had different answers reflecting their various perspectives. The notes from these interview sessions were transcribed an included in the project charter document. The comments from the various stakeholders were used to establish goals for the Data Warehouse system project.

Project Charter

Project charters are documents that establish the purpose, scope, objectives, and participants of a project. These documents are considered best practice and are used to obtain authorization for a project and/or as a focal point for the project team to eliminate expanding scopes. The project charter for this project documents the problem the project addresses, the scope, the stakeholders, the objectives, the constraints that inhibit the project, the milestones, and the resources for completion of the project. Below are the critical aspects of the AOL data warehouse project charter. It is important to note that the project charter was reviewed and approved by the AOL Committee Chair, to ensure that their concerns had been accurately captured. The following sections describe the sections of the project charter.

Problem

The problem addressed by this project is that the Cameron School of Business needs a consistent reporting system for the Assurance of Learning reports for the AACSB accreditation. The AACSB mandates that the AOL program delivers annual reports of the learning goal outcomes and that these reports must be produced in a consistent manner to accurately illustrate trends overtime.

Business Objectives

The business objectives of the project are:

- Utilize AOL to improve student learning,
- Be able to have longitude tracking through the use of quality control charts,
- To be able to identify areas of improvements based on the charts,
- To have consistent reporting, and
- To have a web presence on the CSB website.

Scope

The scope of the project was limited to the AOL program for the undergraduate level at UNCW. The graduate level will be omitted because the learning goals for the graduate program are inconsistent throughout the various degrees. It would be extremely time consuming to restructure the learning goals of the graduate degrees to be uniform and comparable. For a full detail of the project scope refer to section 6.1 Project Plan.

Actor Diagram System Components

An actor diagram "defines the needs and intentional relationships of the actors (users) of a system." (Cervanka) Actor diagrams consist of system components (usually in the middle of the diagram) and the actors (on the outer rim of the diagram). Actors are people or things (such as another computer system) that interact with a system. (Satzinger) The components of a system in an actor diagram represent the pieces of the system that actors will interact with.

The system for the AOL Program is comprised of several components: reporting, data entry, extract transform load, and manual rubrics. Refer to Figure 1. The project focused on the reporting, data entry, and extract transform load components, a description of all of the components of the system are listed below. The Actor diagram was reviewed and approved by the AOL Committee Chair and the AOL Administrative Assistant.

SQL Reporting Services 2005 is a server-based reporting environment that allows users to create predetermined charts, as well as ad hoc charts. Several standard, predetermined queries are created to be used to generate the most frequently used charts. This automation reduces the time the AOL administration spends on generating charts. For scenarios in which the AOL administration needs to create a chart that is not standard, they will employ the Report Builder feature of Reporting Services. The Report Builder feature walks users through choosing templates, chart layouts, data selection, etc to create the desired reports and charts. Having a user friendly environment also helps eliminate the majority of the time spent on creating reports and charts. In addition to the ease of creating the charts, all of the charts have drill down capabilities. Being able to drill down into the reports is essential in helping the AOL administration make better decisions regarding student learning. With drill down capabilities they will be able to isolate issues more accurately versus groping in the dark for the origins of issues.

Currently the AOL program is operating on an Access 2007 project as the user interface, connected to SQL Server as the database management system. For the data entry component of the AOL system, we will continue to employ Access 2007. Access 2007 is relatively simple to understand and a familiar environment for the AOL administration. These features are imperative to the continual operation of the AOL program. Using a familiar and simple environment allows the program to function in the event key personnel leave the committee and/or the university. Someone can be easily brought up to speed and resume the activities of whoever left without interrupting normal operations. The AOL program will be able to assess learning goal outcomes and generate annual reports in a consistent manner.

Access 2007 also makes data entry virtually effortless. The AOL Access 2007 project uses the form feature as a user interface for data entry. Users click on radio buttons associated with the outcome values of learning goals. Refer to Figure 2 for a screenshot of a sample data entry form.

Extract Transform Load

The extract transform load component of the system migrates data from an Excel file to the AOL database. Traditionally ETLs extract data from one data base and import it into a target data base. For this project, the ETL extracts data from an Excel file, because the AOL program uses third party vendors for some of the assessments and UNCW CSB does not have access to the third party vendors' databases. Because UNCW CSB does not have access to these databases, some manual effort is required to extract the data. The AOL administration has to manually visit the third party's web site and export the data into a CSV file. Once the data is transferred to an Excel file, the ETL grabs the data (extract), transform it into a uniform format (transform) and insert it into the AOL SQL Server database (load).

Actors/Roles

As mentioned earlier, actors are people or things that interact directly with a system. In Figure 3 the actors and their rights in the AOL system are defined. It is important define who/what interacts with a system and their abilities within a system since an actor diagram does not show the specifics of the interaction only a general interaction represented by a line connecting the actor to the system.

Context Diagram

A context diagram illustrates the external entities that interact with a system and the relevant information flows between a system and its external entities (Students). In essence, context diagrams are graphical representations of use cases (possible scenarios of interactions with a system) because they illustrate the flow of data.

The context diagram for the AOL system shows the system interacting with 9 distinct external entities (the stakeholders, the UNCW system, and the ETL system). These entities are represented by squares while the AOL system is represented as a circle (refer to Figure 4). The data that travels through the system is represented by arrows with text labels defining what the data is.

Use Case Analysis

Uses cases demonstrate possible scenarios where users interact with a system. The case gives a detailed outline of the steps a user takes to complete a particular scenario and the responses of the system to those steps. Use cases are similar to context diagrams except they are textual representations and they only illustrate one scenario at a time. For the AOL system three scenarios were developed:

The format used for use cases in this project is the formal approach. This approach lists every detail of the scenario. A template for a formal use case is shown in Figure 5.

The example in Figure 6 shows the Data Entry use case. The use case explains in full detail how an AOL administrator takes the outcome results from an assessment and inserts the data into the AOL database. In this particular case the outcome results that the AOL administrator is entering into the database are Leadership outcome results. This does not mean that this use case only applies to entering Leadership outcome results. Any faculty-administered assessment may be entered into the database in the same manner. The Leadership assessment is only used as an example for similar situations.

Documentation of Processes

Swim lanes are a graphical representation of the processes involved in a system. They consist of "lanes" for each actor involved in the process; with the actions performed by the actors in their respective lane, and a time frame for the entire process. Swim lanes were created for each of the undergraduate learning goals:

- Written Communication
- Content Knowledge
- Oral Communication
- Integration
- Team Work
- Leadership
- Problem Solving
- Critical Thinking

Each of the swim lanes generated for the project were approved first by the Capstone Committee, then by the AOL Administration.

An example of the swim lanes is the written communication learning goal demonstrated in Figure 7. The written communication's process start is symbolized by an empty circle. This circle is found in the administration swim lane. The process for the written communication assessment begins prior to the start of the semester with the administration notifying the faculty of the assessment (symbolized by an oval). At this point, the administration no longer performs any actions for the assessment, so the flow moves into the faculty's swim lane. The faculty takes action by incorporating the assessment into their syllabuses. Mid-way through the semester the faculty notifies the students it is time to take the assessment. Here, the faculty's involvement ends and the flow moves into the student's swim lane. For the written communication assessment UNCW uses a 3rd party ETS (external testing system) to administer and grade assessments. The assessment is given online, so students must login to the ETS. Once the students log on, the flow moves to the ETS' swim lane, and the ETS provides the students with the assessment. The flow moves from the ETS' swim lane into the students' swim lane and the students take the assessment. Upon completion of the assessment, the flow moves

back the ETS' swim lane and ETS grades the assessments and subsequently compiles the results. The ETS' involvement terminates at this point and the flow moves into the administration's swim lane. The administration exports the compiled results from the ETS into an Excel file. Once the data is exported, the ETL (extract transform load) can enter the data into the AOL database. The written communication assessment process is now concluded which is symbolized by a filled circle located in the ETL's swim lane.

Prototype Reports

Prototypes are mock up presentations of what the end result of something is based upon. For this project prototype charts were created to help the client decide on the desired format of the charts for the AOL program.

Each chart contained the average for a learning goal for 5 semesters. The semesters were listed across the bottom on the X axis. The Y axis contained a scale for the average score achieved in the learning goal assessment. In the center of the graph there were three lines: the upper control limit (UCL), the lower control limit (LCL), and the control limit (CL). The UCLs and LCLs will be approximately 2 standard deviations from the CL. These limits were calculated on a rolling basis. The past 4 semesters of data will determine the control limits for the current charts.

There were two variations of each chart available: a template that scales everything from 0 – 100 and a template that adjusts the scale to align the control limit in the center of the chart. This approach was chosen so that charts may be presented in a uniform, comparable manner and so that trends will also be identified more easily. The 100 scale charts make it difficult to identify exact variations in student learning trends (refer to Figure 8). By adjusting the scale to a smaller range (refer to Figure 9) one can see the precise amount of variations.

Success Criteria

Success criteria are metrics that will be used to determine whether the project is a success. The project was assessed with the success criteria post completion. The success criteria for the project were overall time saved for the stakeholders and stakeholder satisfaction.

It was estimated that the project would reduce the time spent entering data and generating charts by 50%. Prior to the project, Terrey Hatcher (AOL Administrator) spent hours preparing data in order to create the annual reports for AACSB. Refer to the chart below.

Using the time estimations from the chart, one assessment would take a minimum of 7 hours from an administrator's point of view to organize the data, enter the data into the database, and generating reports. Considering there are 8 assessments, the AOL administration spends about 56 hours per semester on the AOL program. The project immensely reduces this time because it provides documentation and implements the use of SQL Server Reporting Services. The documentation provides standard formatting for the outcome results of assessments. AOL Administration no longer has to sift through various formats of data and re-format it to their specifications. Third party sites' data will be manipulated to the correct format and entered into the database by the Extract Transform Load. SQL Server Reporting Services has templates for generating specific charts. The templates are stored procedures (queries) that grab the necessary data and create the chart. Each chart generated from these templates should take no more than a few moments at worst case. The time spent on creating ad hoc charts, charts not generated by the templates, depends on the user. SQL Server Reporting Services uses a wizard to guide users through creating the charts they want. Typically, a user familiar with the software will generate charts quicker than a user unfamiliar with the software.

Stakeholder satisfaction was measured with a survey. There were different surveys for each of the stakeholders. The surveys requested stakeholders to rate their satisfaction on different aspects of the project on a scale of 1 – 10, 1 being dissatisfied and 10 being the highest amount of satisfaction. The surveys also had a place for comments with questions. The comment sections allowed the stakeholders to fully express their satisfaction or dissatisfaction with the project. The comments will be taken into consideration for future projects. Refer to Appendix J for a list of the survey questions.

Valuation of the Project

Existing Recurring Costs

The recurring costs (per term) in hours were determined to estimate the recurring costs of the existing system (refer to Figure 10). These estimates were purposely conservative. With these estimates, a break-even point for the cost of creating the system was calculable.

Costs

The costs of the project consisted of man hours. The software being used for the project was a sunk cost since the university already owned the software and licenses for the software. Man hours were counted for the project manager, the Capstone Committee (5 faculty), the AOL administrative assistant, and the AOL director (see Figure 11).

Benefits

The benefit of the project is better decision making. Better decision making results from the AOL Committee receiving consistent and accurate data in an efficient manner in order for them to create quality reports. The data will be in a consistent format since the faculty and administration will be following the standards set forth in the documentation. By gathering and reporting the data in a consistent manner the data is ensured to be accurate. The AOL Committee uses the accurate data to produce top quality charts and reports. From the quality charts and reports, the AOL Committee will be able to make better decisions in regard to recommendations for improving student learning.

3. DISCUSSION

The system analysis was a powerful tool that not only served the traditional purpose (specifying a system to be built), but also helped the overall Assurance of Learning process. Some unexpected uses of the system analysis included:

- Direct inclusion of process figures in accreditation documentation.
- Education of stakeholders on assurance of learning concepts
- Helping to understand the scale and scope of the assurance of learning efforts.
- Justifying resource requests for assurance of learning
- Improving consistency of procedures
- Selection of report forms for decision making

In summary, the techniques of systems analysis wer extremely valuable in the realm of assurance of learning.

Figure 1: Actor Diagram

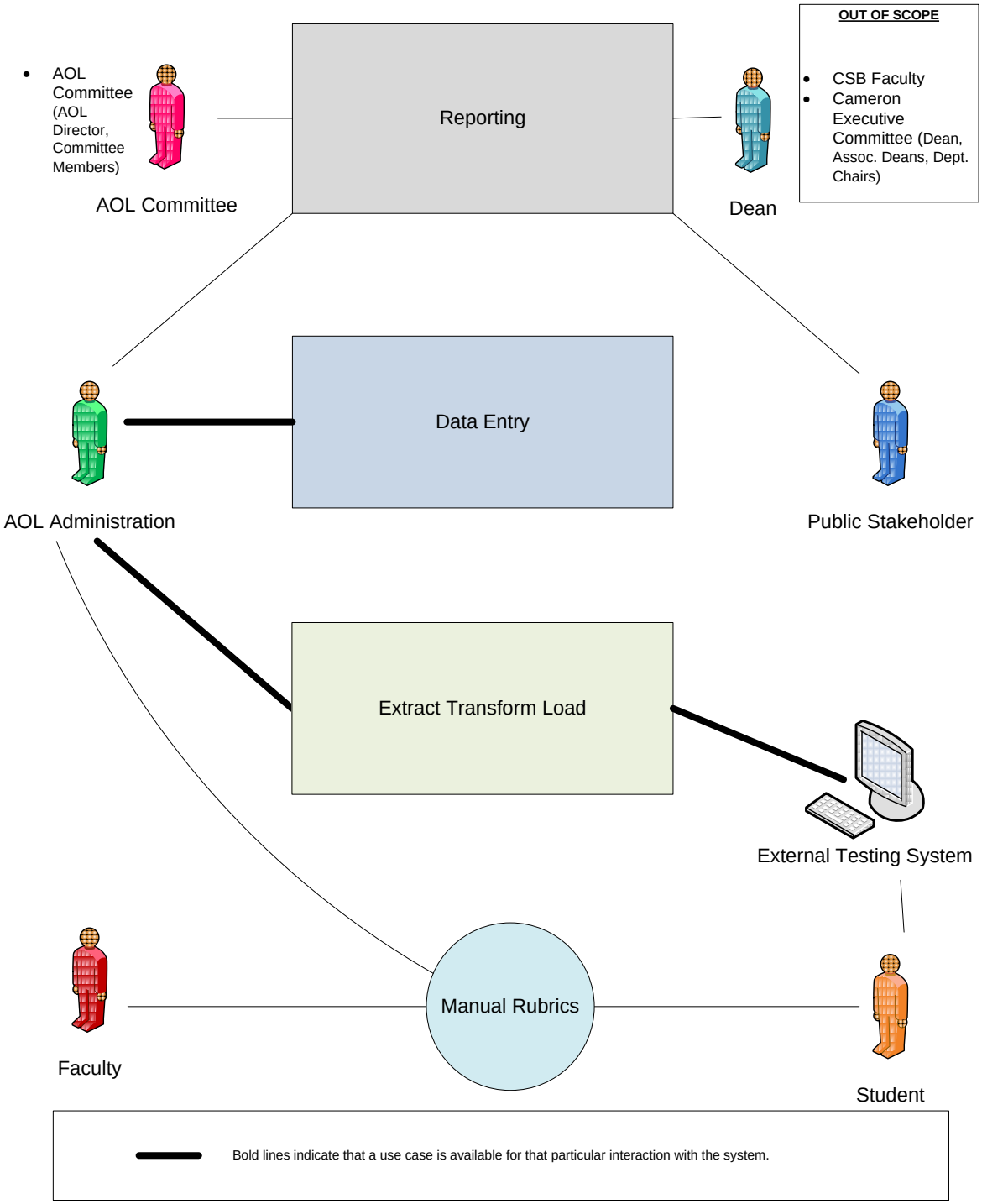

Figure 2: Data Entry Screenshot

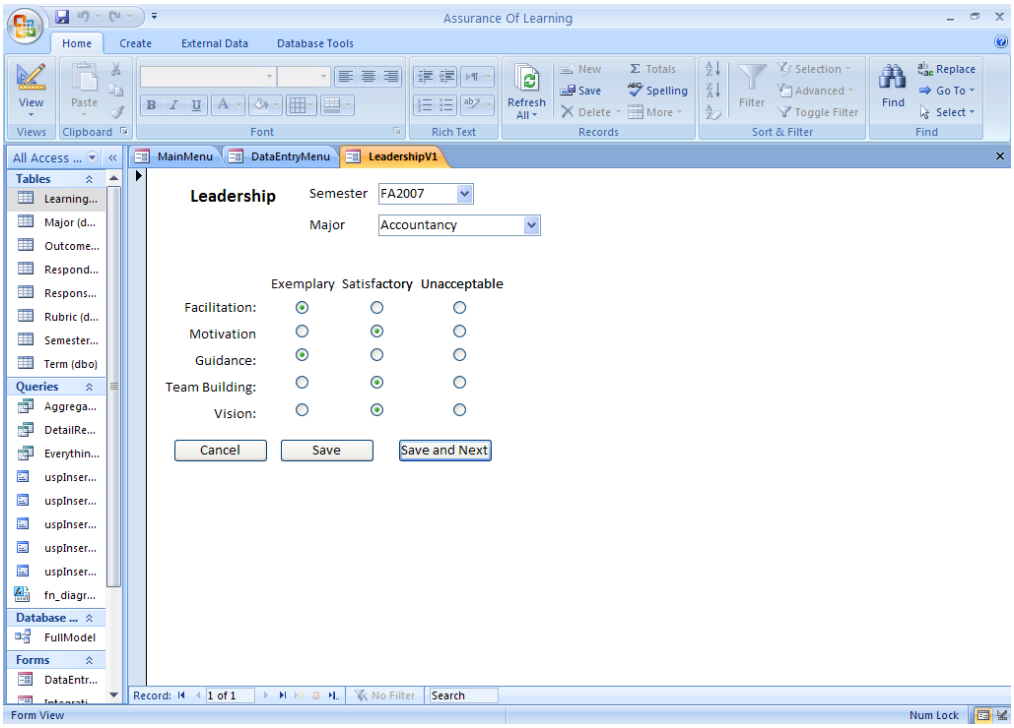

Figure 3: Actors Rights Table

	Rights										
Actors	Data entry	Generate reports	Generate charts	Drill down capabilities in charts & reports	Extract data from 3rd party vendors	Create stored procedures	View charts	View reports	Provide assessments	Grade assessments	Take assessments
AOL Administration	√	√	√	√	√	√	√	√			
AOL Committee				√			√	√			
Dean				√			√	√			
Public Stakeholder							√	√			
Student							√	√			√
CSB Faculty							√	√	√	√	
External Testing System									√	√	
Cameron Executive Committee				√			√	√			

Figure 4: Context Diagram

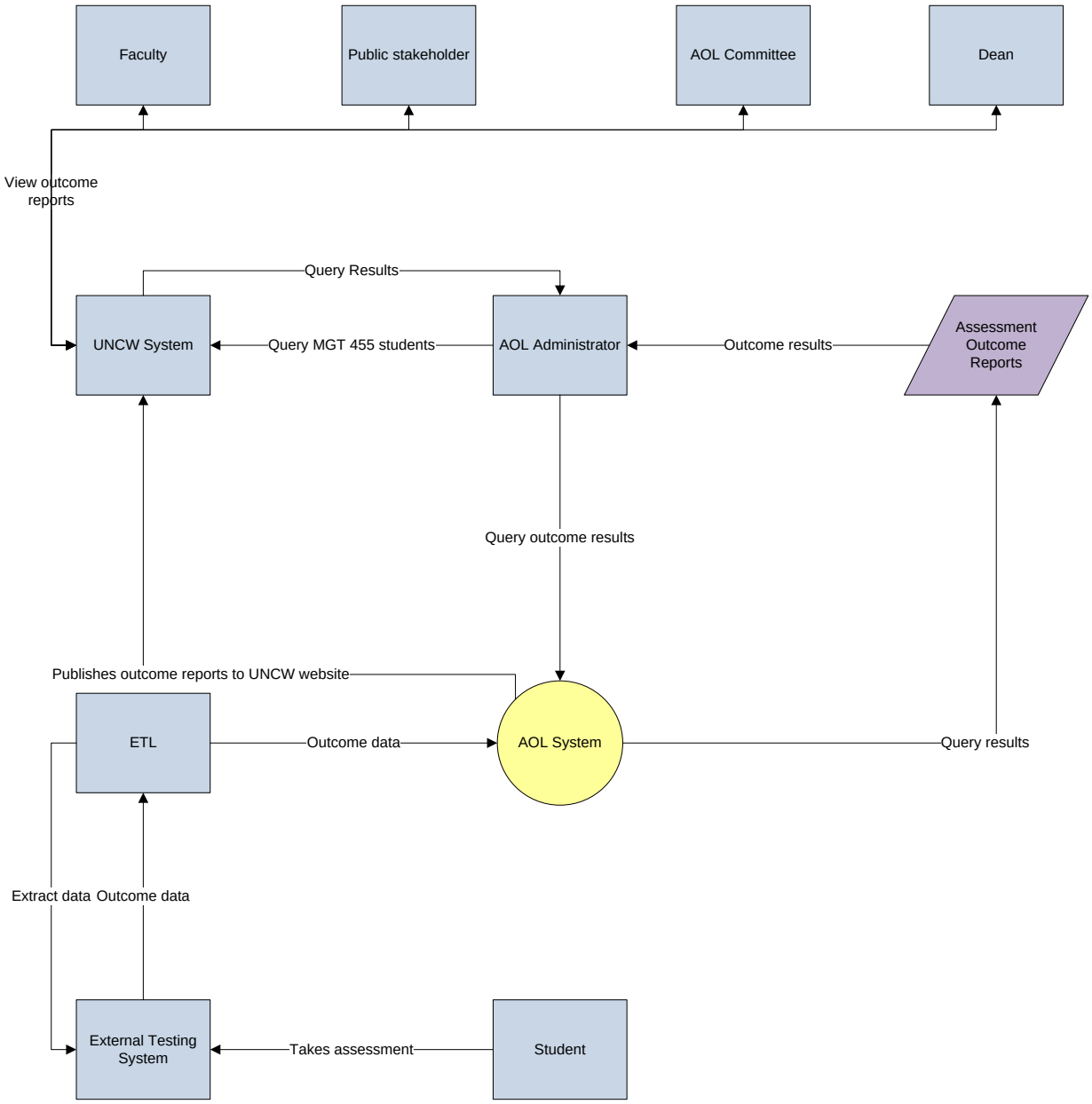

Figure 5:Use Case Template

Detail	Description
Use Case Name	The title of the use case
Scenario	The task the actor/user is trying to accomplish.
Triggering Event	What instigates the need for the scenario.
Brief Description	A synopsis of the events of a use case.
Actors	The external entities that interact with the system in the scenario.
Related Use Cases	Use cases that pertain to the task being accomplished in the use case.
Stakeholders	A person, group, organization, or system that has a vested interest in the scenario
Preconditions	Conditions that must be met before the scenario may take place.
Post Conditions	Conditions that must be met after the scenario takes place.
Flow of Events	The steps taken by the actor and the system to perform the task.
Exception Conditions	What happens if an alternative path from what is specified in the flow of events is taken.

Figure 6: Sample Use Case

Use Case Name	Data Entry	
Scenario	AOL administration entering in outcome results into the AOL database.	
Triggering Event	The AOL administration receives outcome results from Leadership assessment after the faculty has administered the assessment.	
Brief Description	A faculty member has graded the Leadership assessment and gives the results to the AOL administration. The AOL administration logs into the AOL database, chooses the data entry option, and enters in the data.	
Actors	AOL Administration	
Related Use Cases	None	
Stakeholders	AOL Administration: to verify that the data content entered is correct AACSB: the annual report	
Preconditions	The Leadership learning goal must exist. A course has taken the assessment. The faculty member has graded the assessments. The AOL database exists.	
Post-conditions	The data must be associated with the correct learning goal. The AOL database must be updated.	
Flow of Events	Actor	System
	Logs into the AOL database. Clicks on the "Data Entry" button. Clicks on the "Leadership" button. Chooses the semester that corresponds with the data from the "Semester" drop down menu. Chooses the major that corresponds with the course that took the assessment from the "Major" drop down menu. Clicks on the radio button that corresponds with the appropriate score. Clicks the "Save and Next button." Reiterates through steps 6 and 7 until the last outcome result. Here the AOL administrator clicks on the "Save" button. Exits out of the AOL database.	Verifies login information is correct. Redirects the actor to the data entry home page. Redirects the actor to the Leadership entry page. Inserts the data into the database. Inserts the data into the database then redirects the actor to the data entry home page. Exits.
Exception Conditions	If the actor uses wrong login information the system will display an error message and not let the actor login. If the actor clicks the "Report" button he/she will be redirected to the Report home page. If the actor clicks another learning goal's button he/she will be redirected to the data entry page for that learning goal. If the actor does not select a semester no semester information will inserted into the database. If the actor does not select a major no major information will inserted into the database. If the actor clicks the "Cancel" button the information will not be inserted into the database and the actor will be redirected to the data entry home page. If the actor does not exit the AOL database he/she can enter in more data or generate reports.	

Figure 7: Sample Swim Lane for Written Communication

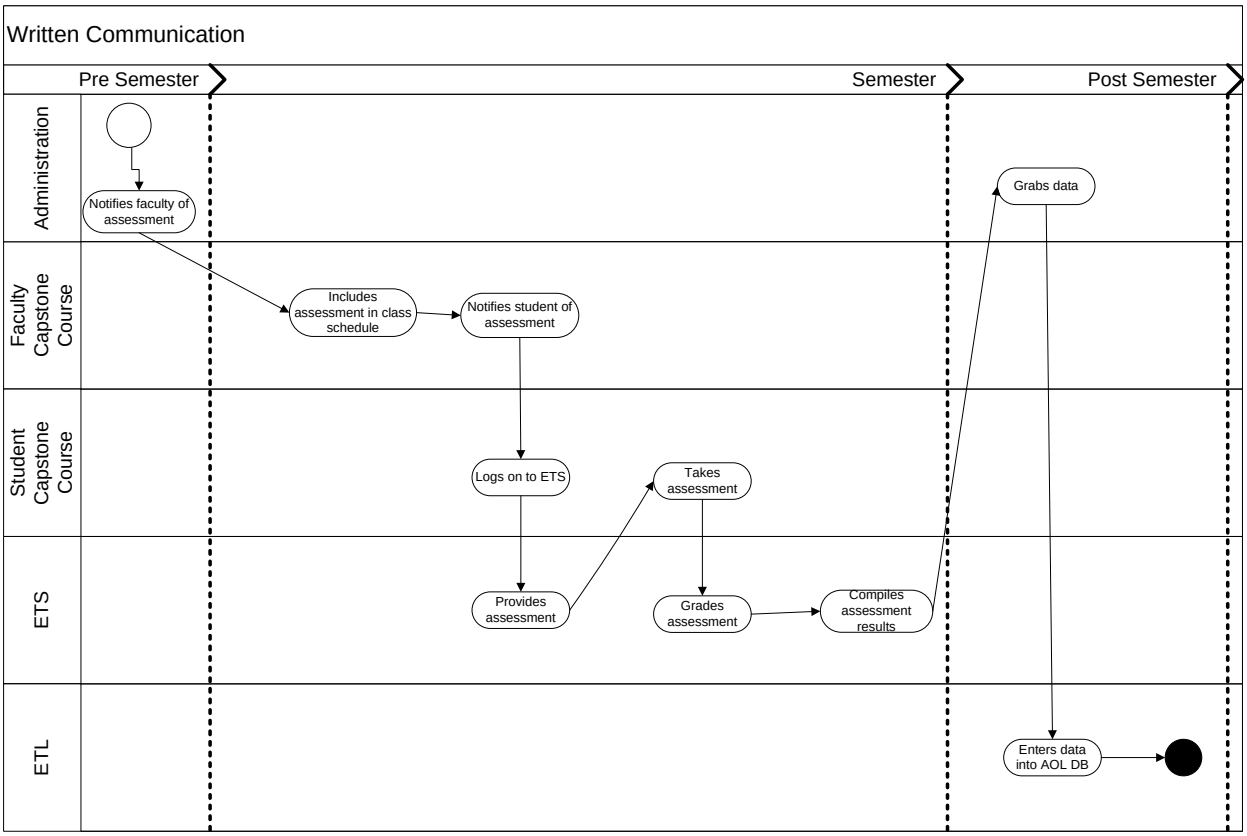

Figure 8: Sample Chart Scaling 0-100

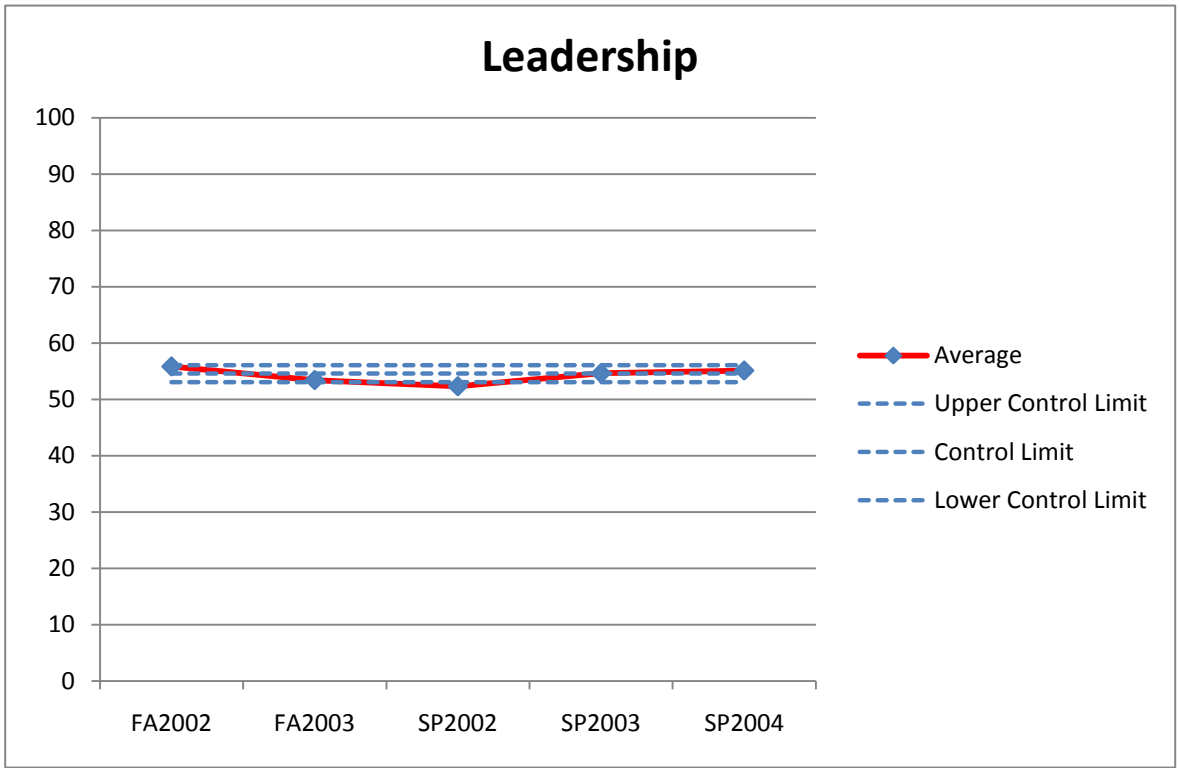

Figure 9: Sample Chart - Zoom Scaling

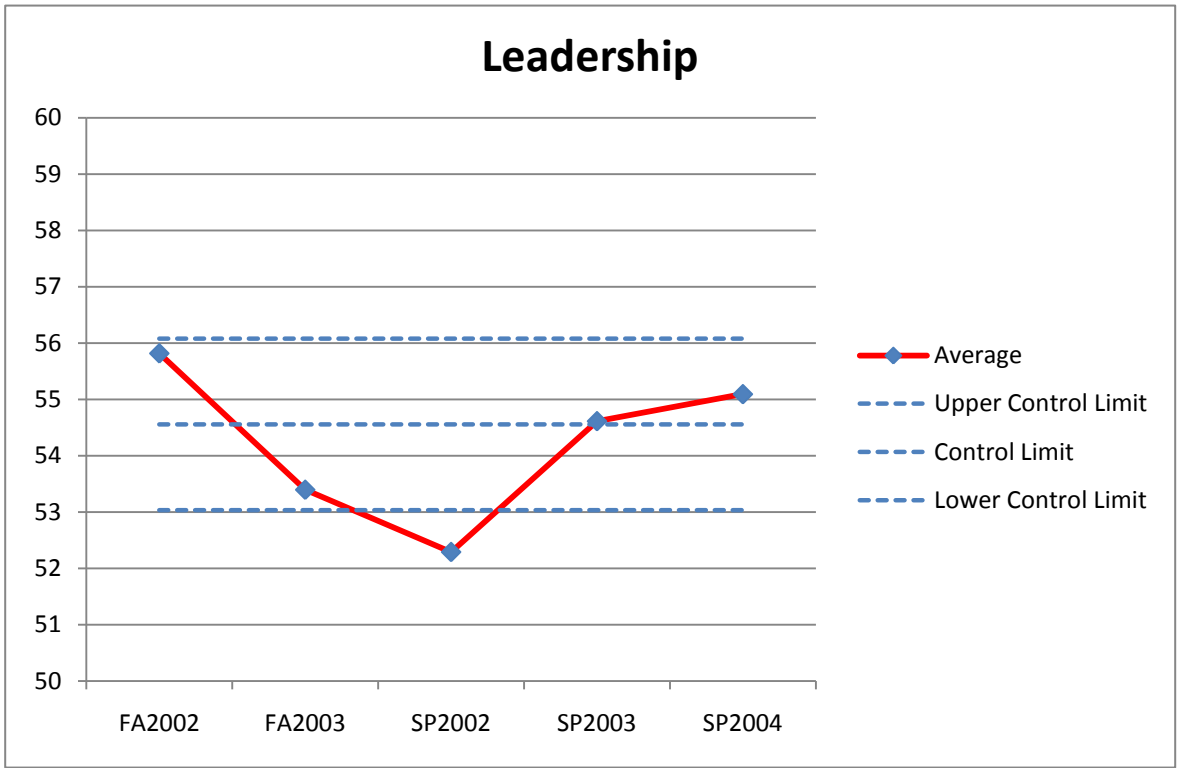

Figure 10: Project Valuation Recurring Costs

Task	Task Details	Time Spent on Task
Preparing for an assessment	Gathering lists of students to take the assessment Providing documentation to professors and/or students Setting up assessment tools Remind professors and/or students of assessment	3-5 hours
Organizing data	Gathering assessment results Printing out data Setting up Excel file for the data	1-3 hours
Data entry	Entering data	1-3 hours per assessment
Consolidating data and generating reports	Generating charts in Excel	2-5 hours

Figure 11: Project Valuation - Implementation Costs

Resource Type	Resource	Hours
Internal	Sarah Peck	135 (15 weeks * 9 hours)
	Dr. Bryan Reinicke	45 (15 weeks * 3 hours)
	Dr. Douglas Kline	45 (15 weeks * 3 hours)
	Dr. Devon Simmonds	15 (15 weeks * 1 hour)
	Dr. Drew Rosen	15 (15weeks * 1 hour)
External	Terrey Hatcher	30 (15 weeks * 2 hours)
	Dr. Rebecca Porterfield	15 (15 weeks * 1 hour)