

Developing an Agile Project Management Course for Graduate Students

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Abstract

The Department of Engineering Leadership and Program Management at The Citadel designed and implemented a new graduate course to teach the fundamentals of Agile project management. The revision was motivated by recommendations from a variety of sources to include input from industry, alumni and the departmental advisory board as well as professional publications. The consensus of faculty, students, alumni, industry and the advisory board was that (1) a solid foundation in Agile methodologies is important preparation for project management practice and (2) “solid foundation” means that graduates can select and execute appropriate Agile techniques to plan, execute and deliver quality results that frequently deliver value to customers. Previously our curriculum did not have an Agile methodologies course that provided our graduates with the solid foundation industry was looking for. In particular, our graduates were not prepared to develop user stories and story maps, estimate and plan for sprints, track project execution and releases using burn-down charts or conduct a retrospective session. Graduate students who have completed program core project management courses that follow the “waterfall or predictive” methodology are encouraged to take this Agile course as a program elective. This course explores Agile-related practices, methodologies, Servant Leadership techniques and applications in development and operational project environments. Team projects are used to focus on developing the knowledge, skills, abilities and attitudes considered essential in effectively managing teams in adaptive project environments and integrating these practices with other project management methodologies.

Keywords

Agile, Servant Leadership, True Leadership, Scrum

Introduction

Expectations for graduates entering the project management profession are changing and intensifying to meet the complex needs of society. Global issues, technological innovation, blending of discipline boundaries, and increased professional complexities are transforming how project managers elicit and analyze customer requirements to develop and deliver effective solutions. Society demands are requiring project management graduates possess technical knowledge and the ability to think creatively and critically, effectively communicate, and work in teams to solve challenging problems. Many contemporary problems project managers face are considered multidisciplinary in nature making it clear that academic programs must educate students to work on projects characterized by flexible scope, adaptive scale and changing complexity. Continuously changing technology and industry demands are influential factors in education. The project management profession relies upon practitioners with the skills to innovate and effectively compete, and towards meeting those needs academic institutions are expected to provide a curriculum that introduces students to appropriate techniques for successful transformation into productive careers. As a result, academic institutions are challenged to adopt appropriate strategies to meet innovative educational demands from both students and industry.[1]

Many projects have traditionally been managed using a waterfall or predictive methodology. This works well when requirements and scope are clearly defined for the project with all activities flowing logically from the beginning of a project through the end. It is not uncommon for project managers to be faced with poorly defined requirements and ambiguous scope and a customer looking for the project manager to help them define what the deliverables should be in terms of specifications and performance. As projects grow larger and become more complex, requirements often become more ambiguous, and significant project issues can occur to include cost overruns, delays, and project failures. Applying waterfall planning and execution under these circumstances becomes difficult and what is needed is a project planning methodology that embraces change and complexity and that is adaptive to scope change. This is where the Agile methodology can be a valuable tool for project managers.

Change management is an important component of effective project management and managers should lead change, not be led by it. Agile works well in complex situations where requirements and scope are evolving because it focus is on developing the project as an iterative process rather than a pre-set plan. Agile supports the iterative release of useable functionality that enables the project team to show the client value creation incrementally and, as the project progresses, a greater understanding and definition of previously “fuzzy” information becomes clearer. One of the fundamental tenets of Agile is a phased approach that supports the client becoming an integral part of the design, working with the project team more and more as the project progresses and being able to see and comment on what they are receiving. [2]

In order to better prepare our project management students to be effective practitioners, faculty developed a graduate course, PMGT 663 Fundamentals of Agile Project Management, which explores Agile-related practices, methodologies, and applications in development and operational project environments. The course focuses on developing the knowledge, skills, abilities and attitudes considered essential in effectively managing teams in adaptive project environments. The goal of this course is to provide the student with an accelerated and disciplined systems approach to plan and manage projects. The focus is on using hands-on

learning activities to clarify relationships between roles, purpose, and performance. Agile team roles and responsibilities, systems thinking, and adaptive capabilities to advance project performance will be emphasized.

By the end of the course, students should be able to perform the following:

1. Adapt Agile techniques in developmental and operational environments.
2. Develop knowledge, skills, and abilities of team members to perform in self-organizing and self-aware cross-functional agile delivery teams.
3. Deploy best known sprint planning and estimation practices involved with themes, user stories, and tasks.
4. Integrate Agile methodologies in new and existing organizational frameworks.
5. Track the work in progress, while communicating velocity, release and validation performance
6. Perform retrospective meetings to identify and incorporate process improvements.

Background

The [Institution] is a teaching college in [City, State location], with a day program student body numbering about 2,200 students, and an evening program of graduate and professional studies with a student body of about 1,600. The mission of the Master of Science in Project Management (MSPM) program is to equip a diverse professional student population with the applied knowledge, principled leadership, and management skills to effectively lead an organization's implementation of projects and multi-disciplinary initiatives. The Department of Engineering Leadership and Program Management recognizes that project managers are people-serving professionals who manage resources as well as technology. Project managers initiate, plan, execute, control, and close projects that are essential to modern life in both the public and private sectors. Accordingly, the Department strives to develop the skills of its students in the management of resources, time, materials, money, and people through effective combination of effective academic curriculum and professional discipline.[3]

Prior to Spring 2020 a three-credit hour course, PMGT 650 Overview of Technical Project Management, was offered to the students. This course introduced concepts of application of the process inputs, tools and techniques, and outputs associated with the ten (10) knowledge areas and the five (5) process groups identified in the Project Management Body of Knowledge (PMBOK). [4] Based on faculty input, industry feedback, and curriculum reviews it was determined that a new course was needed. The course should introduce students to agile-related practices, methodologies, and applications and focus on developing the knowledge, skills, abilities and attitudes considered essential in effectively managing teams in adaptive project environments.

Through the process of review/comparison of curriculums from a number of graduate project management programs at five comparable schools, a list of core concepts and topics was identified for inclusion in a new project management course that focuses on the Agile methodology. The following learning outcomes were developed for inclusion:

1. Adapt Agile techniques in developmental and operational environments.

2. Develop knowledge, skills, and abilities of team members to perform in self-organizing and self-aware cross-functional agile delivery teams.
3. Deploy best known sprint planning and estimation practices involved with themes, user stories, and tasks.
4. Integrate Agile methodologies in new and existing organizational frameworks.
5. Track the work in progress, while communicating velocity, release and validation performance
6. Perform retrospective meetings to identify and incorporate process improvements.

Spring 2020 Offering

To introduce our MS Project Management students to the Agile framework and methodology a three-credit hour course, PMGT 663 Fundamentals of Agile Project Management Special was developed and offered as a technical elective to graduate students. Prior to the initial offering in Spring 2020, the course was approved by appropriate graduate curriculum committees and established as PMGT 663. After which, one section was offered in Spring of 2020. The course was approved as a cross listed course where graduate students in the computer sciences degree program at both the [Institution] and the [local Institution] were approved to take the course as a technical elective.

The major challenge in preparing a course of this type is in deciding how to condense abundant subject matter into allocated time constraints, while still providing significant technical content. In the first offering of PMGT 663 the planned range of topics to be covered in a one semester course was ambitious and it was a challenge to cover all of the desired material. Following the initial course offering the first four class lectures were condensed to provide an introduction to Agile methods. This allowed us to allocate more class time for a group practical exercise we call “The Agile Game”. For PMGT 663 classes met one night a week from 6:00 – 8:45 PM. Table 1 provides a list of the course objectives, while Table 2 depicts how classroom hours are apportioned.

Table 1. PMGT 663 Course Learning Outcomes

PMGT 663, Fundamentals of Agile Project Management List of Course Learning Outcomes
<ol style="list-style-type: none">1. Adapt Agile techniques in developmental and operational environments.2. Develop knowledge, skills, and abilities of team members to perform in self-organizing and self-aware cross-functional agile delivery teams.3. Deploy best known sprint planning and estimation practices involved with themes, user stories, and tasks.4. Integrate Agile methodologies in new and existing organizational frameworks.5. Track the work in progress, while communicating velocity, release and validation performance6. Perform retrospective meetings to identify and incorporate process improvements.

Table 2. Course Schedule showing topic hours scheduled.

Topic	Hours
Class Orientation, Intro to Agile	2.75
Agile Principles and Practices	2.75
Creating the Agile Environment, Scrum Organization	2.75
Implementing Agile, Business Justification of Agile and Case Study, Intro Fundamental Scrum processes	2.75
Scrum Cycle Initiate, (Agile Game); Round 1: Team work and briefs	2.75
Scrum Cycle Initiate, (Agile Game); Round 1: Team work and briefs; Guest speaker	2.75
Scrum Cycle Plan and Estimate, (Agile Game); Round 2: Team work and briefs	2.75
Scrum Cycle Plan and Estimate, (Agile Game) Midterm Exam; Round 2: Team work and briefs	2.75
Scrum Cycle Implement, (Agile Game); Round 3: Sprint 1; Team work and briefs	2.75
Scrum Cycle Implement, (Agile Game); Round 3: Sprint 1; Team work and briefs; Guest speaker	2.75
Scrum Cycle Review and Retrospect, (Agile Game); Round 3: Sprint 2; Team work and briefs	2.75
Scrum Cycle Review and Retrospect, (Agile Game); Round 3: Sprint 2; Team work and briefs	2.75
Scrum Cycle Release, (Agile Game); Round 4: Create Retrospective Reports. Team work and briefs	2.75
Scrum Cycle Release, (Agile Game); Round 4: Teams Present Retrospective Reports. Team work and briefs	2.75
Scaling for larger projects and Enterprise, SAFe	2.75
Final Exam	3.00
Total	44.25

Course Goal

This course will provide the student with an accelerated and disciplined systems approach to plan and manage projects. This approach will focus on using hands-on learning activities to clarify relationships between roles, purpose, and performance. Agile team roles and responsibilities, systems thinking, and adaptive capabilities to advance project performance will be emphasized.

Students enrolled in PMGT 663 should develop a practical background in the Agile methodology that will allow them to apply the techniques to effectively manage projects. This course presents

core learning concepts and uses Agile related scenarios in the assignments to increase comprehension. In the first part of the course, students are introduced to basic concepts, methodologies and framework for employing Agile project management. In the second part of the course, students are introduced to the Agile Game which is a practical application running group assignment based on the game developed and introduced by Eduardo Miranda in a workshop for teaching Agile methods by using group activities and simulation. The Agile Game, which consists of four rounds of deliverables and supporting class activities. The objectives of the assignment are for students to practice the writing of user stories and story maps, estimation using the Planning Poker technique, planning a sprint, track the project execution using sprint and release burndown charts and conduct a retrospective session in which suggestion for improvements are made. [5] The Agile Game activities require students to analyze, synthesize and apply the techniques covered in the lecture topics. The intention is to expose students fundamental Agile practices which build a foundation from which to apply effective project management techniques such as SCRUM which is a process framework for agile development.

Course Design

There are three principal aspects receiving primary emphasis within the course design.

- 1.) Framework and Methodology (Modules 1 to 4). Topics of study include the development of an Agile mindset, theoretical and practical applications of Agile practices, the transition and integration of these practices with other project management methodologies, along with the stages of the Agile development cycle.
- 2.) Practical Planning (Modules 5 to 6). Time is built into classes to discuss Agile planning, execution and reporting and evaluation in the guise of the Agile Game.
- 3.) Practical Application (Module 7 to 10). Module 7 focuses on the Scrum Phase of Implement. This is where we actually have the teams start sprinting. Module 8 focuses on Review & Retrospect. Module 9 focuses on Release. And Module 10 takes a broader look at enterprise-level Scrum applications like the Scaled Agile Framework (SAFe).

The Agile Game

- Is a running group assignment, which consists of four rounds of deliverables and class activities. based on team planning and velocity.
- The objectives of the assignment are for students to:
 - practice the writing of user stories and story maps,
 - estimation using the Planning Poker technique,
 - planning a sprint,
 - track the project execution using sprint and release burndown charts,
 - and conduct a retrospective session in which suggestion for improvements are made.

Module 5

Rules for the Agile Game (Round 1)

- In order to reinforce the Agile concepts we have recently studied we will be engaging in a series of Agile games designed to emphasize key concepts and provide students a chance to gain experience working on a simulated agile development project.
- In Round 1 we will be simulating the first six of nineteen Fundamental Scrum Processes.
- Scrum Phase: Initiate
 - Create Project Vision

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- Identify Scrum Master and Stakeholders
- Form Scrum Team
- Develop Epics
- Create Prioritized Product Backlog
- Conduct Release Planning

Deliverable 1

- At the completion of Round 1, teams will present a 3-minute brief on their output for the 6 Initiate processes.

Module 6

- Scrum Phase: Plan and Estimate
- In Round 2 of the Agile Game, we will be simulating (7 – 12) of the Fundamental Scrum Processes.
 - Create User Stories
 - Estimate User Stories
 - Commit User Stories
 - Identify Tasks
 - Estimate Tasks
 - Create Sprint Backlog
- The students will hear from a guest speaker who will lead them through a User Story Workshop, covering what makes a good user story, what should not be included in a user story, and how to break up user stories into the smallest amount of work possible.

Deliverable 2

- At the completion of Round 2, teams will present a 3-minute brief on their output for the 6 Plan and Estimate processes.

Module 7

- Scrum Phase: Implement
- **In Round 3** we will be simulating the next three (13, 14, 15) of the Fundamental Scrum Processes. Round 3 will span 4 weeks of class in order to complete 2 two-week sprints.
- Deliverable 3: Sprint planning and execution
 - Conduct the Daily Scrum meeting.
 - Prepare/Update a Scrumboard.
 - Prepare/Update an Impediment Log.
 - At various intervals throughout the sprint, the instructor will insert impediments into the team's sprint.
 - Prepare a Sprint resource availability plan.
 - Discuss the initial velocity to be used for planning.
 - Estimate each story/task in your Backlog in story points. Tasks shall be such that they can be completed by an individual in during the sprint time box. Larger tasks should be broken down into the smallest possible increment.
 - Iterate until the work the team will be committing to is doable within the Sprint time box.

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- Create the Sprint backlog.
- Class Activity: Executing the Sprint
The purpose of this activity is for participants to learn how to use the Scrum task board and the burndown charts to manage a sprint. Secondly the activity will provide insights into the things that need to be considered when deciding whether to expedite, multitask or put more than one person to work on a given task. Students must preserve all material and take notes to use them in the retrospective deliverable.

Module 8

- Scrum Phase: Review & Retrospect
- Students will repeat the Module 7 activities and deliverables for sprint 2.
- Students will incorporate any lessons learned or unfinished work from sprint 1 into sprint 2.
- The students will hear from a guest speaker who will lead them through a Review & Retrospect Workshop.

Module 9

- Scrum Phase: Release
- In Round 4 we will be simulating the remaining four (16-19) Fundamental Scrum Processes.
- Deliverable 4: Retrospective Report
- Teams will present a 10-minute brief of their written report that includes the following:
 - Show the completed Release Burndown Chart.
 - Show the completed Sprint Burndown Chart.
 - Calculate the team's velocity, efficiency & quantity of unfinished work.
 - Share insights. Think about the difficulties you experienced and your "Aha!" moments. Were the difficulties the result of logistics or lack of knowledge, or was something intrinsic to the methods? How could you overcome those? What did you learn? When? What were your beliefs before the exercise? What is the significance?
 - Provide recommendations for the team.
 - Provide recommendations to the instructor.

Module 10

- Discuss how to scale Agile for larger projects and Enterprise.
- We will briefly review the Scaled Agile Framework known as SAFe.
- Wrap up this Fundamentals of Agile Project Management course with some final thoughts in the group discussion

Course Assessment

Assessment of student learning focuses on higher-level assignments.

The course focuses on developing a deeper understanding through solving practical application problems. As expected in professional practice, students are taught to apply the techniques and processes. Applicable techniques are introduced and explained then demonstrated during the Agile Game. Students are not expected to memorize processes but rather to synthesize them so

they can be applied in a variety of scenarios develop and implement solutions, and then analyze and report results.

Course assessment of student performance is based on the practical application assignments in the Agile game along with weekly quizzes and graded discussions. The course incorporates four rounds of group deliverable assignments of increasing complexity requiring students to; Initiate, Plan and Estimate, Execute, and present a Retrospective Report based on the simulated Sprints.

Table 3. Assessment of student performance on Learning Outcomes.

Learning Outcome	Assessment Technique	Performance against 80% Standard
1	Scrum Cycle Plan and Estimate, (Agile Game)	Meets; 96%
2	Scrum Cycle Implement, (Agile Game)	Meets; 90%
3	Scrum Cycle Plan and Estimate, (Agile Game)	Meets; 97%
4	Scrum Cycle Initiate, (Agile Game)	Meets; 85%
5	Scrum Cycle Implement, (Agile Game)	Meets; 93%
6	Scrum Cycle Review and Retrospect, (Agile Game)	Meets; 99%

Assessment Achievement Discussion

Table 4. Assessment of Learning Outcomes.

Learning Outcome	Assessment Discussion
1 Adapt Agile techniques in developmental and operational environments.	Throughout the semester, students developed their knowledge of Agile project management. For the most part, the students were largely unfamiliar with the Agile concepts, as the majority of students work in non-software industries. Active class discussions provided students an opportunity to share experiences, express doubts/concerns, and provide insights on project management and to discuss the Agile simulation.
2 Develop knowledge, skills, and abilities of team members to perform in self-organizing and self-	We implemented 4 10-day sprints using the Agile Simulation. We were able to afford the students adequate time during class to form Scrum teams and to start planning. Students finished planning during the week. Affording in-class planning time seemed to help the students.

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aware cross-functional Agile delivery teams.	
3 Deploy best known sprint planning and estimation practices involved with themes, user stories, and tasks.	The mechanics of planning and executing the Sprints allowed students to gain a much better appreciation for the similarities and differences between Agile and Waterfall/predictive processes. By the end of the course students demonstrated a good understanding of the Agile processes.
4 Integrate Agile methodologies in new and existing organizational frameworks.	The lectures coupled with guest speakers and class discussions helped the students appreciate the aspects of Agile and form a solid understanding of the environments where Agile will work and where it will not work. We also discussed how a hybrid approach might be the best place to start in industries where an established predictive model of project management is in place and seen as effective.
5 Track work in progress, while communicating velocity, release and validate performance	By incorporating story boards, burn down charts and backlogs as Agile tools students were able to plan, execute, monitor and control the sprints. The majority of the students easily adapted to the use of these tools and found them to be effective.
6 Perform retrospective meetings to identify and incorporate process improvements.	Halfway through the semester, the students participated in an instructor-led class retrospective via Parabol so they could see the process (and technology) in a controlled environment. We implemented some of the action items to improve the second half of class. In the fourth and final round of the Agile Simulation, students were required to develop and present a large retrospective brief and written report. They were provided with an optional sample retrospective template but were given leeway in developing and presenting the content however they deemed appropriate. The teams did a great job of utilizing graphics, photos and descriptions of the sprint activities in their retrospectives.

Opportunities for Course Improvement

- Varying Agile sources: In addition to the Agile Practice Guide and the Scrum Body of Knowledge, including more commonly referenced Agile sources like The Scrum Guide. The students found the SBOK particularly dry.
- Including more examples from outside of the software industry: Since many students come from outside of software development, it can be a double leap for them to understand software terminology and Agile terminology. More examples will be provided from manufacturing, retail, and other non-tech sectors.
- Incorporate student choice in the Agile Simulation project: While most students stated that the concepts really sunk in when they began practicing them via the Agile

Simulation, the project material of the time reporting system was not as interesting or easy for them to apply the Agile techniques. Incorporating student choice either from a short list of instructor-approved project topics or a free-form choice option would resonate better with this course.

Conclusion

By the end of the Agile Game, students were able to demonstrate the ability to gather and organize data, initiate, plan, execute Sprints and report their conclusions in a clear and concise report format. Initially students showed a tendency to embrace change, fail forward, and always keep at the forefront of their decisions the idea that providing value to the customer at regular intervals is the highest priority.

The Covid-19 pandemic provided a fantastic set of use cases for this class. Many organizations around the world have been forced to change the way they work without fully fleshed-out requirements on how to do it. Students were able to draw connections on how they could immediately implement an Agile mindset into their current employment as they navigated the uncertainty of the pandemic.

A number of students stated that by the end of the course they had obtained a much greater appreciation for applying Agile methodologies. Students felt techniques learned in the course were definitely transportable as they prepared to enter the job market.

In the future, professor's priority is to develop more practical application problems which involve the entire process of planning and executing Sprints. Continued emphasis of introducing the students to key concepts and helping them draw connections is vital. Because Agile project management disrupts the formal, predictive nature that a predictive workflow provides, students can sometimes feel vulnerable without their familiar waterfall tools. Coaching the students through this transformation and allowing them to draw connections between the traditional model and the Agile one is an important role the instruction must play.

This paper discussed development of an fundamentals of Agile project management course for graduate students. The paper discusses the difficulty in topic selection, and how these difficulties were overcome. Although the new course has only offered twice because of scheduling availability, student response to the course has been universally positive. Improvements to the design of the course will include incorporation of a wider set of engineering related problem sets and presentation of homework results.

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Susan Huntington is an adjunct professor in the Department of Engineering Leadership and Program Management at The Citadel in Charleston, SC. Ms. Huntington spent 17 years in the software industry working with engineering teams in both Product and Project Management roles. She led and managed many teams, projects, and programs at companies such as LendingTree, RealEstate.com, American City Business Journals, and BoomTown. Ms. Huntington was responsible for the Agile transformation at three different companies. She is a Certified ScrumMaster (CSM). Prior to her work in the software industry, Ms. Huntington was a high school French teacher in Rock Hill, SC. She has continued to teach and lead various training sessions throughout her career. Ms. Huntington believes strongly in the concepts of Servant Leadership and Self-Empowered Teams.

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