Add-on Course Registration System

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Add-on Course Registration System

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IS642 Management and Information System Graduate Project
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March 16, 2017
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Abstract

The current course registration system (Banner) has problems with tedious registration flow, insufficient registration information, and a lack of feedback. It costs Western Oregon University students, advisors, and registrar’s office too much unnecessary time, money, and labor. A well designed course registration system can help advisors and the registrar’s office reduce workload, and help students efficiently and accurately select and enroll in their courses.

Through the satisfaction survey of the course registration system at Western Oregon University, the interviews of the registrar and the chief information officer, and the experience of the Banner system, people realized that the students using the Banner system must move between multiple web pages to complete the registration process. And the requirement system (DegreeWorks) and the Banner are two separate systems, which does not allow the student to track their progress towards a chosen degree. Moreover, the Banner only provides limited information for students.

Western Oregon University needs a new Add-on Course Registration System, which helps students to choose appropriate courses, avoids time conflicts without switching between multiple screens, gets the information of meeting degree requirements, provides a “forecast” number of each course, and offers course recommendation ranking and reviews. After design is completed, Western Oregon University has two options: the university will build the system, or they have a software company build the system and buy the new system from them.
1.0 Introduction

Currently, most schools offer some online registration. The online course registration system allows students to enroll in classes through the Internet. All higher education institutions in the Oregon University System use the same online student information system, Banner, created by the Ellucian company. Western Oregon University uses this system.

A course registration contains three main components:

1) The selection of courses the student needs to take to meet the degree requirements for the upcoming terms.
2) Guidelines to find and register for classes in the system.
3) The ability to register during the registration period.\(^1\)

The Banner system only helps students register during the registration period. It cannot help students select or schedule their courses. It cannot tell students what their degree requirements are for graduation. An efficient course registration system needs to provide enough information to help the student select and schedule courses. This project aims to design an online Add-on Course Registration System for Western Oregon University to help students quickly and efficiently finish the whole course registration process online.

2.0 Background

2.1 General Online Course Registration System

There are registration systems that will provide a broader registration base with more information but they only work for small populations. Amilia, a company offering online presentation products, claims their activity module allows users to quickly set up registration periods, classes, activities, and events.\(^2\) It targets smaller organizations which have 1 to 1000
Add-on Course Registration System

people. The Amilia online registration system provides the features of activity registration, attendance management, badge management, calendar management, class registration, contact management, event registration, form builder, group registration, marketing management, online and onsite registration, payment processing, refund automation, and self-check-in. These features can meet most needs of their customers. There are other similar online registration systems that help small groups achieve online course registration. A small organization can only provide limited courses to their students. Because most of them offer online courses which only involve an instructor and location of the class, and various departments and processing, the student can quickly select the courses they want, add them to their cart and check out.

Dr. Laghari reminded in his article: “Students register for particular courses, and this information helps the administration to construct class lists and offer other academic activities, etc. The devised system at College of Engineering helps and guides students in selecting appropriate courses suitable to register with the online University Registration System.”

The SASSY advising system which was developed by the Armstrong Atlantic State University suggests courses for a student based on “the frequency of the course offering, balancing the course load, shortening the path length to graduation, preference of advisee, and entertaining different scenarios of course loads for the entire duration of the student’s university life.”

Professor Felson from William Paterson University evaluates his school registration system: “Students and their advisers must go back and forth between different parts of the system to identify course requirements and course availability…The situation is bad enough that students and faculty are taking matters into their own hands.”

The New York Times reported several college students at the Rutgers University, Brown University, Baruch College, University of California, Berkeley, Furman University, Carnegie Mellon University, Florida State University
and the University of Pennsylvania created various apps that repackage course registering formats.\textsuperscript{6}

### 2.2 Banner System

![Banner Stack Diagram]

The typical architecture of a University operating system needs three components: Banner, Colleague, and PowerCampus. They cooperate with each other to achieve course registration, financial aid/finance and human resource system. The current course registration system of Western Oregon University is Banner 8. The Banner system is a student information system built by the Ellucian company, which is based on a database from Oracle company and a Red Hat Linux operating system from Red Hat company.\textsuperscript{7}

Western Oregon University is a member of Oregon University System, who share one system resource.\textsuperscript{8} The Oregon University System is planning to upgrade to Banner XE, the latest released version. The highlights of Banner XE upgrade are an extensibility framework,
attendance tracking, registration and advisor self-service. Because the Ellucian company will be releasing Banner 9 in the future, the institutions of the Oregon University System have to update their system to Banner XE in order to be prepared. To use the upgraded XE product they have to update their server which is located at Oregon State University. The staff working on maintaining the system will take courses to be prepared to run the new system.

2.3 General Banner Procedure

2.3.1 Course Registration

Figure 2.2 The Course Registration Page of Banner

Figure 2.2 shows the interface of course registration of Banner system. The student needs to fill out each course CRN in each block to register. Clicking submits to registration the classes they need. It means that the student has to know what classes they need and the CRN of each class before the registration date.

2.3.2 Look-up Classes to Add

1) Select a term
When a student is registering for a computer science course, they first need to identify the quarter they are registering. A student selects a term to look up all the classes they can take, and they can only select one term for each search. If they choose the past quarter, they can view the course records but not register.
2) Choose one or multiple subjects

In this step (see figure 2.4), the student selects one or multiple subjects to get all the courses for their major/s and general education classes.
3) Lists courses

![Course Catalog of Computer Science Subject of Banner](image)

The search result page only displays all course numbers and course names of the selected subject/s, but no other course information.
4) Choose a course

![Figure 2.6 Individual Course Selection of Banner](image)

A student only can pick one course and view its details. This list shows its available times, days, instructor, location, date and remaining seats. The student registers for the class with the CRN of this class and then begins a new search for another class.

5) Other: Advanced search

![Figure 2.7 Advanced Course Search of Banner](image)

The system provides section search and advanced search two ways. Comparing with section searching, advanced searching narrows the class time and days, which helps students
simply find out what courses they want. Also, the result of section search and advanced search is different.

![Figure 2.8 Advanced Course Search Result of Banner](image)

The advanced course searching result screenshot is figure 2.8. The student can get all his course information on this page rather than a list of course number and name. However, the search result is an extensive list; a student needs to spend much time to find any class time conflicts and select courses.

The Banner system not only works on course registration, but it also relates to the finance system and the human resource system. If the university replaces the Banner system, the other systems aside from registration would be jeopardized because they are interconnected. Therefore, if a college wants to figure out the problem of the course registration section, they should not change their whole system. By creating an Add-on Course Registration System, the institution only needs to input their data into the relational database, and it can replace the course
Add-on Course Registration System

registration section of the Banner.

3.0 Statement of the Problem

3.1 Tedious Registration Flow

Students and advisors need a course registration system that detects course conflicts quickly and easily. Currently they must move between multiple systems to complete the registration process. An alternative design for registration systems allow students to choose appropriate courses and avoid scheduling conflicts without switching between multiple screens.

3.2 Insufficient Registration Information

A good registration system allows students to track their progress towards a chosen degree. Currently Western Oregon University uses two separate systems. Banner allows students to register for courses. DegreeWorks tracks their progress toward a degree. Limited interaction between the two programs makes it difficult for registering students to track their progress toward graduation. A functional system needs to include registration, tracking degree requirements and students progress.

3.3 A Lack of Feedback

Students desire additional information before registering for a course. Additional information might include instructor rating, and average grade received. Current systems provide limited information such as the number of seats available. Additional information, although available at the university, is not presented to the student. Examples include faculty rating, number on waitlist, or average grade. With good design, each course in the course registration
system can have a discussion board much like that of Amazon, where students, based on student reviews of the courses and professors, can select the course they want.

### 4.0 Technology Component

#### 4.1 Disadvantages of the Banner System

Western Oregon University students are not highly satisfied with the current course registration system, Banner, primarily because of its tedious registering flow. In the Banner system, the attributes of course information are discrete type. All students with the same major get the same course search results throughout the system. The search is similar to getting the original data from the source database. Banner is not clearing up the data for students, the students need to do it themselves. To view a class detail, the information on the result page is from an action select query of the database. The system selects the information of one class and grabs it from the database directly. All information is discrete type; it is the reason Banner cannot provide only the available courses for each student.

Moreover, if there are too many choices for students, there is a higher probability of omissions and problems. If a class offers two class times and another class offers three class times that creates six possible course plans between these two classes. However, a student would not only have two classes a term, so there can be many more than six possible course plans provided to the student. Some of them have time conflicts. Students have to find the course conflicts manually in the Banner system. This can easily lead to mistakes. When the students register, the Banner system only flags time conflicts between classes by failing the registration. The student has to reschedule before the registration period ends. The Banner system does not give the student the information they need in an efficient way, making it hard for the student to
reschedule their courses.

4.2 Advantageous Features of the Add-on Course Registration System

- **Major feature #1 Avoid time conflict of course**
  
  If several courses are conflicted, they display in the same grid cell of the schedule grid and the conflict will be obvious to the students.

- **Major feature #2 Provide information of meeting arbitrary requirements (LACCs, prerequisites, etc.)**
  
  The Sidebar highlights the courses which meet arbitrary requirements. All courses are sorted by the degree of importance; the major required course which also meets the arbitrary requirement are listed first.

- **Major feature #3 Provide a “forecast” of students planning on taking a course**
  
  The side of each course has a number to show how many students choose the same course as you.

- **Major feature #4 Provide course recommendation ranking and reviews**
  
  If courses have the same degree of importance, they are sorted by their ranking score from students who took this class. Students also can read each course review in the course discussion board, and after they took this class, they can write feedback in that page.

<table>
<thead>
<tr>
<th>Figure 4.1 Main Features of Add-on Course Registration System</th>
</tr>
</thead>
</table>

4.2.1 Avoid Time Conflicts of Courses

In the Add-on Course Registration System, students already have a schedule plan before they plan their next quarter course schedule, because all available courses of the student would be shown in a schedule grid (see fig. A.1 in appendix A for a more detail). Students remove the
unavailable classes from the Schedule Grid through clicking the checkbox next to the course number. It means the Add-on Course Registration System helps the student to explore and avoid all time conflicts by prohibiting students from choosing the unavailable course inside the system.

4.2.2 Provide Information of Meeting Arbitrary Requirements

Each student needs to get enough credits for their degree. Western Oregon University divides all courses into four types: major requirement course, minor requirement course, elective course and additional graduation requirement course. However, there are some arbitrary requirements that hide from the course catalog, which can be applied for any type of course in a particular section. A business student from Western Oregon University, will need to meet his arbitrary requirements with six credits in writing intensive courses, six credits in cultural diversity courses, 11-12 credits in mathematics or computer science courses, and 54-58 credits in liberal arts core curriculum course. One of the four credit hour courses, called quantitative business method, is a lower division credit course which is both a major requirement course as well as an arbitrary requirement course. It meets the quantitative literacy requirement which is part of the mathematics or computer science courses requirement. That makes it a valuable course because it allows the student to meet two requirements with one course.

In the Add-on Course Registration System, having a sidebar to show which courses meet the student’s arbitrary requirement as a list, it is a simplified version of student DegreeWorks (see fig. A.2 in appendix A for a more detail). This allows students to know what requirements each course meets; how many required course credit hours are remaining and how to plan their courses with more flexibility. For example, if two lower division credit courses meet at the same time, one of them only meets the student’s major requirement, and another one meets both their major required and writing intensive. The Add-on Course Registration System will order the
latter one higher and recommends it to the student to choose it. Because it helps the student meet their degree requirements as fast as they can, there is more flexibility to plan their remaining courses when the student is ready to apply for graduation.

4.2.3 Provide a “Forecast” of Students Planning to Take a Course

Before the filing date, every student needs to check their registration status and time to confirm they are qualified for registration. Also, the student plans all their courses for the following quarter before the registration date. Students are grouped in several different batches to register. However, when a student is actually registering, some preparative courses might be full. This means that if the student does not have a backup plan, they need to reschedule all their courses in a short time without much consideration. If the student does not decide what courses they are going to take during their registration period, the next batch of students might register for these courses, causing more classes to be filled and unavailable.

The Add-on Course Registration System provides the forecast number of students for each course (see fig. A.5 in appendix A for a more detail), decreasing the probability of putting students on the waiting list. It shows the number of students who selected this course when they are scheduling their courses. If the student batch number is posted earlier, students can decide if they want to select the popular one in their preparative registering for courses. Also, a student can find a substitute course for popular courses in advance or create a substitute schedule plan. The Add-on Courses Registration System only counts student's first planning for the forecast number, but it helps students by allowing them to save second or more course schedules (see fig. A.4 in appendix A for a more detail).
4.2.4 Provide Course Recommendation Ranking and Reviews

The sidebar in the Add-on Course Registration System is similar to a simplified version of DegreeWorks. It can tell a student how many credit hours of each section they are required for their bachelor degree, what courses they completed, and what courses they have not scheduled for yet. All courses are sorted by the degree of importance in the sidebar. However, sometimes more than one course would have the same importance level. In this situation, the courses can be ordered by average course score.

Who could give points to a class? The answer is the students. A student who already has taken this class can give feedback on the course Discussion Board and grade this course. Students would click the class number in the Sidebar to go to its sub-page, course Discussion Board (see fig. A.6 in appendix A for a more detail). The reason that the Add-on Course Registration System does not have the pop-up window to show the reviews is that a course can be offered in several class times with different instructors. Having a sub-page for each course provides in depth information to students, but it would not make the registration main page too complicated at the same time. Not every student wants to get the information of each course.
4.3 User Interface Design

The Add-on Course Registration System interface (see figure 4.2), has four main sections: Schedule Grid (see fig. A.1 in appendix A), Sidebar (see fig. A.2 in appendix A), View Box (see fig. A.3 in appendix A), and Save Bar (see fig. A.4 in appendix A).

Figure 4.2 Add-on Course Registration System Interface for Western Oregon University
5.0 Business Component

5.1 Cost

After designing this Add-on Course Registration System, the next step is to consider who should build it and how to make it function. There are two ways to do it: One would be that Western Oregon University cooperates with the computer science department and organizes a program group to build it. The second is for the school to provide the proposal to another company to design and build, and buys the new program from that company. To decide which way is better, comparison data has to include the prices of each options’ initial program costs, the ongoing costs of updates, and maintenance fees. The current registration system Banner 8, besides the initial software cost, costs Western Oregon University $114,563 per year in maintenance, and the cost of software updates is included in the maintenance fee.

Building the Add-on Course Registration System by Western Oregon University probably means the school will need to spend more on initial program building but it will be easier to update and maintain. The finished software will also be a product which the school can sell to other companies and institutions. Building the program at Western will be a long-term investment, but will likely be paid back by selling the software. To calculate the cost of the program, we need to know:

1) What will be the salary of each programmer?
2) How many programmers are needed to build this software?
3) How long will building this program take?
4) How many people are needed to maintain this software?

Software Initial Cost = Programmer Salary \times The Number of Programmer \times Time
However, if Western Oregon University buys an existing Add-on Course Registration System from a company or has it designed to the new add-on specifications, it means that there may be a lower investment in the initial software, but there will be an ongoing maintenance and update fees. In addition, staff will have to be trained to use, edit, test and maintain the software. Once the software updates, the staff have to be trained again to get the new knowledge about the new system. This means the second option may be a less expensive short-term investment but long-term may require a higher payment.

5.2 Benefits

5.2.1 Efficiency

The Add-on Course Registration System provides an intuitive course planning interface. A better course registration system helps students and faculty save time. According to Q5 in appendix B, the result (see figure 5.1) shows that 50% of students spend 30-60 minutes on planning their schedules, 28.9% of students spend more than an hour, and only 21.1% of students spend less than 30 minutes.

By using the Add-on Course Registration System, it can take all students less than 15 minutes to plan their courses. Western Oregon University has 5,445 students; 4,808 undergraduates and 637 graduate students. We assume that students using the Add-on Course Registration System would spend around 15 minutes to plan their schedule. The formula below calculates how much time students were saved per quarter through using the Add-on Course Registration System, omitting the segment of 21.1% of students who already spend less than 30 minutes planning their schedule. (Because the average of the less than 30 minutes’ segment is 15 minutes, which means these segment students would not save time when using the Add-on
Course Registration System. Moreover, using the lowest limiting value of each segment to calculate, and the result would be the minimum value of planning time saved:

\[ \text{Saved Planning Time} = \sum_{i=0}^{n} t_i Q P(t_i) \]

\[ t_i = \text{each student saved time} \]

\[ Q = \text{the number of Western Oregon University students} \]

\[ P(t_i) = \text{the percentage of students who selected each answer} \]

**Figure 5.1 How Much Time Do Student Spend on Searching for Courses and Planning Schedules?**

Saved Planning Time = 45 × 5,445 × 28.9% + 15 × 5,445 × 50%

= 111,650 minutes =1861 hours

The calculation result shows that the system can save Western Oregon University students at least 1861-hour worth of planning time per quarter.
From the result of Q4 in appendix B, we know that about 43.3% of students take 15-30 minutes with their advisor, 40% of students take less than 15 minutes with their advisor, 15.6% of students take 30-60 minutes with their advisor, and the remaining 1.1% of students take more than 1 hour. By using the Add-on Course Registration System, not only saves students’ time, but also advisor’s time. The Sidebar on the Add-on Course Registration System functions as the advisor, which provides course selecting advice to each student. It means when the school uses the Add-on Course Registration System, the student does not need to spend any time with their advisor unless they have a problem. We can use the formula below to calculate how much time the advisor can save through using the Add-on Course Registration System.

Moreover, when people spend more than one hour, we use 1-hour time to calculate. When others are using the average time of each interval, there are 45 minutes for students who spent 30-60 minutes, 22.5 minutes for students who spent 15-30 minutes, and 7.5 minutes for students who spent less than 15 minutes.

\[
Saved \text{ Advising Time} = \sum_{i=0}^{n} t_i Q P(t_i)
\]

\(t_i\) = each advisor saved time

\(Q\) = the number of Western Oregon University students

\(P(t_i)\) = the percentage of students who selected each answer
Saved Advising Time = 60 × 5,445 × 1.1% + 45 × 5,445 × 15.6% + 22.5 × 5,445 × 43.3% + 7.5 × 5,445 × 40% = 111,200.5 minutes = 1853 hours

It shows that advisors can save 1853-hour worth of advising time per quarter. However, the survey result of 40% less than 15 minutes can have a different meaning. Some advisors provide the next quarter course real time class list to their student, and recommend three to five major courses, but do not help their student for planning their schedule during the advising time. It means a student would meet their advisor more than one time if they have any problem when they are planning their courses.

5.2.2 Accuracy

The Add-on Course Registration System can help students plan their course schedule in a few minutes. Students do not need to do research among classes to find out course conflicts, or to find out which classes are required toward their degree. Its Schedule Grid interface helps the
student planning their schedule more accurately. The Add-on Course Registration System is designed to eliminate course conflict.

![Pie chart showing time spent on registration]

Figure 5.3 How Much Time Do Students Spend on Registering for the Term’s Classes?

From the pie chart we knew that 20% of the students spend less than 2 minutes to register for their courses, 38.9% of the student spend 2-10 minutes, and 26.7% of the student spend more than 10 minutes registering with the banner system. However, some students cannot complete their registration during the filing period. 14.4% of students were put on the waitlist. Only 20% of students are time efficient at registering. Under the Banner system, people should spend less than 2 minutes to type the CRN of each course in the registration page and submit them to complete the registration. But 80% of students took longer than 2 minutes registering. That means they cannot complete registration in a timely and accurate manner and when problems occur they cost students time and increase the workload of the advisor and registrar’s office.
This can be proven by the results of the Q8 in appendix B, “How often do you experience problems getting the course you need? What is the problem?”, one third of Western Oregon University students never experience problems getting their course. Evaluating the comments of the problems students had, there are course conflicts, classes filling up quickly, prerequisite course requirements, course canceled, and too long of a waitlist, and more. These kinds of problems mess up students’ schedule nearly 66% of the time. For instance, a student is told they need a prerequisite course before registering for some courses. Or, in another case, a student proposes to apply to graduate, but finds some required courses only offered in certain terms. That lack of pertinent information when it was needed prevents the student from graduating on-time.

5.2.3 Better Utilization for Departments

Currently, departments cannot see the full scope of the registration situation before the end of the registration period, which can cause imbalance between supply and demand of course openings. However, the new Add-on Course Registration System can alleviate this somewhat.
Because the “forecast” student number of each course is changing automatically as students plan their course schedules, departments can obtain the registration information before the class beginning date, and adjust the course openings accordingly. Full classes are the best balance for both the institution and student. No matter how many students in class, the cost of a professor teaching a class is the same, but the profit for the school is different.

When course supply exceeds demand, some courses would only have a few students in class. The maximum seats of each course means the quantity of students a classroom can accommodate. If a large classroom has only a few students using it, there is a monetary loss for the department. Registration information can be found on the real time class availability website of Western Oregon University. There are 1,641 courses offered in winter 2017, about 261 courses have less than a 10% registration rate, and only 13 courses have been canceled. If the department knows the registration situation early, they can cancel more of the less cost-effective courses and save on their instructional budget.

Conversely, when demand outstrips supply, the course fills up quickly, and some students have been put on the waitlist, or some of them would request an override for the course. Each quarter registration period, the registrar’s office of Western Oregon University has to process large numbers of override request for students, which costs the registrar’s office a lot of labor and time. After Western Oregon University uses the Add-on Course Registration System, the cost of these actions would be saved.
5.2.4 Satisfaction

One of the questions on the survey is “Overall, how satisfied are you with WOU’s current online registration system? (1) unsatisfied - (10) highly satisfied”, the result data (see figure 5.5) finds the average score is 6.9 out of 10, is a moderate to high score. However, the comments on the survey showed that people are have realized what problems the Banner system has, but feel they are unable to do anything to change the situation. Students do not have any alternatives, and have to use the Banner system to complete registration. Some students complain that the long waitlist for needed classes has caused them to miss graduating on time or that a complex course catalog gave them insufficient course information toward their earning their degree, again interfering with their graduation plans.

Through the Add-on Course Registration System, most of these complaints can be solved. Student satisfaction with the new Add-on Course Registration System would be higher. With
higher satisfaction, students are more likely to stay, and the retention rate would be higher. Having a stable student population who remain at the University and complete their degree on schedule is important to the school as an indicator of its quality.

6.0 Results

6.1 Tedious Registration Flow

An alternative design of the Banner is the Add-on Course Registration System which allows students to choose appropriate courses and avoid scheduling conflicts without switching between multiple screens. It integrates the information of courses and students, helps the student clear up missing courses and conflicts, and displays all available courses to the student in an intuitive way: a schedule grid.
How can the Add-on Course Registration System display all available courses into a schedule grid? The answer is the data from database needs to be cleaned. From the figure 6.1, we find that if courses start at the same time, the Add-on Course Registration System lists these courses’ course number inside the same grid cell. Because the attribute of class time from the class table of the Banner system Oracle database is a discrete type attribute, the system cannot compare them or it is not numerical. Once two classes have the same class start time but different end time, the time conflict would not be found. However, the Add-on Course Registration System needs cleaning data for data warehouse. The class time-slot should be in continuous type.
When students select a class, the Add-on Course Registration System can discover which other courses have a time conflict with it since the class time-slot overlap. The Banner system found the time-slot was already registered, so other classes cannot fill in again because it would cause registration failure.

The course numbers are presented with various colors; when students are selecting a course, the colors change accordingly. A regular available course in the Schedule Grid is black, a course with a required prerequisite course is light blue. When a student chooses a class, all classes that have a time conflict with that class will change from black or light blue to gray like the changes between figure 6.1 and fig. A.1 (see fig. A.1 in appendix A for a more detail).

The View Box is the dark red area below the Schedule Grid (see fig. A.3 in appendix A for a more detail), which provides two different views to students. The Add-on Course Registration System considers the normal view as default. The simple view will hide all courses that are not available during schedule planning (see figure 6.2).
The Add-on Course Registration System also can view one or multiple types of courses in the schedule grid. The student can choose to view what types of the course that will be explained in 6.2 section in Sidebar. The figure 6.3 shows the view of only required core course with the same sample course information.
The feature of simple view is useful to the freshman, because they have numerous available courses, which would make the Schedule Grid very large. Comparing the figure 6.4, the simple view of the required core courses only and the figure 6.3 with normal view, people can find how the new system simplified the Schedule Grid.
A student has many available courses, so the Schedule Grid will be too large if it contains more than a course number. But students are confused, if the only information displayed is the course number. Therefore, the Add-on Course Registration System makes a course summary pop-up window when a student hovers over the course number of the Schedule Grid. The figure 6.5 is the pop-up window of the regression analysis class of Western Oregon University.
Students obtain the information of course name, reference number, time, days, credit hours, instructor, location, and met arbitrary requirement status, of each course in the schedule grid. This feature helps the student better to arrange their courses. Because sometimes the time gap between two classes is only 10 minutes, the location of two back-to-back classes too far away from each other is not good for students. It is not easy for students to realize the location problem in the Banner system.

In the Add-on Course Registration System, people do not need to find out which courses are succeeding. Because the grid cell next to each other means that they might have a location
problem, so long as the student checks the location from the class pop-up windows, they can arrange the courses more reasonably.

6.2 Insufficient Registration Information

The Add-on Course Registration System needs to include registration, tracking degree requirements and students progress, which means it should integrate the course data and student record. Comparing with the relational database of the Banner system, the Add-on Course Registration System need to access more data. Besides the current regular course information, we should add these 6 attributes to the course table of the database:

1) Complete Course: the student completed this course or not.
2) Course Type: required core course or elective course
3) Required Prerequisite Course: yes, what class is the prerequisite course of this class? Or this course does not need any prerequisite course.
4) Prerequisite Course: Yes, this course is the prerequisite course of which class. Or this course is not any course prerequisite course.
5) Attribute: this course meets what kinds of arbitrary requirements. Or this course does not meet any arbitrary requirement.
6) Forecast Number: the number of students selected same class when they planned their schedule.

With the additional attributes of database, the Add-on Course Registration System can create the select query to count and sum the required course credits, elective credits, and degree required credits to support the Sidebar. Moreover, the new system using the additional attributes divides all courses into 10 level groups for the student by the decision tree algorithm.
These I～X level courses can help system to have a simplified version of the DegreeWorks; the Sidebar section of the Add-on Course Registration System. It orders the course by importance level. A I level course is the most importance to the student, one class can meet 3 rigid indexes, it is a required core course, a prerequisite course, and it meets the arbitrary requirement at the same time. The X is least important, which the student might never select. On the Sidebar, the most important class is listed first, so student does not need to meet their advisor to know which class is important to them, they only need to select the course from the top of the Sidebar list. In addition, the Schedule Grid has several cells, and some of the cells would have more than one course number on it. And course numbers in the same schedule grid cell are sorted the same as the Sidebar list. There are also various same level courses when ordering the course, after ordering them by course level, the system sorts them by the average course score which will be explained in 6.3 section.

Moreover, the color of each course number on both Sidebar and schedule grid are
changing automatically, when students are selecting courses. Three Sidebar screens capture images are displayed in figure 6.7. The left picture of figure 6.7 is what the Sidebar looks like when students logged into their school account. The second one shows that people can choose to view which types of courses they want to see. The right one is an example of what the Sidebar will look like after the student selected 4 classes.

The dark red cell is the type of the course. Each of them has a checkbox on the left. By clicking the checkbox to view this type courses, the system default checked all boxes, but students can choose to check one or multiple of them. There is round bracket on the right side of each course type, and it has two numbers inside. The Add-on Course Registration System helps students to track their degree process. The first number inside the round bracket is the credit of
the student already had of this section, and the other one is the required credits for the student degree (see figure 6.8). For example, the 3\textsuperscript{rd} picture of the Sidebar, (8/53) means the student needs to get 53 credits total from the required courses to get his degree, and after he finished the course he selected, he has 8 credits in required courses. The (20/73) from the complete section means the student needs to complete 73 credits courses to get his degree. And after he finished the courses he selected he can get 20 credits, 8 credits from required courses and 12 credits from elective courses. But the student only completed the CS361 currently, which has a filled checkbox in front of the course number; and the course with an empty checkbox means the student selected this course but has not finished yet.
Figure 6.8 Sidebar of Add-on Course Registration System
When students are selecting courses, the course number of the course on the Sidebar will add its course number from its course type section to the complete section, and it will show an empty checkbox next to the course number. The numbers inside the round bracket beside the course type section also change automatically.

Each class also has a round bracket beside it, but the meaning inside of this round bracket is different to the number in the dark red section. It means the maximum available seats of this course and the “forecast” number. For instance, the BA367Q has (83/35) means that this class has 35 available class seats provided, but there are 83 of students are going to select this course. The Add-on Course Registration System helps students saving their schedule plans, but it has Prime Save and Draft Save (see fig. A.4 in appendix A for a more detail), and the Save Prime is service for the “forecast” number. “Forecast” number shows how many students selected this course on their prime schedule plan, which indicates how popular this course is.

6.3 A Lack of Feedback

The add-on course registration system contains a comment board similar to those used by Amazon for each course (see fig. A.6 in appendix A for a more detail), shows the Discussion Board for BA361D. The course Discussion Board where students, based on student reviews of the courses and professors, can select the course they want. The Discussion Board is a platform where students can find feedback about each class.

By clicking the course number in Sidebar, the student can go into the Discussion Board page of this course. People have to log into their school account to view the discussion page, because the system needs to join into the database to identify who completed this course, and allows them to leave review. Because all reviews are from the students who had this class experience, the review for other students are more reliable than third-party rating websites, like
rate my professors.

One course could be offered from different professors, so below the course number and course name the Discussion Board provides the option of instructor. The Discussion Board provides the information for when the student took this course, the score for this course, if the student is willing to take this course again, if this course has a textbook required, the methods of the instructor, the content of this course, comments from students, and files from this course. The student who are interested in this course can use the sort and filter buttons to view the reviews. It can sort by score and grade received, filter by terms, score, grade received, methods of instructor, content, comment, and uploaded file. The system restricts students to answer the score, would take again and textbook used, and the system will fill the term and choose the instructor automatically, because the student record table in the database has the record of when they took this course and from which professor.

In addition, the Discussion Board can support the order of the Sidebar. All courses would be divided into ten level types. After ordering them by course level, for the same level courses, the system sorts them by the average course score. The average course score equals to create a select AVG query in the database to calculate each course average score and create an order by query to have a sequence in Sidebar.

7.0 Conclusions

7.1 A Review of Results

Registering for courses at Western Oregon University has been difficult at best and almost a nightmare at worst for two-thirds of the students who attend. The Add-on Course Registration System promises to change that. This new system uses a schedule grid to intuitively
display all available courses to the student and can eliminate the tedious registration flow of the Banner system. Because it integrates all necessary information into the Schedule Grid it helps students move their planning procedure from manual to online. In the manual way, the procedure of schedule planning forced students to look up course information in the hard copy catalog, find all course time conflicts, solve those time conflicts, and select their courses accordingly, without knowing if the courses would actually have space for them and without having a way to create an alternative schedule if there were any problems. Using the Add-on Course Registration System means that students can skip all those steps and select their courses directly online, which saves the student a lot of time. Because the Add-on Course Registration System integrates the information, the registration flow is no longer tedious and it is much simpler. Not only can the student find the classes they are looking for, but they can find out whether there is a place for them in that class at the time they want to take it, and where the class fits into their graduation degree requirements.

The left section of the Add-on Course Registration System, the Sidebar, through simply partitioning course types and through the completed credits number, degree required credits number, course forecast number, and course maximum seats inside the round bracket, helps students select courses. It replaces the role of an advisor in many ways, which saves advisors time. The relational database of the Add-on Course Registration System has more related attributes and joins the table of course information and student records, helping the student have perspective for their degree process.

The Discussion Board is a platform for students to get and give feedback of each class. From the feedback, student can choose better courses and instructors for themselves. The course forecast number is a part of the feedback students and departments get from each course. It
uncovers potential problems for students in advance, preventing students being placed on the waitlist. In addition, course average scores supports the sequence of the Sidebar, and the Sidebar guides the schedule grid generation.

7.2 Limitations

The design of the Add-on Course Registration System is based on integrating the course information, degree requirement, and student record in the database. Currently, DegreeWorks is an add-on program of Banner from Ellucian to the Banner system. However, in the Add-on Course Registration System, the DegreeWorks will be integrated into the system, making the whole course registration system more complex. A complicated system is more difficult to maintain and update because each section of the system relates to other sections. System bugs and errors always happens during any system update period. A problem that will complicate the adoption of the new add-on registration system at Western Oregon University is that they, along with the entire Oregon university system, still uses the Banner version 8.8, but the newest version Banner XE was released in 2012. Western Oregon University, like the rest and has not updated to the new Banner XE product. Western Oregon University does not want to update it because of the many problems that can occur after updating a system. But, as has been seen in this paper, the state-wide registration will be upgrading to this newer upgrade in the near future and Western Oregon University will be required to upgrade along with the rest of the schools. The university computer service department and registrar’s office will need to do a lot of testing to adjust the system, and the university computer service department will need to write lots of reports to adapt the updated system.

More procedures done by any system means a higher potential for system error. This can be shown by the report of the Oregon State University:
Student grades listed in the system were not always supported by source documents…The departments did not retain adequate documentation for 12 of 50 grades tested…Under limited circumstance, system processing incorrectly assessed tuition and fees on student accounts…had not determined the cause or the number of students affected.11

The Oregon State University is a member of the Oregon University System, so its course registration system is Banner, the same as Western Oregon University. Banner does not only have the problem of structure and interface, but also has many system operating problems. Testing and maintenance should be routine work for the system. The Add-on Course Registration System would be the same situation. It would still have some problems. The registrar’s office cannot be replaced completely, but they can employ less people since the Add-on Course Registration System would solve many of the most work intensive problems for the registrar’s office and students. Similarly, when there is a Sidebar, the advisor for students is not as necessary, except when they have very complicated problems.

**8.0 Future Research**

The Add-on Course Registration System is not functioning yet, therefore, in essence, future research in part includes management of the problems of integrating the Add-on Course Registration System into the existing system. This is complicated by the fact that the current Banner system being used by Western Oregon University is not even the most current version of that software. This paper only provides an idea of what the new Add-on Course Registration System prototype is, and how to build it. We cannot do any testing to confirm if the system would work, and to predict what kinds of problems it would have. The Add-on Course
Registration System is a complicated system.

Once the school has the Add-on Course Registration System, they will need to modify the database to adapt it to the new Add-on Course Registration System. The database design would be an important factor for supporting the new Add-on Course Registration System operations. However, how to design a good database to support the Add-on Course Registration System would be the primary task: how to integrate the student record, degree requirement, and course information in the database, and how to clean the existing data of each course for the data warehouse.
Appendix A. Proposed Add-on Course Registration System Interfaces.

![Completed Schedule Grid](image)

Fig. A.1 Completed Schedule Grid. Illustrates courses and times selected by the student.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Credits</th>
</tr>
</thead>
<tbody>
<tr>
<td>BA367Q</td>
<td>83/35</td>
</tr>
<tr>
<td>BA477W</td>
<td>64/25</td>
</tr>
<tr>
<td>BA431</td>
<td>46/35</td>
</tr>
<tr>
<td>IS600</td>
<td>19/25</td>
</tr>
<tr>
<td>BA432</td>
<td>32/35</td>
</tr>
<tr>
<td>BA610</td>
<td>33/33</td>
</tr>
<tr>
<td>BA640</td>
<td>39/25</td>
</tr>
<tr>
<td>IS620</td>
<td>20/22</td>
</tr>
<tr>
<td>IS625</td>
<td>8/33</td>
</tr>
<tr>
<td>CS650</td>
<td>11/20</td>
</tr>
<tr>
<td>IS641</td>
<td>15/20</td>
</tr>
<tr>
<td>IS642</td>
<td>5/11</td>
</tr>
<tr>
<td>CS161L</td>
<td>25/22</td>
</tr>
<tr>
<td>BA361D</td>
<td>36/35</td>
</tr>
<tr>
<td>CS365</td>
<td>24/30</td>
</tr>
<tr>
<td>CS431</td>
<td>13/20</td>
</tr>
<tr>
<td>IS589</td>
<td>5/20</td>
</tr>
<tr>
<td>BA615</td>
<td>2/25</td>
</tr>
<tr>
<td>BA620</td>
<td>36/36</td>
</tr>
<tr>
<td>BA630</td>
<td>48/50</td>
</tr>
<tr>
<td>CS653</td>
<td>24/25</td>
</tr>
<tr>
<td>IS675</td>
<td>18/20</td>
</tr>
<tr>
<td>BA676</td>
<td>49/50</td>
</tr>
</tbody>
</table>

**Required Core Courses (8/53)**

**Electives (12/20)**

**Complete (20/73)**

Fig. A.2 Sidebar. Illustrates which courses meet the student’s arbitrary requirement as a list.
Fig. A.3 View Box. Illustrates the view selections of Schedule Grid

Fig. A.4 Save Bar. Illustrates
**Fig. A.5 Course Forecast Number.** Illustrates the number of students who selected same course when they are scheduling their courses.

<table>
<thead>
<tr>
<th>Course</th>
<th>Forecast</th>
<th>Seats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Required Core Courses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA367Q (83/35)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Course Forecast Number</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA610 (33/33)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA640 (39/25)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IS620 (20/22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IS625 (8/33)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS650 (11/20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IS641 (15/20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IS642 (5/11)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electives (4/20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS161L (25/22)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA361D (36/35)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS365 (24/30)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS431 (13/20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IS589 (5/20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA615 (2/25)</td>
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<td></td>
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<tr>
<td>BA620 (36/36)</td>
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<td></td>
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<tr>
<td>BA630 (48/50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS653 (24/25)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IS675 (18/20)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BA676 (49/50)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete (4/73)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CS361</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Fig. A.6 Discussion Board for BA361D of Add-on Course Registration System

<table>
<thead>
<tr>
<th>Instructor</th>
<th>Score (1-10)</th>
<th>Would Take Again</th>
<th>Textbook Used</th>
<th>Grade Received</th>
<th>Mode of Instruction</th>
<th>Content</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>FALL 2018</td>
<td>9.2</td>
<td>YES</td>
<td>YES</td>
<td>A</td>
<td>Mr. Ciloney is a tough instructor but not too tough. He really wants his students to learn but isn’t going to make it easy for them and the students are better off for it. This was an enjoyable class.</td>
<td>Feel free to download the syllabus</td>
<td></td>
</tr>
<tr>
<td>FALL 2016</td>
<td>8.5</td>
<td>YES</td>
<td>YES</td>
<td>A</td>
<td>Funny and wants to teach you more than textbook concepts.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FALL 2015</td>
<td>9.3</td>
<td>YES</td>
<td>YES</td>
<td>A</td>
<td>Good class. Good Instructor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WINTER 2018</td>
<td>5.2</td>
<td>NO</td>
<td>YES</td>
<td>MDE</td>
<td>Very unclear at what he wants you to understand. If you say something other than the correct answer, he grills you for it and picks on you for the rest of the term (he will always assume you are wrong if you are wrong the first time).</td>
<td>Direct teacher that actually cares about his students succeeding! :)</td>
<td></td>
</tr>
<tr>
<td>WINTER 2015</td>
<td>9.3</td>
<td>YES</td>
<td>YES</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WINTER 2014</td>
<td>4.8</td>
<td>NO</td>
<td>YES</td>
<td>MDE</td>
<td>So much studying and hard to get an idea of what type of questions will have on test. A study would be very necessary for this class but know it’s kind of matter of understanding everything. The group project is exhausting to prepare for.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FALL 2013</td>
<td>5.9</td>
<td>YES</td>
<td>YES</td>
<td>C</td>
<td>Disney is a knowledgeable professor, has high expectations, and is a tough grader. Tests are difficult, but he does give the essay questions in advance. Wading on multiple choice questions can be very confusing. Focus is on critical thinking skill!</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WINTER 2014</td>
<td>7.8</td>
<td>NO</td>
<td>YES</td>
<td>B</td>
<td>I enjoyed this class, there were a few case studies and tests.</td>
<td>There was a group presentation towards the end of the term.</td>
<td></td>
</tr>
<tr>
<td>WINTER 2015</td>
<td>9.9</td>
<td>YES</td>
<td>YES</td>
<td>A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>FALL 2014</td>
<td>7.6</td>
<td>YES</td>
<td>YES</td>
<td>B</td>
<td>The work wasn’t that difficult, but if you got an NA you would have to go to the writing center and redo the assignment. Test was hard, go to class for essay questions.</td>
<td>Every student is required to do a current event at the beginning of class, he assigns the days each student presents.</td>
<td></td>
</tr>
<tr>
<td>WINTER 2014</td>
<td>4.3</td>
<td>NO</td>
<td>YES</td>
<td>C</td>
<td>Class is so boring I don’t like even bringing it up. Headaches.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Appendix B. Satisfaction Survey Questionnaire

Satisfaction Survey of WOU Registration System

Circle one:
1. (If you were a graduate student, please skip Q1 and fill Q2)

Undergraduate:
   a. Freshman
   b. Sophomore
   c. Junior
   d. Senior
   e. Non-traditional

2. How long have you been in the graduate program: _______ quarters

3. What is your major:

4. Each time you meet, how much time do you spend with your advisor?
   a. Less than 15 minutes
   b. 15-30 minutes
   c. 30-60 minutes
   d. More than 1 hour

5. When registering for courses for a given term, how much time do you spend searching for courses and planning schedules?
   a. Less than 30 minutes
   b. 30-60 minutes
   c. More than an hour

6. How much time do you spend registering for the term’s classes?
   a. Registering for classes often takes more than 1 session of registration because I often get put on the waitlist.
   b. Less than 2 minutes
   c. 2-10 minutes
   d. More than 10 minutes

7. How often do you experience the course time-conflict reminder when registering for classes?
   a. Never
   b. Sometimes
c. Nearly every term

8. How often do you experience problems getting the courses you need? What is the problem?
   a. Never
   b. Sometimes (The problem is:)
   c. Nearly every term (The problem is:)

9. Do you know what the BA/BS graduation arbitrary requirement courses are? (Liberal Arts Core Curriculum (LACCs), writing intensive course, culture diversity, etc.)
   a. Yes
   b. I have heard of them, but not clear on what they are
   c. I have never heard of them

10. How difficult would you say it is to find specific courses that meet your major or minor requirements?
    a. Easy
    b. I occasionally need to search through the catalog to find courses
    c. Hard; it is difficult to find the right courses

11. How difficult would you say it is to find specific courses that meet your LACC, Writing, Diversity, Quantitative or overall graduation requirements?
    a. Easy
    b. I occasionally need to search through the catalog to find courses
    c. Hard; it is difficult to find the right courses

12. Do you know how many credit hours are remaining in your each requirements? (Major requirements, Minor requirements, LACC requirements, Writing intensive, etc.)
    a. Yes
    b. I rely on my advisor help
    c. No

13. Overall, how satisfied are you with WOU’s current online registration system?
    (1) unsatisfied - (10) highly satisfied

14. Overall, how would you rate your experience with your last use of WOU’s online registration system? (1) very difficult - (10) easy, no problem

15. What other features would you want to add to WOU registration system?
Works Cited

[1] Laghari, Mohammad Shakeel. "Knowledge Based Course Planning System for EE Students at UAE University."


[7] Bill Kernan (chief information officer, University Computing Services, Western Oregon University), interview by Yilin Li, October 28, 2016, ITC 009.

[8] Amy Clark (University registrar, Western Oregon University), interview by Yilin Li, October 13, 2016, University Registrar’s Office.
