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An Active Learning Approach to Core Project Management Competencies

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Abstract
The Engineering Management Body of Knowledge (EMBOK) establishes required competencies for engineering managers, practicing engineers, and educators. As stated in the EMBOK, practitioners utilize their "professional judgment, experience, and discretion" to determine appropriate practices to situations. Provided within this paper is a comprehensive pedagogical approach utilizing active learning modules for instructors to teach currently demanded project management core competencies. In order to create the pedagogy, the Kolb Learning Cycle and the Felder-Soloman Index of Learning Styles are used as foundational theories. The structure and methodology include technical objectives and development of soft skills required for effective project management. The approach considers project management capability maturity models from Kerzner's and the International Institute for Learning. Their model is adapted to analyze core competencies presented by the pedagogy, and is directed at the shop floor level for manufacturing operations.

This paper defines a core set of project management competencies determined through extensive field work providing customized project management training classes for engineering staff members from diverse manufacturing industries. The core competencies are mapped to the Project Management Institute's Body of Knowledge (PMBOK) and the EMBOK to establish relevancy for the defined undergraduate project management course.

Introduction

The Project Management Institute (PMI) defines project management as the application of knowledge, skills, tools and techniques to manage activities required to meet objectives within a project scope.[1] The role of a project manager is to lead a team while balancing competing constraints of scope, cost, and time which are impacted by project risks and desired quality. The Engineering Management Body of Knowledge (EMBOK) establishes competencies for engineering managers, practicing engineers, and educators.[2] The EMBOK states that practitioners utilize their "professional judgment, experience, and discretion" to determine appropriate practices to situations; EMBOK Domain 4 contains the generally recognized best practices and concepts for engineering projects.

This paper will propose an undergraduate project management course pedagogy by first establishing the state of project management maturity in the manufacturing industry, and then defining a set of core competencies engineering managers seek from their staff. The core competencies will be mapped to the Project Management Institute Body of Knowledge (PMBOK), as well as the EMBOK, to demonstrate key areas to impart a level of competency on tools and techniques new engineering graduates need to "hit the ground running." A review of various student learning styles is undertaken and applied to the foundation theory of the Kolb Learning Cycle to produce a balanced pedagogy containing an active learning component.

Newly graduated engineers hired into manufacturing operations are often required to be project managers, with the expectation that they demonstrate competency in appropriate practices as called for by the PMBOK and the EMBOK. These new hires bring tools and techniques typically taught from text book curriculum mapped to the PMBOK and lecture based pedagogy.

This pedagogy includes mathematical models which are generally presented without stressing connections to student experience[3] and favors learning styles that are intuitive, verbal, reflective, and sequential, as defined by the Felder-Soloman Index of Learning Styles (ILS). Felder and Brent point out the futility of trying to tailor instruction individually[4] and Alghasham posited that educational planners desiring to enhance teamwork should group students of mixed learning styles.[5-7] A balanced pedagogy blending learning styles will challenge students to step outside their comfort zone to "stretch and grow."[3] This allows those that favor the opposite end of the learning style spectrum, sensory, visual, active, and global, to benefit from the proposed pedagogy. Through the approach presented, new graduates will have a better chance to apply an appropriate degree of rigor for project management tools and techniques, while providing leadership to team members with more years of experience.

Sensory Concrete, practical, and procedural info preferred; look for facts.	-11 ⟷ + 11	Intuitive Conceptual and theoretical info preferred; look for meaning.
Visual Graphs, pictures, and diagrams preferred for visual representation.	-11 ⟷ + 11	Verbal Prefer to hear or read info; look to words for explanations.
Active Enjoy working in groups; enjoy group problem solving and experimenting.	-11 ⟷ + 11	Reflective Enjoy individual learning; like to think things through before working.
Sequential Orderly presentation of info preferred; assemble details to see big picture.	-11 ⟷ + 11	Global Systematic approach preferred; see big picture first, then fill in details.

Figure 1. Felder-Solomon Index of Learning Styles (ILS)

PM Education and the Project Management Maturity Model (PMMM)

Several research papers establish that project management has stagnated for two decades at Level 1 on the Project Management Maturity Model (PMMM), shown in Figure 2.[1] In 1997, Ekmark, et al., placed project management maturity at Level 1, determining planning and execution was mainly ad hoc.[8] Projects were generally focused on immediate problems, schedules and budgets were often exceeded, and quality compromised to meet deadlines.

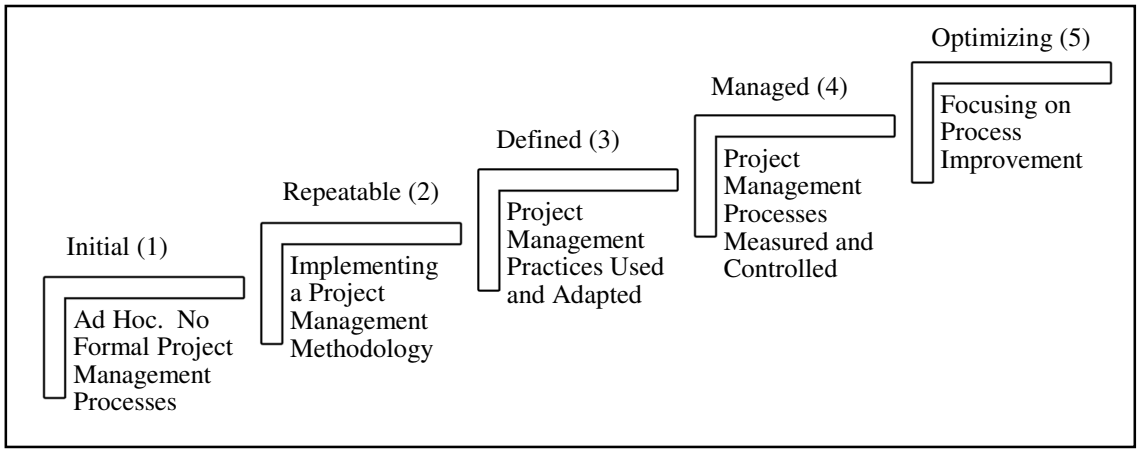

Figure 2. Project Management Maturity Model (PMMM)

A decade later, a 2006 survey by Grant and Pennypacker revealed little movement for capabilities exhibited by manufacturing operations.[9] Table 1 summarizes the percentage of manufacturing operations that achieved a particular capability maturity level, showing a majority of operations were still at Level 1, with decreasing percentages up the maturity scale. The data was validated when compared to research by Yazici.[10] Additional field work conducted in eastern North Carolina from 2008 - 2014 confirmed that manufacturing operations are still in the processes of trying to establish themselves at Level 2 of the PMMM.

Table 1. Percent of Manufacturing Operations Achieving PMMM Capability Levels

Knowledge Area	Level 1	Level 2	Level 3	Level 4	Level 5
Schedule Development	70.6	11.8	11.8	5.9	0
Resource Planning	70.6	23.5	5.9	0	0
Cost Control	58.8	17.6	23.5	0	0
Scope Change Control	41.2	41.2	17.6	0	0
Organization Planning	41.2	47.1	5.9	5.9	0

The field work involved semi-structured interviews with fifteen manufacturing companies of products ranging from pharmaceuticals to automotive components, provided evidence that while seasoned engineering managers were well versed in technical PM requirements and tools, their staff's did not exhibit the same capability. Typical projects reviewed included planned maintenance shut-downs, manufacturing process improvements projects, and capital acquisition/installation projects. Engineering managers look for their staff and new engineering graduates to have competencies that primarily comprise planning, scheduling, and communication. The research results are listed in column 1 of Table 2 as "Staff Core Competencies." These technical skills / core competencies are then mapped first to the PMBOK, second to EMBOK, and third to "typical" project management text book topics in the last two columns. As PMBOK 5e contains forty-seven project management processes grouped into ten separate knowledge areas, instructors are advised to teach the core competencies and add a subset of text book topics based on their interest and degree program.

Faculty must also consider that manufacturing engineering culture typically fails to embrace formal PM practices, support by research that fails to find a correlation between a company's project management maturity and project performance.[10] Research points out that many experienced project managers consider "the formal use of PM tools and procedures to be wasteful" of time and resources and "all but the most rudimentary tools were far too cumbersome."[11] Kasten sites a large, multi-country survey confirming that many industries forsake all or many of the formal practices taught in project management courses. He goes further stating there is a "mismatch" between what is being taught to engineering undergraduates and what is being used in industry.[11]

The challenge in teaching project management at the undergraduate level is that there is extremely diverse content and no uniform definition of an "ideal" project structure.[1] The instructional conundrum is two-fold: 1) What are the correct technical skills required, and 2) How to integrate required soft skills? Stevenson and Starkweather conducted a review of literature on critical project management behavioral competencies and found many conflicting results. The difficulty lay in the diversity of studies, which included both organizational and

industry constructs. However, they did agree upon critical behavioral competencies of top project managers such as acting with authority, planning more, and communicating more.[12] Soft skills required to understand corporate culture, manage interpersonal dynamics, and provide effective decision making included team building, flexibility, creativity, and trust.[12] Research conducted by Anholon and Sano on implementation of lean manufacturing projects found critical success factors include human resource management, communication, risk management, procurement, and stakeholder management.[13]

Table 2. Engineering Staff Needs Mapped to PMBOK, EMBOK, and Textbook Content

Staff Core Competencies	PMBOK Knowledge Area*	EMBOK PM Techniques	Instructor Discretionary Related Textbook Content	
• None	(4) Integration	(4.2) PM Techniques 4.2.1 Fundamentals and Strategies: WBS, Schedule, EV Analysis	• Stakeholder Register • Statement of Work • Business Case	• Project Charter • Change Request Logs • Forecasts
• Define Scope • Create Work Breakdown Structure (WBS) • Validate (Approve) Scope	(5) Scope Management	4.2.3 Scope, Schedule, Budget .1 Scope .2 Scheduling • WBS (4.3) Scheduling .1 WBS Table .2 Effective WBS 4.4.2 Adapting to Changing Customer Needs	• WBS Dictionary	• Scope Change Control
• Define and Sequence Activities • Developing Milestones • Create Network Diagram • Develop Schedule • Schedule Network Analysis	(6) Time Management	(4.2.3) Scope, Schedule, Budget .2 Scheduling • Network • CPM • Gantt • Resources .3 Budgeting 4.3.2 Work Scheduling	• Bottom Up and/or Top Down Estimating of Resources and Durations • Earned Value Rules • 3 Point Estimating (PERT) • Reserve Analysis (Time Buffers)	• Resource Breakdown Structure (RBS) • Critical Chain Method • Resource Leveling • Crashing and Fast Tracking • Leads and Lags • What If Analysis • Simulation
• None	(7) Cost Management (Resources)		• Estimating topics from “Time” are repeated here • Earned Value Management (EVM) • EVM Forecasting	• HR Management Plan • Vendor Bid Analysis • Budgets and Mgt Reserves
• None	(8) Quality	(4.5) Total Quality Mgt 4.5.1 Industry Standards 4.5.2 Other Than TQM .1 Process Mgt Tools .2 Other Tools: Six Sigma Kaizen. FMEA, QFD (4.6) Project/Process Tools 4.6.1 RCA Analysis 4.6.2 Problem Response	• Cost of Quality • 7 Basic Quality Tools • Quality Assurance Tools	• Statistical Sampling • Design of Experiments • Benchmarking

Staff Core Competencies	PMBOK Knowledge Area*	EMBOK PM Techniques	Instructor Discretionary Related Textbook Content	
• Development of Team	(9) Human Resource Management	4.2.5 Project Plan Concepts and Tools .1 Successful Project • Teamwork • Managing • Leading .2 Potential Failure	• Organizational Theory • Negotiating • Virtual Teams • Training • Building Trust	• Interpersonal Skills • Performance Appraisal • Conflict Management
• Communication Plan	(10) Communication	4.6.3 Project Management Software	• Information System Management	• Communication Model
• None	(11) Risk	4.2.4 Assess Project Risk .1 Financial .2 Environmental and Legal 4.6.4 Simulation	• SWOT Analysis • Risk Categories • Risk Assessment • Risk Probability and Impact Matrix	• Quantitative Risk Analysis • Strategies and Contingencies
• None	(12) Procurement		• Types of Contracts • Statement of Work • RFI, RFP, RFQ, IVB	• Negotiations • Purchase Agreements
• None	(13) Stakeholder	(4.4) Maintaining Customer Service and Satisfaction .1 Customer Feedback .2 Measure Satisfaction	• Stakeholder Analysis • Interpersonal Skills	• Management Skills

* PMBOK Chapters are shown in parentheses ( )

Active Learning and the Kolb Learning Cycle

The proposed pedagogy embraces active learning strategies, utilizing cooperative learning exercises, role plays, and simulations. Learning styles may be defined as student cognitive characteristics that serve as reliable indicators of how learners respond to their educational environment.[4] The Myers-Briggs Type Indicator of personality types has strong learning style implications, but the Kolb Learning Cycle and Felder and Silverman models have been extensively applied to engineering education studies.[4] In the Kolb Learning Styles, students are segmented using two types of characteristics that lead to four categories of learner classifications. The first segmentation regards how information is absorbed, either "concrete experience or abstract conceptualization." The second segmentation defines how they processes information, either "reflective observation or active experimentation." As shown in Table 3, the Kolb learning styles are defined as: 1) Diverger, 2) Assimilator, 3) Converger, and 4) Accommodator.

Table 3. Kolb's Learning Styles[14]

	Reflective	Active
Concrete	Type 1 – Diverger • Students ask "Why?" • Instructor role: Motivator	Type 4 – Accommodator • Students ask "What if?" • Instructor role: Socratic
Abstract	Type 2 – Assimilator • Students ask "What?" • Instructor role: Expert	Type 3 – Converger • Students ask "How?" • Instructor role: Coach

Figure 3 shows the Kolb's experiential learning framework, learning styles, and learning cycle used to model how experience can be translated into conceptual competencies.[14] The Kolb Experiential Learning Cycle proposes that the most effective instruction involves teaching around the cycle.[4] The cyclical nature of the model is critical to success, as different learning styles will have different entry points. The Kolb Cycle shows the instructor's role of "motivator" and "expert" for Type 1 and 2. These roles and learner types are most suited for lecture and written assessments[4] which are typically addressed with text book content. Instructors create a foundational base of theory and technical tools needed for project initiation, planning, execution, monitoring, and closure. The goal for is reflective observation and abstract conceptualization by the students, as preparation for active experimentation and concrete experience. Type 3 practice opportunities and Type 4 exploration are best suited for active, experiential learning exercises.

Incorporating the Kolb Cycle with lecture and active learning is the desired pedagogy detailed herein. The strength is activities that alternate between theory and experiential learning, which tend to propagate the Kolb cycle. Critical to success is repetition of teaching around the cycle, and does not require assessing individual student learning style preferences since teaching around the cycle ensures all are addressed.[4]

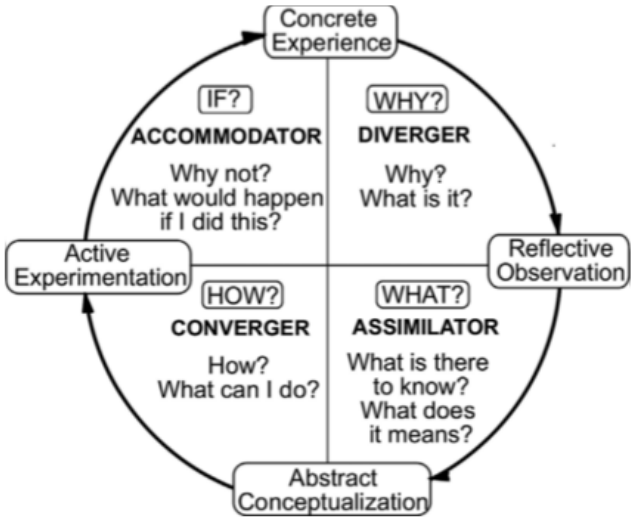

Figure 3. Kolb's Experiential Learning Cycle[14]

Pedagogical Approach and Course Structure

Edum-Fotwe and McCaffer state that project management competency is attained by knowledge acquired through training and "skills developed through experience" via the application of acquired knowledge.[15] Gokhale state that entry-level employees may "bring knowledge, skills, and abilities, but competencies are the result of experience."[16] Therefore, pedagogy founded in active learning is desirable for an undergraduate student demographic that has little or no hands-on experience. Integration of active learning with the Kolb Cycle provides effective project management education through the application of technical skills while providing a forum to practice soft skills.

The proposed structure, shown in Table 5, combines a lecture based delivery of core competencies defined within Table 4, active learning components to enhance development, plus

room for an instructor discretionary subset of PMBOK and EMBOK skills from Table 2, packaged into a fifteen week semester. Table 4 provides required core competency content, divided into three modules, mapped to the PMBOK and EMBOK. There are two "active learning" project simulations run concurrently with students employing more and more involved processes as the semester progresses. Additional lecture based content needed to provide thorough understanding of additional PMBOK and EMBOK requirements are listed as "Text Book Concepts" in Table 5.

The desired entry point for Kolb's model is "reflection and experience", followed by repetition for reinforcement.[17] The proposed pedagogy embodies this with application of text book content along with parallel and staggered application of active learning by student project teams, as shown in Table 5. Active learning is achieved through multiple experiences to provide feedback as a basis for reflection, conceptualization, and experimentation, including: 1) Teamwork via Tuckman's group development stages of Forming, Storming, Norming, and Performing, 2) problem based learning through real and simulated project management simulations, 3) Role plays as project manager for team leadership and presentations of progress reports.

Table 4. Syllabus Modules: Core Competencies Only

Module	Core Competencies	Tools and Templates	PMBOK Chapters*	EMBOK Domain
Project Management Overview and Communication	• Leadership Skills • Interpersonal and Conflict Mgmt. • Meeting Mgmt. • Stakeholder Mgmt.	• Written Communication • Kick Off Meeting • Meeting Agendas	(9) Human Resources (10) Communication (12) Procurement (13) Stakeholder	
Planning and Scheduling	• Stakeholder Analysis • Scope • Work Breakdown Structure • Activity Sequencing and Scheduling • Resource Analysis • Communication Planning	• Scope Elaboration • Mind Mapping • Yellow Sticky Approach / Network Diagram • Responsibility Matrix • Communication Plan • WBS / OBS / RBS	(4) Integration (5) Scope (6) Time (11) Risk	Scope: 4.2.3.1 Budget: 4.2.3.3 WBS: • 4.2.1.1 • 4.2.3.2 • 4.3.1 / 2 Schedule: • 4.2.1.2 • 4.2.3.2 • 4.3.2
Monitoring and Control	• Progress Reporting • Scope Control • Closing/Lessons Learned	• Gantt Charts • Scope Mgmt.	(7) Cost (8) Quality	Earned Value 4.2.1.3 Scope Control 4.4.2

* PMBOK Chapters are shown in parentheses ( )

Student Team Projects

A critical tenant of this pedagogy is Team Project Based Learning (TPBL), which is an active learning environment designed to provide real-world experience in project management.[6] Frank concluded that project based learning experiences provide greater learning than traditional methods.[18] A well designed TPBL assignment includes three provisions: 1) team rewards, 2) individual accountability, and 3) equal opportunity for success.[6]

Organizationally, student project teams are run within a "weak matrix management" structure, with the instructor as the "functional manager", a student PM, and student team members. The first project, designated as P1 in Table 5, is in essence a project about completing the second project (P2). Restated, P1 is about getting the assignment done, and P2 is a creation of a project plan defined by the team that is managed and tracked by P1. For P1, student teams are required to work through the core competencies to introduce, plan, execute, monitor, control, and finally close the assignment using project management skills and tools. Key aspects of active learning include teamwork, cooperative planning, problem based learning, and role play of project manager. To instill a level of realism, teams are assigned three milestones, conduct two live status reports, and simulate closure with finalization of a lessons learned document.

The second project, designated as P2 in Table 5, only carries students through the first two phases of a self-selected topic/objective: project introduction and project planning. Students select a real world company and create a feasible project of mutual interest. After company selection, a project definition/summary and a frame of reference establishing the background/circumstances for virtual project P2 are defined. This student defined background becomes key baseline information for instructor evaluation of all subsequent work. Next, the students role play within the virtual project's frame of reference to create a project charter, conduct stakeholder analysis, and develop a communication plan for the defined stakeholders.

The student teams conduct progressive elaboration of project scope for both P1 and P2. Project plans, including WBS, schedules, and Gantt charts are developed using Microsoft Excel, and if desired, a project planning software such as Microsoft Project. Included in the project planning process for both is development of a risk management plan and creation of a kick-off meeting agenda. Project budgets are only required for P2. Both projects require development of standard forms, based on PMI templates, for reporting progress.

Project Milestones and Core Competencies

Core competencies include the processes required to create and progressively elaborate a scope, produce a comprehensive WBS, and then sequence activities. Active learning engages students through a series of milestones and progress reports providing reality to the term "milestone." No milestones may earn points if preceding work is not complete and satisfactory. Student teams are required to complete missed milestones, without additional points earned, prior to the next milestone.

The first team milestone includes completion of three tasks: 1) Project Manager selection to manage the student team, 2) Preliminary Scope for P1 (the student team's goals and objectives), and 3) the project definition with a frame of reference for the virtual project P2. The goal of the first milestone is to ensure students understand they are working two projects. The second team milestone is to ensure students organize to complete P2 by creating the following to manage the virtual project: 1) a finalized P1 scope, 2) the P1 Project Priority Matrix, 3) a P1 Work Breakdown Structure, and 4) agreed upon P1 Responsibility Matrix to establish individual team member tasks. The third milestone is completion of the preliminary scope statement for the virtual project P2.

Project scopes are developed for P1 and P2 as it is generally accepted that poor project management execution is the result of a poorly defined scope. A key concept is to define the "why" of a project before the "what are we going to do." Once the "why" is established, the

project manager can start to define what needs to be done by developing a formalized scope statement through the process of progressive elaboration. Creating two scopes is intended to provide experiential learning through multiple loops of the Kolb Cycle.

Table 5. Active Learning Mapped to Sequential Text Book Lectures

Week	Text Book Concepts	Managing the Virtual Project (P1)	Virtual Project (P2)
1	Intro to Project Management		
2	Organization Strategy and Project Selection		
3	Organizational Structures and Culture		
4	Defining a Project • Stakeholders • Charter and Scope • WBS • Communication	Milestone 1 (Forming) • Project Manager selection (P1) • Preliminary Scope (P1) • Project Definition and Frame of Reference (P2)	
5	Defining a Project (continued)	Instructor approval required for Project Definition and Frame of Reference (P2)	• Project Goals and Objectives • Project Priority Matrix
6	Estimating Cost and Timing	Milestone 2 (Storming) • Final Scope (P1) • Project Priority Matrix • Work Breakdown Structure • Responsibility Matrix (RACI) chart	• Project Charter • Stakeholder Analysis • Begin Preliminary Scope
7	Project Plan • Precedence Networks • Critical Path		• Initial WBS (plus resources) • Initial Project Plan
8	Risk Management	Milestone 3 (Storming, Norming) • Preliminary scope complete (P2)	• Progressive elaboration WBS and Scope
9	Resources Management		• Progressive elaboration WBS and Scope
10	Crashing	Status Report 1 (Norming, Performing) • Instructor provided template	• Communication Plan • Risk Management Plan • Final WBS and Project Plan
11	Leading and Managing		• Final Scope and Budget • Final Gantt Chart
12	Monitor and Control	Status Report 2 (Performing)	
13	Monitor and Control (continued)		• Kick Off Meeting Agenda • All Forms and Templates
14	Closing	Lessons Learned Document	

PMBOK establishes six primary requirements for a project scope along with a template which includes the items in Table 6. The concept students have a difficult time grasping is that scope development is iterative and happens in parallel with WBS development. Therefore, scope assignments include a preliminary and final submission. Students are advised to begin development early and encouraged to submit draft copies to the instructor prior to deadlines. Important to the active learning is for the instructor to be tolerant of errors on preliminary scopes, but be critical when scoring final scope statements.

Table 6. PMBOK Project Scope Requirements

Scope Requirement	Description
Project Description and Objectives	• Developed by progressive elaboration • Characterizes the result of the project by defining the "what and when" • Project milestones (not in PMBOK, but recommended)
Acceptance Criteria	• A set of conditions required for acceptance of deliverables
Deliverables	• Any unique and verifiable product, result, or capability to perform a service • Ancillary reports and documentation
Project Limits and Exclusions	• Identifies project boundaries • Specifies what is excluded from the project in order to manage stakeholder expectations
Constraints	• Internal and external limiting factors affecting the project execution or processes • May include budget, imposed dates (deadlines), schedule milestones • Contractual agreements for external projects (if applicable)
Assumptions	• A factor assumed to be real that impacts planning • Explains the impact if an assumed factor proves to be false (not real) • Must be identified, documented, and validated during scope development

The importance of the WBS as a core competency was substantiated as the PMBOK moved from 4e to 5e. First, PMBOK 5e added that verbs should begin any activity/task definition within a WBS. Second, a subtle change in the PMBOK printing incorporated this as PMI renamed project management processes into "verb-noun" format, which provided additional evidence of the need to impart clarity on WBS definition and content requirements.

Once a WBS is generated, a communication tool is required for project coordination and management. PMBOK differentiates communication into three styles: pull, push, interactive.[1] Pull information is large volumes of information maintained by the project team in a common repository such as SharePoint for stakeholders to access on their own. Push information is communication sent to specific users, and is the most challenging because it involves stakeholder analysis and the art of written communication. PMI provides a communication management template plan that includes a matrix of stakeholders, information required, method of distribution, timing or frequency of distribution, and person responsible to send the information. The template also includes a list of assumptions and constraints on which the plan itself is based, and room for a glossary of terms.

The responsibility matrix is a typical approach to both organize work and communicate to team members within small projects, and is therefore appropriate to manage the semester project P1. In practice, other communication tools may be used to provide a WBS and timing include the six sigma DMAIC or the popular A3 format "story board." These methods will list activities needed, i.e. document the work breakdown structure, and provide a communication tool for resources and date, one of the fundamental organization methods in the PMBOK Chapter 9 on human resource tools and techniques.

Monitoring and Control

To simulate the execution phase of P1, student PMs will routinely review the responsibility matrix between status reports and follow-up to ensure all tasks are completed in a timely manner. Communication of task and milestone progress is inherent in project management, and as such, standard reporting methods are a core competency. While PMI provides a reporting template, it is much too basic for practical use and must be adapted for individual course requirements. Thus, project teams develop standard reporting templates along with stakeholder analysis and a communication matrix to document distribution. Gantt charts are required as they are the predominant reporting tool, and should be taught in both manual (Excel) format and as a standard output from project management software.

Critical to success in the active learning pedagogy is the status reporting done as part pedagogy. One student manages P1 through the first three milestones and initially leads status reporting. Thereafter, the other two students take turns managing the project and creating/defending status reports. Student teams create status report templates to provide updates and then verbally present to the instructor, who serves as the project sponsor. The instructor must embrace the sponsor role and make no allowance for substandard reporting. Other project teams are allowed to listen in to the report/defense, but do not contribute to the discussion. Students generally learn a great deal by listening to the approach and critique of other student teams.

It is contingent upon faculty executing this pedagogy to be impervious to student complaints and frustration about team member's performance. One goal of TPBL active learning is to inject the uncertainties and ambiguities that are part of real world projects. Active learning is further supported through the use of "live" status reporting of project progress, and is the mechanism that requires the instructor to approve the P2 frame of reference and follow student activity closely. Instructor guidance is what establishes the assignment as TPBL and active learning.[19] The key is to instill in students that lessons learned must be documented throughout the project as things go wrong and corrective actions defined on progress reports.

Summary

There is a wave of PMBOK prepared graduates entering the workforce, but the gap between academic training of formal project management processes is yet to be rationalized to the realities of projects assigned to newly minted engineers hired into the manufacturing industry. As all classrooms contain students with various learning styles, research has shown that a mix of learning approaches allows for enhanced comprehension by learners. The proposed pedagogy provides a template for core project management competencies as defined by qualitative research with manufacturing industry engineering managers and review of literature. Faculty's goal is to provide a balance of instructional methods rather than attempting to teach each student to their own style/preference.[3]

A balanced approach with lecture based instruction and active learning is provided for an undergraduate pedagogy to prepare students to meet entry level project management demands, but also have the background to lead an organization up the PMMM ladder. Instructors must query students during progress reports to reinforce core competencies, and insist on a final document for project closure. The goal is to train undergraduate engineers to drive overall business success through projects, and be a catalyst for an organizational culture moving toward collaboration and communication practices to achieve higher levels of the PMMM in industry.

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