Managing Real-World Projects in Capstone Computing Courses

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## Overview

Managing Real-World Projects in Capstone Computing Courses
What is Capstone? Capstone course is a vehicle used to assess student’s application of what they have learned in their major. It is a great opportunity for students to apply and demonstrate their full knowledge acquired during their time at the university. It usually involves students working in teams following typical industry standard project management philosophies.

The Capstone Project is usually a 30 to 40 pages document including the presentation. The final report should include the results experienced while working on the project. Any products that results from the project can be submitted via cds/dvds etc.

Capstone projects typically covers many important areas in the society, for example health, technology, social welfare etc. They can last one semester or longer depending on the type of project. There is usually a capstone project for each university degree program.

**Rochester Institute of Technology**

My choice for the Capstone research is the Rochester Institute of Technology. I chose this school because of the in-depth information on the course, and also because of the different style capstone course RIT offered.

Before we can discuss the particulars of the RIT capstone, it's important to understand what a capstone course means. According to the RIT guide, “a project involves some type of practical development with a deliverable.” The guide goes on to say, “this may include development with computer equipment, software packages, and programming or scripting language.”

RIT offers four different capstone projects. There is a capstone preparation course, a human-computer interaction course, game design and development capstone, and finally a software development and management course. Each of these capstones is a student directed work, with the specific purpose of applying the education the student has received, combined with the chosen direction and concentration that has developed over the course of his education. In the capstone course a student must do the design and planning, and complete all the work. RIT's guide mentioned that
students should plan to spend at least 6 months completing the capstone. Students are expected to complete their capstone after they complete their MS work. RIT mentions that all capstone work is an individual effort, it seems that teams are not the preferred choice.

The first step in RIT’s capstone is creating an initial idea document. This step is important because the student will need the support of faculty members throughout the process. It is suggested that a student find faculty members who share the same interests. Once they’ve achieved that, a short, well written document, should be created to convey the ideas.

Identifying faculty who will be interested in serving on the graduate committee is critical. RIT suggests that a student dedicate sufficient resources on researching faculty members who share the same interest. They go on to explain certain techniques that will help in that endeavor, such as looking at faculty websites and reading articles that they have published. It is important to tell the faculty member why they would be interested in the project.

Creating a proposal is the next step. This means that the initial document of 2-3 pages, will have to be turned into a full proposal that contains a clear statement of the problem for the project, the reason for choosing the topic, the skills that they have that will support the work, a plan that they will use to solve the problems list of deliverables, which includes how they will know when they are done, and a time-line. RIT suggests that this document must have the highest standards of writing. Since the student is taking a capstone course, they need to form a faculty capstone committee of at least two members. The guide goes on to indicate that there is a fairly large amount of paperwork which must be filed in order to move forward.

Once a student completes his capstone work they will have to defend it in a public forum. The capstone defense is intended to allow the student to demonstrate their expertise, skills, and professionalism within the context of the individual project. The faculty committee sets the requirements for the defense. It typically involves a formal presentation, and if necessary, a demonstration of the work. The defense can be done on campus, or as is the case for out of state
The grading system states that if the work is not completed by the end of the quarter, the student will automatically receive an incomplete. They then have two quarters to complete the work and replace the incomplete grade with the actual capstone grade. If this is not achieved, the incomplete becomes an “F”. The MS capstone requirement is only successful if they completed all the work, made a proper defense, and the capstone document has been completed to the satisfaction of the capstone faculty committee. Once this is done, a student is awarded a letter grade of “A”, “B”, or “C”.

New Jersey Institute of Technology

Abstract

The NJIT’s capstone program is a combination of senior-level courses offered to students under NJIT’s college of Computing Sciences, which offer the Computer Science, Information and Information Technology Majors. The courses can also be taken as an elective by students from other majors at the school, such as Management, Engineering or Architecture.

Introduction

The program was founded in the fall 2002 semester, by Professor Osama Eljabiri, he wanted to instill students with valuable real-work experience. The capstone teams and well-selected sponsors, has become a shining star with more than 350 projects and 250 sponsors in the last six years with a very high rate of success. Starting as a 3-credit-hour new course in 2002, to introduce senior level college students to some real world experiences, the program has evolved over the years into a complex learning organization that took undergraduate education, graduate education and high school education to a whole new level that integrates real world practices with every curricula and learning activity. Today, the capstone program is expanding even further to include new learning communities such as middle school students, community college’s students and statewide, national and international
collaboration and partnership opportunities with current international student and sponsor partnerships forming.

**Sponsor and Projects**

$ Capstone Sponsors are partners in a capstone experience, and contributes time, resources, and provide valuable real world experience.

$ Sponsors act as clients for students

$ Steps to becoming a sponsor: complete online form, read Sponsors Manual

<table>
<thead>
<tr>
<th>Sponsor</th>
<th>Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>City of Newark /pension</td>
<td>Pension System Automation</td>
</tr>
<tr>
<td>Benjamin A. Guzman - System Analyst</td>
<td>To create a database that manages pension needs.</td>
</tr>
<tr>
<td>Tunkey Properties</td>
<td>E-Vacations Rentals Commercial Website</td>
</tr>
<tr>
<td>Gracie Diaz  Owner</td>
<td>To design and development of an e-commerce website that will function as a referral network for the vacation rental market.</td>
</tr>
</tbody>
</table>

**The Team Formation Process**

The following process will be followed to form project teams in the senior project capstone class:

$ The instructor creates project proposals’ database in collaboration with sponsors.

$ Interested students apply for project managers position--should have good grades in prerequisite classes, a competitive GPA, interdisciplinary background, leadership skills, team spirit and ability to create synergy and cohesiveness among team members. Project
management experience and background is definitely a plus.

$ The instructor selects the best applicants who meet the criteria.

$ Students apply to available positions directly to selected project manager.

$ Teams declare projects approved selection, project titles, project abstracts and team structure formally through both online form and the first team presentation.

**Team Composition**

The teams should reflect multi-disciplinary skills in their composition to handle task diversity:

<table>
<thead>
<tr>
<th>Position Code</th>
<th>Position</th>
<th>Job description/responsibilities</th>
<th>Qualifications</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Project manager management tech</td>
<td>The project managers will be responsible for project, team, and deliverables. Etc.</td>
<td>Project management techniques are essential.</td>
</tr>
<tr>
<td>02</td>
<td>System Analyst</td>
<td>the System analysts will be responsible for requirements gathering and documentation and coordinating with other team members.</td>
<td>Experience/background in requirements analysis, etc. and project documentation.</td>
</tr>
<tr>
<td>03</td>
<td>Back-end designer, 0301 Data’s Base Designer, 0302 Network Designer</td>
<td>Responsible for designing the back-end of system including data structures, entity relationship models normalization, system structure and other architectural model, etc.</td>
<td>Experience/background in DBMS, case tools and modeling techniques in software engineering.</td>
</tr>
<tr>
<td>04</td>
<td>Front-end designer</td>
<td>Responsible for designing the user interface for users</td>
<td>Experience/background in HCI, cognitive psychology,</td>
</tr>
</tbody>
</table>
including GUI components, forms, reports, navigation, etc.  
user interface design, user manuals.

| 05 | Programmer | Implementing the system at the unit level and system level. Testing and Maintaining the system. Writing user manual. | Experience in web programming and other programming such as C++, Visual Basic, Java etc. |

**Project Team Rules**

The team group project will be graded as one, but each team member will receive the given grade. Anyone who does not participate in the group project does not receive group grades. Instead, they will receive what represents their percentage of contribution:

$ All team members should participate in the work of the project.

$ Project managers are the lead contacts with sponsors, all team members should interact with sponsors as needed.

$ Do not tolerate a free rider in senior project class. Teams may divorce free riders through due process. If the team divorces you, you will receive a grade of "F."

$ Volunteer are to do whatever you can do on the project.

$ The successful completion of the project depends on the work of every member throughout the entire project.

**Team Firing Policy**

As a team, you have the right to fire any member that is not contributing to your project. The policy is there to enforce group work and to a problem member. If a team member is fire, you must write a memorandum as soon as possible. Do not write it late in the course so that the team member
can join another group or develop their own project. **If the member fails to join another group or develop their own project, the member will get no points in the project and no exceptions!**

$\text{Within the first month of the semester:}$ The team can fire the team member and the member will be asked to join another group or do a project on their own.

$\text{Within the second month of the semester:}$ If free rider wishes to put sufficient efforts in they are recommended to drop the course.

$\text{After the second month of the semester:}$ The team project manager will decide the free rider percentage of their duties and responsibilities that was actually accomplished in comparison with other team members. For example, if the member's work versus team members work was 10% and the group achieved 90% in the final evaluation, this team member actual grades will be 9% (this 10% x 90%).

**Conclusion:**

$\text{The additional time allows for more comprehensive projects, allows students to more fully develop their design and conceptualization abilities, and allows for stronger development of teamwork and other project related skills.}$

$\text{The additional time allows for increased development of technical communication abilities, with more deliverables (written and verbal) during the semester.}$

**Managing Real-world Projects in Capstone Computing Courses**

**Indiana University School of Informatics**

After doing a few hours of researching universities in the USA, a university capstone project caught my attention it was the Indiana University School of Informatics. The School created the capstone projects for senior undergraduates that have reached toward the end of their degree requirements. The project will allow students to progress and use different type of programs such as:
XML, PHP, and database design. Once a project is determined, the team would develop a plan that will allow them to succeed in the creation of the project. Teamwork and communication are empathized in a real-world environment.

The following describes the basic project outline that student would follow from the formation of team to the delivery of the project. Prior to team formation and project proposals student will need to attend what lectures describe as Practice Sections:

**Practice Section:** The practice sections are scheduled in a way to accommodate opportunities to get the projects started as soon as possible. The practices allow breakouts of smaller numbers of students to allow team formation, design activities, problem solving, and discussion of class topics.

**Team Formation:** Student determines what team members they would like be with.

**Project Proposal:** A proposal will be submitted to the instructor that contain the following information, project name, high level detail description of the proposed project, what customer will system be developed for, Team profile information, Benefits statement, and a project plan.

The following are sample Capstone projects that past developed:

**Massively Parallel Architectures:**
Parallel computation using cellular automata framework, using patterns to compute.

**TeleCom:**
Creating a complete checkout system, including database, for the Department of Telecommunications Production Lab

**iCycle:**
Implementing RFID (Radio Frequency Identification) technology into the Indiana University Little 500 for race data analysis

**Project Selection:** Instructor will evaluate and determine the best projects, if a project fails to meet what the instructor seeks, and then a meeting will be required for student to discuss in further detail about the project.
**Project Requirements:** The project requirement expands from the proposal of the project and its identities. What are some requirements needed for the project to function that way it should, a validation that will determine if the project succeeded what it supposed to do. Prototypes and sketches of the project will be needed and last a detail project plan.

**Project Design:** The design phase of the project will determine what will actually be needed for the construction of the project. This phase should also show detail structure-breakdown that identifies who will do what and by when.

**Project Implementation:** The goal is to build the system, whichever way possible. Just build the system.

**Validation:** The testing of system by the designer, and the customer testing will be required.

**Documentation:** Not every system will have documentation. The documentation will help assist developer, and not the users.

**Delivery:** To satisfy the course requirements you will need to demonstrate it to the instructors, even if it is not complete at the time of the demonstration. You will need to provide two written documents. The first is a two page abstract that describes your project to an uninformed person. Think of it as something we would post on the website for customers, parents, and future classes. The second is a longer version of the abstract that provides more details about the project, including team/process issues.

The following information show the instructor way of grading Capstone project.

Project

- Requirements 20%
- Training plan 5%
- Design 15%
- Implementation 20%
- Process/reporting 15%
Midterm Exam 10%
Final Exam 10%
Participation 5%

Communication: The way students and professors communicate is using Indiana University internal blackboard system.

<table>
<thead>
<tr>
<th>Method</th>
<th>John Macal</th>
<th>UnivB</th>
<th>UnivC</th>
<th>UnivD</th>
<th>UnivE</th>
<th>UnivF</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instructor-chooses students randomly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructor-using student abilities</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instructor-using student abilities and other student information</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Students choose team members</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hybrid approach-instructor and students together form teams</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Other methods</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Southeast Missouri State University

Capstone as it is referred to as “putting the final stone in place” (Parente, Brown and Warner) to complete what is usually the final course in completing your studies, whether it be a Bachelors, Masters, PhD. Capstone are courses were developed so that they provide the student with an understanding of what some of the career computing positions in the professional working world are expected to be like. It requires working in a team oriented type of environment, where extensive research is done. The Capstone assists in “how to interact with customers and conduct requirements analysis, how to build and test systems, and the related technical and soft skills. Emphasis is placed on developing skills and knowledge in technical areas that have realistic value in the workplace.” Capstone’s involves students’ to interact with the customer, stakeholders, colleagues, simulating a product to be produced involving a
group of professionals with different levels of expertise to formulate the plan or final product. Most
Universities but not all have a required capstone course, but the capstone course itself has been around
for many years.

“The earliest capstones can be traced to the end of the eighteenth century when college
presidents taught courses generally integrating philosophy and religion. One of the most famous was a
class at Williams College in Massachusetts taught by President Mark Hopkins that inspired, among
others, future U.S. President James A. Garfield. Since its inception, the senior seminar has appeared
and disappeared in colleges and universities throughout the United States.” (StateUniversity.com
Capstone Courses in Higher Education Types of Courses and the Future)

The University of South East Missouri State University combines different sections of
computing the MIS, CIS and CS together into one semester 3 credit course. The project covers the
areas of software development, system analysis and design. The course is set up so that the team sets up
a project management, communication between all levels of stakeholders, testing of the developed
product to cover the quality assurance and develop the software product. The capstone course at
Southeast Missouri State University does mention that there is project leader and does not mention how
the leader or other members are selected. The other members of the team include programmer, tester
and communicator. In this university’s course the team leader is expected to develop a plan and
delegate the work to others. In the “real world” project the following deliverables are expected from
each of the logs from each individual of the report and their reflections, an oral presentation to
members (customers) and faculty. A project report must be presented and three stages and the final
report has to include details and the user’s notes. Presentation: Use of a Case Diagram or Data Flows
Diagrams, Presentation of Case Model and User Interfaces and a full presentation to customer,
instructor and classmates. The peer-oriented evaluation form is used in order to assess the level of
input each individual as made.

This University makes no mention of having any global issues since they do not demonstrate to
have offered this course online. This particular example does not mention how to deal with disputes are handled among team members. My idea of what a solution would be if there is a dispute affecting the progress of the project and the dispute is based on a conflict affecting proceeding then the members of team need to be reassessed before the project can continue because it will affect the outcome or the timeline. If there it is a personality issue but you have a great team of professionals with good backgrounds that can ultimately result in an outstanding finished product then that will have to be set aside.

The pros of conducting real-world projects in university courses, it gives students the experience of working in a group with other backgrounds and can exchange their knowledge and ideas as one unit. The cons of conducting real-world project in university courses, if it’s not an area that a student(person) would be working in the “real-world”, they will not be engaged to their full potential and not be of much use in the project. This project would not be getting a detailed ideal of the capabilities of each individual unless it would cover all backgrounds and interest and if that be the case you may not get members to be motivated and working to capacity.

Capstone course is to designed to demonstrate skills, understanding, independence, teamwork, critical thinking, communication and produce the finished product.

Bibliography

Overview:
1) http://wagner.nyu.edu/capstone/
2) http://www.essaytown.com/writing/write-capstone-project
3) http://www.rit.edu/~w-cfms/grad/capstone.html
4) http://www.healthcareitnews.com/news/capstone-project-requires-students-develop-ehr-plan-
demonstrates-meaningful-use

5) http://capstoneprogram.com/default.aspx

Rochester Institute of Technology
2) http://www.csis.pace.edu/~ctappert/it691-10fall/projects-journal-2010.pdf

New Jersey Institute of Technology
1) http://capstoneprogram.com/testimonials.aspx
2) http://capstoneprogram.com/sponsors.aspx

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