INSTRUCTOR'S GUIDE

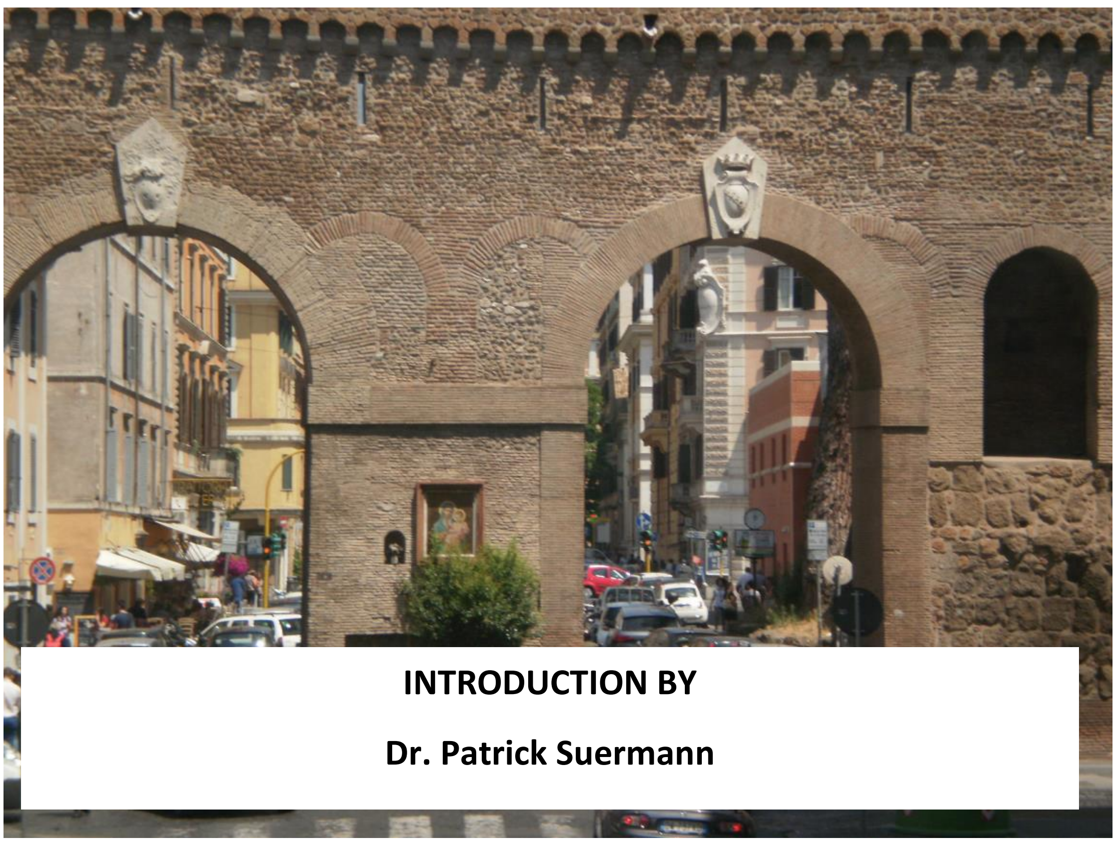
TO COMMERCIAL CONSTRUCTION CAPSTONE COURSE

BY

DR. JOSE L. FERNANDEZ-SOLIS

Department of construction science

20 august 2020



INTRODUCTION BY

Dr. Patrick Suermann

About the Author:

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Dr. José L. Fernández-Solís received a Ph.D. degree from Georgia Institute of Technology in 2006. He is currently an Associate Instructional Professor in the Construction Science Department at Texas A&M University.

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Department of Construction Science

Memorandum

Date: **14 AUG 2020**

To: **All who shall see these presents, greetings**

From: Dr. Patrick C. Suermann, P.E. LEED AP
Department Head and Associate Professor

Subject: **Commercial Capstone Open Access Book Introduction**

The purpose of this memorandum is to introduce Dr. José Fernandez-Solis' open access book, Commercial Capstone, COSC 442. While this book describes the capstone in our department, it is applicable to any engineering, architectural engineering, architecture, construction, or technology course centered on the higher education and matriculation of professionals into the Architecture, Engineering, and Construction (AEC) Industry. This book is the culmination of more than three years of the author's diligent work and the zenith of his passion for "PBL" or project-based learning.

You may ask, "why publish an open access book on capstones?" First and foremost, all college Professors can attest that many courses need to include tangible "real world" material that offer the students a meaningful and validated experience. This is especially true for seniors who are returning from Co0Ops and internships. To put it simply, these students need more from a course than to be told to "look up the answer" in a book – successful Professors will be the expert guide on the journey towards showing students that the students have the skills for success. A capstone course is merely the "exclamation point" on the foundational knowledge and experiences that students gathered and curated throughout their time in their programs.

It is with this impetus that Dr. Solis presents a proven and successful format for a Project Based Learning course with 20 overlapping team outcomes where students can demonstrate proficiencies. More importantly, experiment in the capstone leadership laboratory and understand how to achieve team success rather than merely individual academic accomplishment. I am confident this book will be very helpful for anyone searching for a framework for how to help your students have rich and rewarding capstone experiences.

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Preface

I approached the writing of this book in much the same manor that I approach design. I used a step by step process that follows a definite sequential order. In design as in writing a book, the order is as follow:

- Conceptual – the original idea; This phase took time for me to figure out.
- Charette – intensive planning process; This is where I got my ideas and concepts for the book, but first, I had to go through several schemes in the charette. The current scheme is an evolution of previous ones. Preliminarily, I had to conceptualize the ideas, and then allow myself adequate time in order to give an abundance of thought as to how the book should be written.
- Schematic Design Process – the initial design phase of any project; In this phase, I had to figure out what I wanted in my book. My first step was to form a preliminary 'table of contents' that narrowed my focus. There is always a back and forth between schemas, concepts, and charette. Filling in the outline, gave the schema the body of information I wished to present in the form of words and dates under a formal pedagogy.
- Design Development – yields more detailed plans; I began by deciding what details I wanted to include in the book. The pedagogy, teaching method to be used, itself also required detailed explanation in the design development.
- Construction Drawings – blueprints – a thorough plan to ensure the project's successful completion; In my book, I had to fill in all the content, find all the gaps, relate and coordinate words with the data through a continuous loop of document revision and improvement.
- Final Contract Documents – details the work to be executed under the contract; In the writing of my book, this included ascertaining a quality control of the grammar, word choice, elimination of vague or non-essential wording, coordination of the table of content with the actual content and making the tables and figures as clear and readable as possible.

Commercial capstone uses the same principles as architects use in their design process, and I used in this book. The students have five lecture session to work on a Task. The first lecture session is akin to the conceptual session in which teams are formed, work is broken down into Tasks and assigned to groups around the concept of that Task. The second session, like schematics, is where the team begins assembling the information and data along the major areas of inquiry. During the third lecture session, the team identifies the assumptions and exceptions, work on weak areas and start envisioning the deliverables much like design development in architecture. The fourth and final session is similar to the construction documents where the information is 90% to 95% finished. Presentations of the Task as per the POR and instructions are presented during the fifth lecture session. Between the fourth and fifth lecture sessions, the students collaborate and fine tune their presentations. They are encouraged to concentrate on order, content, and how to create interest in their Task.

A brief background on my qualifications for presenting this book as my professional and academic legacy:

Dr. Jose Fernandez Solis' foots steps to success in the United States is a journey that is loaded with many impressive opportunities that gifted him unique qualifications to write this book. It will be his professional and academic legacy: Here is a brief summary of his life's journey.

My father was a successful developer and builder in La Hababa, Cuba. I was born in La Habana. Cuba just a few years prior to Fidel Castro's takeover of that island country in 1959. Until the age of 13, I spent many Saturdays visiting my father's projects with him as he checked to insure they were progressing as desired. One year after Castro took over Cuba, 3 December 1960, I was sent to the USA on vacation. I was going to visit relatives there until the US Marines could liberate us from Castro. The Marines never came. Therefore, I am technically still on vacation.

Ultimately, while on my extended vacation in the US, I graduated from high school where I entered architectural projects in my high school's science fair. That was a piece of cake for me. Later, I graduated from the Miami-Dade Junior College North Campus after mastering the 'Engineering Slide Rule', (Texas Instruments existed only in a dream somewhere) Chemistry I & II, Physics I & II, Calculus I & II, English and more. While there I earned more credits than I could transfer to GA Tech College of Architecture. Also, while attending Miami-Dade, I applied for a position at ABC Components, Inc., a new innovative company that was advertising for engineering help. ABC invented the gang nail for trusses, and had the first UNIVAC privately owned computer. I checked the number of Gang Nails on the chords and the amount of steel left in the plate. The exciting part was watching the truss tested to failure to determine if the UNIVAC calculations, and my estimates aligned and with the ultimate failure loads. In the end, I learned everything about trusses to the point that I could look at a diagram and easily calculate joint forces and figured out compression, tension and neutral members.

ABC was instrumental for landing my next job in Atlanta GA while studying at GA Tech. Two engineers, Jack Weems and Keith Pharr teamed up in Atlanta, GA as Weens and Pharr, a newly organized Weems and Pharr Engineers. They needed a sharp kid that could help with both structures and civil work. I was a junior at 25 years old and one among many engineer students who applied for the position, and based on my experiences was selected. From 1970 to 1972, I worked on more than 400 small and large projects, and paid for my GA Tech education. The wealth of knowledge I received there was a key factor in my obtaining my first job as Intern Architect with Jova Daniels and Busby in Atlanta, GA. After I passed my Architect Registration Exam, I was hired by Niles Bolton and Associates in Atlanta, GA as Project Architect. Shortly afterwards, I was promoted to Project Manager where I worked on the team that serviced Post Properties with projects on the East Coast of the USA.

Fortunately, every time the economy dipped, I was able to find a position that extended me more responsibility. Before moving to Texas, I had earned the position of Vice President, Director of Contract Administration. While only registered in seven states, I work in thirty states through corporate licensing privileges. By this time, a new project delivery system came into our world---"Design Build”. Architects and contractors all over the USA were trying to figure out how this new system could be implemented. In addition, a large construction company in Dallas, Texas with a regional office in Atlanta, Georgia, was exploring the idea of how to make ‘Design Build’ work to minimize risk, avoid Architect Contractor litigation and risk, while maximizing margins for all stakeholders including the owner. After the company decided to use the word ‘Integration’ instead of Design Build Projects, I was recruited as Director of Integrated Projects.

Next, GA Tech Building Construction Department Head approached me while recruiting at their career fair, and explained that a new PhD was being created, the ink was still wet on the proposal, and asked if I would be interested. After checking with my wide and with Peter Beck in Dallas, I agreed. Peter was very gracious and said, “Jose this is a great idea to find out what academia has to say about integration. for us to contribute to academia our experiment in integration. I will tell you what, we will support you by buying your books. As a matter of fact, as long as you work your 60 to 80 hours a week, you can do your studies with the rest of your time.”

Afterwards, upon graduation, GA Tech Building Construction Program which was under ACCE reaccreditation review led by Dr. Jim C. Smith, Construction Science Department Head of Texas A&M University recruited me to apply for an open position at COSC starting in August 2006.

The rest is local history, found on my CV.

After experimenting with several versions,’ Commercial Capstone’ is my professional and academic legacy. I fully understand that every faculty member teaches a topic their own unique way and, therefore, the likelihood of someone using this book verbatim is highly unlikely. My purpose in the book is to showcase what can be done and how a course, any course that uses a project as the basis of instruction, could be set up and offered.

I owe a debt of sincere gratitude to Patrick Suermann PhD, Department Head, Construction Science Department at TAMU for his encouragement and support. At Patrick’s suggestion I canvased this work and eliminated any vague term such as “some” and others found on a comprehensive list of common terms. Patrick followed Prof. Joe Smith as Department Head who followed Dr. Jim Smith, as Department Head. Dr. Jim Smith was the creator of the original capstone course program.

Furthermore, Bruce E. Herbert PhD, Director, Office of Scholarly Communication - University Libraries TAMU was instrumental to opening the possibility of placing my book online as an open source for anyone and everyone interested in its use, worldwide and for all times. Dr. Herbert backs his offer by providing a final linguistic editing pass and an array of services to make the book as professional as Texas A&M University can provide.

Additionally, Ms. Jean Inmon, Linguistic Editor and friend, has been extremely important in grinding whole text review after review in order to make the book as complete and correct as possible in words, grammar, spelling, punctuation, content, context and so many more attributes that showcases her innumerable skill sets. Her encouragement and suggestions are what makes this book stand out.

Manjil Mulepati was my graduate teaching assistant from the fall semester of 2018 until his graduation in May 2020. Manjil and I took the first summer session of 2019 to develop a plan of action, review past student's constructive criticisms and discuss the pros and cons of options we came up with during our brainstorming sessions. Having worked diligently, we were ready with a pilot class program for the second summer session of that year. I am most grateful for his dedication, focus and excellent work that has contributed to making commercial capstone an exciting and realistic course for our students.

Also, Commercial Capstone Classes - COSC 442 930 and 931 of Summer II 2020 volunteered to use the text as a pilot version and provided insights and suggestions on how to improve the content and process.

Also, Jay Hamel, Project Executive, Turner Construction Company – Houston, Texas is not only a friend but has presented in my capstone classes whenever and how many times I have requested. Jay knows the evolutionary history of my capstone classes since 2008 and is the best position to review and critique the book, offer advice and bring his experiences both as a professional and a capstone juror to the quality of content and presentation of the class and book.

Equally important, Joseph Vaughn, CEO Opifex graduated from COSC after excelling in my commercial capstone class. He has been accepted to Harvard but the Business degree requires that he start his own company and show success. Opifex is now two years old and is worth multi-millions. Joseph is, like Jay, in great position to reflect on his own experience in the classroom, as a juror of past capstone presentations and recently of the new version.

Moreover, Roger Berry, Vice President of Operations, Houston Division, SpawGlass Construction Company – Houston, Texas has always been a faithful supporter and contributor to my capstone classes and juried presentations.

Ms. Sam Shields, Center for Teaching Excellence - TAMU College Station Campus accompanied a COSC team to Worcester Polytechnic Institute's annual workshop on their Integrated Project Based Learning. Afterwards, he brought the presentation to TAMU. Sam has been an avid supporter not only of IPBL but also, Active Learning and the latest morphing called Transformational Learning. Sam's expertise in pedagogy has kept a narrow focus on objectives and assessments.

Finally, Richard F. Vaz, Professor, Interdisciplinary and Global Studies Co-Director, Center for Project Based Learning - Worcester Polytechnic Institute was and is a firm supporter of capstone as it has morphed within the last three years. I owe Richard the impetus that was required to move me out of my safe orbit of teaching capstone as before. It was not easy and took a while to figure out the schema and design in addition to creating a pilot test for summer teaching that students validated. Subsequent versions are part and parcel of continuous improvements to a Lean Construction Concept that is as old as ancient history of construction but deserves a constant reminder. To each and to all, my most sincere gratitude, stay well. GRACIAS MIL!

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List of Acronyms

ACCE	American Council for Construction Education
ACC&U	Association of American Colleges & Universities
AL	Active Learning
BIM	Building Information Modeling
B20	B is the University Designation for Summer Semester Year 2020
C-course	Communications Intensive Course
CEFP	Certified Educational Facilities Professional
CEO	Chief Executive Officer
CIAC	Construction Industry Advisory Council
CIPBL	Center for Interdisciplinary Project Based Learning
COSC	Construction Science
CMAR	Construction Manager at Risk
CTE	Center for Teaching Excellence
EPA	Environmental Protection Agency
F2F	Face to Face Class Format
FF&E	Furniture Fixtures and Equipment
FH	Francis Hall
FHR 2014	Francis Hall Renovation 2014
FRAN	Francis Hall
GA	State of Georgia
GA TECH	The Georgia Institute of Technology
GC	General Contractor
HUB	Historically Underutilized Business
IPBL	Interdisciplinary Project Based Learning
LEED	Leadership in Energy and Environmental Design
OSHA	Occupational Safety and Health Administration
PE	Professional Engineer
PMBOK	Project Management Book of Knowledge
PPT	Power Point
PhD	Doctor of Philosophy
QA/QC	Quality Assurance / Quality Control
POR	Program of Requirements
RFP	Request for Proposal
SLO	Student Learning Outcome
STC	Sound Transmission Class
SUBS	Subcontractors
SWPPP	Storm Water Pollution Prevention Plan
TAMU	Texas A&M University
TAMUS	Texas A&M University System
U SLO	University Student Learning Outcome
WPI	Worcester Polytechnic Institute

Chapter 1 – Course and Project Set Up

Overview

History:

The College of Architecture was created in 1969 along with the Building Construction Department. In 1983, Building Construction was changed to Construction Science. Professor James Smith, PhD is credited with starting the capstone series in the mid 1980's that grew to five types paralleling a growing student population. The types are COSC 440 Interdisciplinary Capstone (capturing a collaborative effort with either Architecture or Engineering students and faculty); COSC 441 Residential Capstone (focusing on single and multi-family residential development and construction); COSC 442 Commercial Construction (the most offered capstone and popular with the students); COSC 443 Industrial Capstone (due to the State of Texas' need for heavy industrial construction); COSC 446 Specialty Capstone (due to MEP Specialty Contractor needs for student specializing in Mechanical with Plumbing and Electrical subcontracting).

COSC 442 Commercial Capstone is described, along with prerequisites, in the University's HOWDY curriculum posting as:

*A senior capstone course for students preparing to enter the commercial construction sector; project management of commercial construction projects, including aspects of design, and bidding/estimating. Presentation, value engineering, contracts/negotiation, subcontractor relations, cost controls, management during construction, close out, and post-construction requirements. (3-0). Credit 3; **Prerequisites:** COSC 475; Must be taken last full semester or summer before graduation. This is a University designated C-course (communication intensive).*

A communications intensive course requires that content and assessment meet minimum requirements in written and oral presentations that are assessed through published rubrics. These are found in the syllabus, see Appendix C, pages 3-5.

Syllabus:

The syllabus meets University and Departmental content requirements, as well as, instructor's objectives and general information.

Student Learning Outcomes

The syllabus lists the following as minimum required learning outcomes by both the University and by the American Council for Construction Education (ACCE) accrediting board:

University Student Learning Outcomes (U SLO):

Master the Depth of Knowledge Required for a Degree

- Evaluate, analyze, and integrate information from a variety of sources
- Use appropriate strategies and tools to represent, analyze, and integrate information
- Develop critical, reasoned positions

Communicate Effectively

- Demonstrate effective oral communication skills (these could include the use of languages such as, American Sign Language for those who do not communicate orally),
- Demonstrate effective writing skills
- Demonstrate effective nonverbal communication skills (these could include appropriate use of performance, design, or representations such as maps, tables, and graphs)
- Listen actively and critically
- Present work effectively to a range of audiences
- Effectively communicate original and creative ideas

Work Collaboratively

- Participate effectively in teams
- Consider different points of view
- Work with others to support a shared purpose or goal

ACCE Student Learning Outcomes (ACCE SLO):

ACCE accredits Construction Science curriculum and program through a series of learning outcomes that are distributed among the courses according to the topics taught. Table 1 lists Commercial Capstone required outcomes.

Table 1. ACCE Required Student Learning Outcomes (ACCE SLO)

COURSE LEVEL	COSC/ACCE LEVEL
Apply critical thinking to the body of knowledge student has acquired through coursework in the development of the project Tasks Boards or PPT and the oral presentation. The oral presentation will assess student's problem-solving skills shown through complex reasoning techniques in a real-life project of projects.	SLO #1: Create written communications appropriate to the construction discipline (R) SLO #2: Create oral presentations appropriate to the construction discipline (A) SLO #3: Create construction project safety plan (R) SLO #4: Create construction project cost estimates (R) SLO #9: Apply construction management skills as a member of a multi-disciplinary team (A)

Legend: Assessed (A); Reinforced (R)

A topic presentation either Assesses a learning outcome or Reinforces a previously assessed learning outcome.

Rubrics:

- Written Communication – ACCE SLO #1 & U SLO **Communicate** effectively
- Oral Presentation – ACCE SLO #2 & U SLO **Communicate** effectively
- Teamwork - ACCE SLO #9 & U SLO Work **collaboratively**

A. Table 2. Written Communications Assessment Rubric

Item	Points	Content	Language
Correct [20 points]	11-20	Accurate, free from error, exact, precise, perfect, right and true	Excellent grammar, spelling and composition
	6-10	Unsuitable or inappropriate verbiage	Inaccurate grammar, spelling and composition errors
	0-5	Wrong, erroneous, inaccurate, imprecise	Imprecise, with grammar, spelling and composition errors
Complete [10 points]	6-10	Has all necessary and appropriate parts, perfect	Good sentence structure, right number of sentences with the right amount of words per sentence
	0-5	Has deficient, insufficient information, data or development, defective	Sketchy, partial, and unfinished grammar and composition, spelling errors.
Timely [10 points]	10	On time	
	5	Late or resubmittal	
	0	Not submitted	
Un-ambiguous [10 points]	6-10	Clear, exact, good data, metrics	Well-defined, precise,
	0-5	Double meaning, repetition	Wordy, no definitions, vague

B. Table 3. Oral Presentation Assessment Rubric

	COSC 442 Session	931
TASK	Each Task must have a visual, that includes the names of the students working on that particular Task. Quantitative components such as data, findings, information and a proposed solution or design, quantitative components such as area, volume, weight, types and number of items…) Qualitative components such as assumptions and exceptions, professionalism, clarity of the information and presentation. The grading is from 0 lacking on all the above to 10 excelling on all the above and more. Grades must be realistic, or they will be considered out-layers and disqualified. NOTE: Deduct 10 points (a letter grade) for each misspelled word found. Professional presentations lose jobs because of spelling errors indicative of lack of care and attention.	
1	Cover page must include: project image and name, team participation by Tasks, project title and information, owner information, table of contents, enforced codes and dates, FH buildings 1 and 2 dates of completion, FH building existing and proposed additional student, faculty population and total square footage (including roof). Oral presentation will require an interesting story on FH existing and proposed addition with project information added.	
2	Site logistics layout plans and details	
3	Erosion control plans (SWPPP) and details	
4	Site safety, and evacuation plan and details	
5	Demolition drawings (ground and vertical) and details	
6	Civil, drainage, (relocate as needed and show in plan), temporary and permanent utilities	
7	Landscape, and irrigation plans and details	
8	Foundation design, basement plans and details	
9	Structure and stair design, plans and details, live and dead load for all levels, calculate total column loads and girder loads, propose a floor slab design	
10	Elevations, window schedule	
11	Roof plans	
12	Architectural finishes, reflected ceiling plans, door and hardware schedules and details	
13	Mechanical and plumbing plans, calculate fixture count for new population based on currently enforced plumbing code, calculate roof rain water run-off and size of downspout	
14	Electrical, power, emergency, audio visual, technologies, and lighting plans and details	
15	Conceptual estimate by systems (based on Tasks 2 - 14 estimates plus general conditions and overage factors)	
16	Conceptual cost loaded schedule by systems (base on Task 15 estimates)	
17	Sub-contractor and HUB selection strategy by systems and sub-systems components	
18	QA/QC and commissioning plans	
19	Lean Construction plans and details	
20	Building Information Model, BIM360, AutoDesk (PlanGrid), ProCore, or Builder’sBox model	

C. Table 4. Teamwork Assessment Rubric - Adapted from ACC&U & WPI IPBL)

ACCE SLO #9 & USLO WORK COLLABORATIVELY: PEER EVALUATION

Score: 0 ⟵	⟶ **5**		Team Student
TRUST		Item	#
Conceal weaknesses and mistakes from other	Admit weaknesses and mistakes	1	
Hesitate to ask help or provide constructive feedback	Asks for help	2	
Jump to conclusions about intentions and aptitudes of others	Give others benefit of the doubt	3	
Hold grudges	Offers and accepts apologies without hesitation	4	
Dread meetings and find reasons to avoid them	Looks forward to meetings and opportunities	5	
CONFLICT			
Bored during meetings	Interested in meetings and acts lively	6	
Engages in personal attacks	Focuses on conflict resolution	7	
Ignores controversial topics	Engages in controversial topics seeking solution	8	
Wastes time posturing and interpersonal talk	Engages critical topics on the table for discussion	9	
COMMITMENT			
Creates ambiguity about direction and priorities	Creates clarity around direction and priorities	10	
Breeds lack of confidence	Aligns team around common objectives	11	
Promotes fear of failure	Develops team ability to learn from mistakes	12	
Encourages second guessing among team members	Changes directions boldly and without hesitation or guilt when necessary	13	
ACCOUNTABILITY			
Creates resentment among members who have differences	Encourages poor performers to improve	14	
Encourages mediocrity by passive behavior	Identifies potential problems quickly by questioning other's approaches without hesitation	15	
Misses deadlines and milestone deliverables	Celebrates respect and encouragement of on time performance	16	
Places undue burden or blame on team leader	Shares group performance responsibilities	17	
RESULTS			
Encourages individual goals (use of the "I")	Encourages team goals (use of the "we")	18	
Does not care about team success	Enjoys team success	19	
Is easily distracted	Avoids distractions	20	
TOTAL (20 items at 5 points each - maximum of 100)			

Instructor Information:

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Dr. Solis achieved the rank of Vice President Director of Contract Administration in a large architectural firm in Atlanta, GA. He also held the position of Director of Integrated Projects at BECK's Atlanta, GA, regional office. His Ph.D. is from the Department of Building Construction in the College of Architecture at the Georgia Institute of Technology. Dr. Solis' academic expertise is based on a successful professional practice serving clients. He continues a legacy of service by teaching students at COSC who will serve more clients. Dr. Solis' research focus areas are in Sustainable Construction and Lean Construction theories, and advanced practices integrated with the most advanced building information and technologies.

'Instructor information' establishes the faculty's qualifications for teaching the course. Capstone started by taking a set of contract documents with drawings and specifications of a project under construction and asking the students to form a cost and time estimate. This required faculty with expertise in these two areas. Capstone evolved to a more holistic project delivery requiring a group of students, forming a virtual company to vie for a project by responding to a Request for Proposal. The students in a class, typically 4 to 5 per group, were in competition with the other class group, as well as, other virtual companies from the instructor's same semester commercial capstone classes. Among other items, RFP response example contains: Cost – Sub Capacity and Contingency; Time – Planning and Scheduling; Site Safety and Logistics; Quality – Lean Construction.

However, this approach did not advance newly University encouraged pedagogical insights in Interdisciplinary Project Based Learning (IPBL), Active Learning (AL) and Transformational Learning (TL). IPBL is modeled after the Worcester Polytechnic Institute (WPI) program, that created, perfected and promoted it in their annual convention. I was selected to participate with a team that COSC organized along with a member of the Center for Teaching Excellence. Furthermore, the WPI was invited by TAMU to present their IPBL approach to all TAMU interested faculties, and I availed myself of the opportunity to affirm and further understand the IPBL's principles, theories, and practices. This led to a radical change in the capstone use of a project as a base of learning. A summer 2019 offering of two capstone courses provided a pilot study of the new approach that also changed the oral presentation at the end of the semester.

A commercial capstone class is now one whole virtual company. The "company" responds to a Request for Proposal (RFP) as a Construction Manager at Risk (CMAR) before selecting the architectural firm. The RFP requires the company to provide pre-construction services at a time when drawings are sketchy at best. There is no project issued specifications. The RFP has Program of Requirements and Pro-forma that requires the selected general contractor "company" to track design services to stay within budget, time, and quality.

This new approach required a different set of deliverables and a different format for the written and oral presentations. In turn, this required a new set of rubrics that better monitors students working in teams with peer reviews, presented later on this book.

The pilot summer courses received a tacit approval from the Department Head that was very pleased with the oral presentation, energy and enthusiasm displayed by the students and jurors.

Fall and Spring presented opportunities to capture the student's comments and integrate them into a revised commercial capstone that is now fully Project Based and uses Active Learning Principles. Active Learning is further explained in the following section titled Pedagogy, Tasks Activities and Major Project List, found in pages 12-13.

This type of teaching requires that the faculty teaching commercial capstone be immersed in IPBL and AL. Hence, the ultimate deliverables by the students are more complex and covers the whole gamut of lower and upper level courses in the COSC program. The RFP response as CMAR is based on typical pre-con topics:

General Project Information	**COSC COURSE WITH TOPIC**
Project (Task 1 cover page, POR and Pro-Forma)	– COSC 353 Project Management
Site Work Systems	
Site Logistics Layout Plans and Details (Task 2)	– COSC 353 Project Management?
Pollution control Plans (SWPPP) and Details (Task 3)	– COSC 353 Project Management?
Site Safety, and Evacuation Plans and Details (Task 4)	– COSC 184 & 464 Safety
Demolition Drawing and Details (Task 5)	– COSC 353 Project Management?
Civil, Drainage, Utilities (Temporary and permanent, Task 6)	– COSC 353 Project Management
Landscape and Irrigation Plans and Details (Task 7)	– None
Structural Systems	
Foundation System (Task 8)	– COSC 421 Structure
Structure and Stair Design System (Task 9)	– COSC 321 Structure
Architectural Systems	
Exterior Envelop System (Task 10)	– COSC 253 Materials & Methods
Roof Plan (Task 11)	– COSC 321 Structure
Interior Finish System (Task 12)	– COSC 254 Materials & Methods
Vertical Transportation	
(Stairs – included on the structural frame system plans and details)	
Mechanical Systems	
Mechanical System (Task 13, includes Plumbing)	– COSC 325 & 326 MEP
Electrical System (Task 14)	– COSC 325 & 326 MEP

General Conditions

Conceptual Estimate by Systems (Task 15)	– COSC 275 & 375 Estimating
Conceptual Cost Loaded Schedule by Systems (Task 16, i.e. schedule of values)	– COSC 475 Planning
Sub-contractor and HUB Selection Strategy by System and Sub-System (Task 17)	– COSC 353 Project Management?
QA/AC and Commissioning Plans (Task 18)	– COSC 353 Project Management
Lean Construction Plans and Details (Task 19)	– COSC 353 Project Management?
Building Information Model (Task 20)	– COSC 461 BIM

Textbooks and/or Resource Materials:

Required: Francis Hall 2014 Renovation Drawings and Specifications. Students must read carefully and reference Francis Hall 2014 Renovation Drawings and Specifications. The presentations are like an exam showcasing how well the student has read, understood and used the information on the FH 2014 Renovation Drawings and Specs provided to you on a thumb drive at the beginning of the semester.

Note: FH documents and existing building are used as a project textbook. Architecture studio and other capstone courses use a different project every time it is offered. However, this is not what we are doing here. FH documents and project as a textbook are equivalent as saying any course must have a different textbook every time it is offered. The student learning challenges based on IPBL / AL are radically different once they are fully understood as will be apparent in this commercial capstone book.

For the pilot study of commercial capstone based on IPBL/AL, it was beneficial to provide more information than a pure pre-construction project would have. A real life pre-con project, where the architect is not selected at the time of a General Contractor (GC), responding to an RFP will have very sketchy conceptual drawings and a draft POR with guidelines on what the owner can afford as indicated in a Pro-Forma.

The information that the students have is more than what will be provided in future course offerings. As faculty, I made this decision so that the students and I could focus on the IPBL/AL process and make sure it works without increased anxiety on the part of the students.

The current project envisions a POR and Pro-Forma for adding a wing to Francis Hall that mirrors that which already exists and which was renovated in 2014. The documents at hand are from that renovation. The IPBL provides a real-life exercise in finding the pertinent data in a vast array of documents, drawings and specifications, to determine what will be expected in the new addition. This approach has proven to be very well received by the students and has no problem with students copying final product from one class to another as the deliverable requirements are slightly modified to capture any infringement on Aggie Honor Code.

"The College of Architecture requires all students to have a personal laptop. This laptop is required to perform classroom activities. You will need your laptop in this course, and you

are required to bring an operational laptop to class every day.
See http://www.arch.tamu.edu/inside/services/information-technology-services/recommended-laptop-enrolled-students/ for additional information.

The students will be asked to produce a Building Information Model (BIM) and they need to have access to Blue Beam, Navisworks, ProCore, AutoDesk (PlanGrid), BIM360 or Builder'sBox and a series of collaborative programs. All students will form teams for a collaborative effort, plus, dissolve and form different teams again and again. This format exposes them to the real-life situation where every project has a different team, and the project itself has a dynamic team that changes composition according to project needs.

Grading Policies:

You must earn a C in this class in order to graduate.

Communications intensive 3 credit hour courses must have 25% of the grade based on writing and/or speaking where the individual effort is 70% of the total. This capstone class meets or exceeds the Writing Center communication intensive requirements as shown in the grading policies that follow. "To receive C credit for this course, you must pass the C component(s) in this course." (In the case of student failing a C course requirement, the section number would be changed from a 900 to a 500, so the student would pass the course but would not receive C.)

Final Grades will be awarded based on the following:

90.0 – 100.0:	A
80.0 – 89.9:	B
70.0 – 79.9:	C
60.0 – 69.9:	D
00.0 – 59.9:	F

Evaluations cover the reading and classroom presentations; THERE ARE NO MAKE-UP PROVISIONS. Grades are not <u>curved</u>. Failure to complete required peer reviews and evaluations on time will result in a half-grade drop for the course. The schedule allows for two formal student/faculty progress and performance feedbacks: One around midterm after a number of Tasks grades are posted and the second one at the end of the semester before the final presentation. However, students are able and encouraged to meet by appointment during office hours with the professor.

Table 5. Grading Policies: Graded Activities and Points (highlight indicates SLO Assessment)

Activity	No.	Value Each	Total Points	%	Communications Requirement %	Assessment
* Tasks 1-20 In-Class – Task Team presentations	4	100	400	**40**	**20 - individual**	**SLO#2 Oral, See K. 1 SLO#9 CM Team Work, See K. 2**
** Tasks 1 – 20 Final – Individual presentations	1	200	200	**20**	**100 - individual**	**SLO#2 Oral, See K. 1 SLO#9 CM Team Work, See K. 2**
*** Tasks 1 – 20 External - Individual evaluations -	1	400	400	**40**	**100 - individual**	**SLO#2 Oral, See K. 1 SLO#9 CM Team Work, See K. 2**
Peer evaluations	4	**Ratio 1.0**				
Attendance	1	**Ratio 1.0**				
		total	**1000**	**100%**	**30%**	

Note: Peer Evaluation and Attendance are multipliers that affect the overall grade. There is a midterm and final peer evaluation. The student received the average of the peer evaluations**.** Project and Tasks grades will become final two weeks after they are returned in class. A maximum of 5 bonus points may be offered, at the discretion of the instructor, for the student successfully completing and submitting the **Senior Exit Survey**. An individual must participate in the oral presentation of the project Tasks, and submit all required peer reviews, in order to receive bonus points. Furthermore, the class must email (or provide a thumb drive) the instructor all the final presentations in **one** electronic PDF / PPT before the oral presentation. Awarded bonus points are added to the final grade point system.

Table 6. Grading matrix for students to keep score:

Task 1 to 20	NAME	Student Number	Task 1 to 5	Task 6 to 10	Task 11 to 15	Task 16 to 20	Individual – Task 1 to 20	External – Task 1 to 20	Total / base 1000	Average/base 100	Peer Evaluation	Attendance	Running Score	Bonus Points	Grading Score	Letter Grade
	Basis		**100**	**100**	**100**	**100**	**200**	**400**	**1000**	**100**	**1.0**	**1.0**	**100**	**N**	**100+N**	

The grading system using peer evaluation is essential to keep students in a responsible relationship during the collaborative. However, this requires a modifier of five bonus points, half a letter grade to make the class grade realistic in relation to other capstone courses while achieving the departmental requirement of 100% participation on capturing senior exit survey data.

Pedagogy, Tasks Activities and Major Project List:

Active Learning:

Active Learning is an approach to instruction that involves actively engaging students with the course material through discussions, problem solving, case studies, role-play and other methods. Active learning approaches place a greater degree of responsibility on the learner than passive approaches such as lectures, nevertheless instructor guidance is still crucial in the active learning classroom. Active Learning activities may range in length from a couple of minutes to a whole class session or they may take place over multiple class sessions.

Task Activities:

Commercial capstone active learning uses twenty Tasks, grouped in five sets, each with five classes devoted to active learning as noted below:

- The first class is based on inquire learning principles: Task teams will frame the significant questions that need research and answers, as well as, the critical issues that the Task must address. The different Tasks topics require consulting with multi-disciplinary practitioners, experts, consultants and faculty.
- The next two classes are based on scaffold learning: Students present their initial findings; plus, they create additional questions and issues that need to be addressed by the Task group with the feedback and involvement of the entire class as guided by the instructor. Between the second and fourth class, the students continue finding answers, creating solutions, drawings, sketches and data that addresses the Task. The collaborative mode of learning is emphasized in these two classes.
- The fourth class focuses on interdisciplinary project-based learning: Students finalize the Task solutions to the class project and discuss them in class with feedback from the entire class and instructor. Between the fourth and final Task class, the students prepare a formal presentation. Another name for the pedagogical approach is constructionism where knowledge is actively built by the students either through assimilating new experiences into what they already know or accommodating their existing ideas to incorporate new knowledge provided in a collaborative community - the class. The instructor acts as a mentor, consultant or advisor.
- The Task group presents their solution in the fifth class and receives final critique and suggestions from the entire class and faculty. This presentation is peer graded. Students, in an

Active Learning mode, may discover additional information and solutions in subsequent Task presentations and may modify their Task solution with corrections, additions and new information that may come from subsequent Tasks.

- Each Task has a leader that will present the Task solution on the final presentation date as noted on the syllabus calendar. They will receive an individual grade. The objective of capstone, as envisioned, is to provide an atmosphere conductive to a transformative-active learning experience that will be remembered and cherished throughout a student career.

General Notes:

- All Tasks must cite faculties, companies and individuals that were contacted and contributed to the Task completion.
- Tasks 2 through 14 must include total material, total labor cost and total time for each Task with assumptions and exceptions.
- All plans must have North Arrow. Specialties (Structural, Mechanical, Plumbing and Electrical) must cite current project Building Codes enforced. Interiors must cite current ADA code enforced.

Project Tasks:

Project and Team Information

1. A cover page must include: project image and name, team participation by Tasks, project title and information, owner information, table of contents, enforced codes and dates, FH buildings 1 and 2 dates of completion, FH building existing and proposed addition, student and faculty population and total square footage (including roof). Oral presentation will require an interesting story on FH existing and proposed addition with project information added.

Site Work System

2. Site Logistics Layout Plan and Details
3. Pollution Control Plans (SWPPP) and Details
4. Site Safety, and Evacuation Plans and Details
5. Demolition Drawings (ground and vertical) and Details
6. Civil, Storm and Sewer Drainage, (relocate as needed and show in plan), temporary and permanent utilities (locate both in plan)
7. Landscape, and Irrigation Plans and Details

Structural Systems

8. Foundation Design, and Basement Plans and Details
9. Structure and Stair Design, Plans and Details

<u>Architectural System</u>

10. Elevations, Window Schedule
11. Roof Plans
12. Architectural Finishes, Reflected Ceiling Plans, and Details

<u>Vertical Transportation</u>

(Stairs – include on your structural frame system plans and details)

<u>Mechanical System</u>

13. Mechanical and Plumbing Plans

<u>Electrical System</u>

14. Electrical, Plans and Details

<u>General Conditions</u>

15. Conceptual Estimate by Systems (based on Tasks 2 - 14 estimates, general conditions and overage factors)
16. Conceptual Cost Loaded Schedule by Systems (base on Task 15 estimates)
17. Sub-contractor and HUB Selection Strategy
18. QA/QC and Commissioning Plans
19. Lean Construction Plans and Details
20. Building Information Model, BIM360, AutoDesk (PlanGrid), ProCore, or Builder'sBox model

Student Performance and Expectations:

Our industry is based on responsive, responsible, timely and unambiguous performance.

- **<u>Responsiveness</u>** means that you comply with the scope of the work, that is: It is your responsibility to assure that your Tasks and projects are complete regarding requirements. Regarding class, it means that your readings are completed before class and you are prepared to participate according to the expectations on this syllabus. Regarding the project, this means that your Tasks complies with all the POR requirements.
- **<u>Responsible</u>** performance means that you are responsible for reading and participating to the best of your abilities in a team-learning effort. Regarding the project, this means that your team has the experience, expertise and resources (financial, boding, personnel and safety record) to accept and complete the project per the POR, and the design intent.
- **<u>Timely</u>** means that: LATE TASKS WILL NOT BE ACCEPTED (unless in the case of individual submittal you have an excused absence pursuant to Student Rule 7). Regarding class, it

means that you are present and on time. Regarding the project, this means that your team is committed to the schedule and timetables set per the POR and take no exceptions.

- **Unambiguous** means that: You will strive for clarity in your writing and words so that there is no misinterpretation of what is intended and what is communicated. Regarding the project, this means that all communications sent and received are correct, complete, timely and do not have ambiguities that could lead to misinterpretations.

Facts and Information Finding per Active Learning:

For each Task, the students, individually and in groups, will generate a list of questions and information needed to complete the Task, discuss the list with the faculty or visiting consultants and generate a viable solution to the project specific Task. Your professor is a resource person and there are no presentations on the topic unless they are asked for, before or in class.

Weekly Writing and Presentation Task:

A team will orally present the Tasks on which they collaborated and created their PPT presentation. During the last week of the semester, the leaders of each Task will give a final presentation to faculty and students. These presentations will be peer reviewed and graded.

Each Task presentation must contain a graphic component, a list of students participating on the Task, and addresses all the items required on the instruction template. A second board of PPT will further address the Task quantitative components (such as area, volume, weight, types and number of items, etc.) and qualitative components (such as assumptions and exceptions).

Project:

The virtual project used for this course is TAMU's Francis Hall Addition.

- Students are competing with other commercial capstone classes offered during the semester for the project.
- The class is performing pre-construction services as part of a CMAR consortium submitting a proposal for the project.
- The owner representative is Dr. Solis. The owner is Texas A&M University Systems.
- Students will work on and create the 19 Power Point (PPT) after each week, display and explain them in Zoom. The 20th Task is the BIM model. Professor and peers will grade the weekly work.
- The last day of class students will display all 19 revised PPT and the BIM laptop model, and explain them to other students and faculties that will use a rubric to grade the work.
- The rubrics for selecting the class winner is based on best value.

Professor's Teaching Philosophy:

You, the student may ask: What does excellence in Dr. Solis' COSC capstone look like? So, here it is:

- You, the student, captures your career-learning journey through your journal reflections. Those reflections are honed, insightful and well-written.
- You have a positive attitude, energy, enthusiasm, and good disposition in your teamwork. You collaborate inside and outside class settings. You build a solid collegial network through your deep engagement in your work.
- You become an agent of change and innovation by finding the information needed, providing well-founded analysis and critique, and being passionate about the project. The information is current, authoritative, and accurate on the topic.
- You take responsibility for your own learning, focusing on context, as well as, content. Context is how the pieces fit within the overall framework of the issues.
- Besides proven group collaboration, you function well independently; you are self-directed in framing and solving difficult messy problems.
- You sharpen oral communications skills and show self-confidence in your presentation role.
- You develop a strong character that can overcome the unknown, tensions, obstacles and adversities of complex problems that may be personal or project in nature.
- Most importantly, you come out of the capstone experience significantly different from when you began. That is, you experienced a deep-seated change, improved your leadership skills, became secure when taking risks (open to experimenting for success), and you embraced ethical behavior in difficult interpersonal and group experiences.

The attached video gives you an idea of Summer II 2019, class final presentation:
https://youtu.be/T6GUJ2JLnSg or
https://twitter.com/TAMUARCH/status/1161654979863699456?s=20

What is the role or your professor and presenters? (Adapted from WPI - CIPBL, with permission):

Your professor acts in the roles of coach, advisor and potentially, mentor.

- As a coach, I let you make mistakes. Mistakes are treated as great learning opportunities and not occasions for scolding and degrading. As a coach, I provide a safe learning, experimenting, exercising, and practicing environment, thus, strengthening your potential while applying lessons learned. As coach, I also help you identify weaknesses early so that your awareness may guide you to work through, and compensate for them.
- As an advisor, I guide you to strategies for successful completion of the Task. As an advisor, I intervene when needed to keep you and your team on the path that will lead you to a solid plan of action and authentic information, helping you understand how the industry works and how you can thrive and succeed in it. As your advisor, I provide a well-grounded scaffold of learning that builds up your confidence concerning your deliverables, i.e., the project Task boards, and oral presentations.
- As a mentor, I care for your success and character development. Strengthening and validating your proven leadership qualities and ethical backbone is my primary concern. As

your mentor, I care for your career plans, your short-term and long-term goals and objectives, as well as, the tools you use in making critical life decisions.

Tasks and Assessments Purpose

- To illustrate your progress in learning how to learn (Active Learning)
- To provide the instructor with feedback
- Feedback information is used to identify gaps and opportunities for continuous improvement.

Interdisciplinary Component

The students are instructed to reach out to experts in the field of the Task assignment. This requires consulting with Interdisciplinary Stakeholders: Building Code Officials, Fire Marshalls, Civil Engineers and Subcontractors, Structural Engineers and Subs, Mechanical and Electrical Consultants and Subs, Architect, Suppliers and Vendors, see Table 7. They may also contact professors on campus that teach a discipline of interest to them. For example, students have reached out to Safety Ann for OSHA and project safety list of requirements and to structural professor for advice on foundations, columns and types of slab design that could be proposed for the project.

Sharing Professional Life Stories

I have a wealth of stories from my architect and construction experience that I use to bring reality in the form of experiences which relates to the Tasks that are being discussed. I will choose the most appropriate story from two or three from my career experiences. Oftentimes, different class sessions will hear different stories.

Task Questions and Directions

This book gives examples of questions that I field to the students to guide them on their search. These questions are part of a larger set of questions that I have developed throughout the years of capstone presentations. As in the professional stories, the students in one class may hear different questions and prompts than those in the other classes. The questions probe missing information or what needs to be further developed and elicit critical thinking from the students.

PMBOK List of Terms Applicable to Tasks

The Project Management Book of Knowledge (PMBOK) has a comprehensive list of definitions on construction topics. PMBOK has made these definitions available for publication. I have taken the definitions and grouped them by this book 20 Tasks when applicable. Table 7 below shows for each Task number, the topic, the Interdisciplinary Stakeholder that students will consult, the Task Activities involved in the search and the number of terms with definitions that the PMBOK devote to the topic.

Of great interest, and as expected, the highest number of terms are dedicated to scheduling. Task 16 Conceptual Cost Loaded Schedule for this project is at the conceptual level or budget schedule. It is used to establish a preliminary benchmark that is later checked with an estimated schedule and tested against the actual project schedule. This is, therefore, a project most critical item that controls the project flow. Lean Construction practices also address the project flow and could be added to the list of critical terms on the subject. Task 15 Conceptual Cost estimate or budget cost is further defined with estimated cost, project buy out cost and is tested against actual project costs. Both cost and time combined are used as a cost loaded schedule for the owner to establish the project funding profile, schedule of values that later informs the application for payments.

I am amazed to report that I recognized all the PMBOK list of terms and definitions as I was rearranging them per this book 20 Task schema. It is my hope that our graduate students, in time, will also be able to recognize and use the words and the information or actions that their meanings imply.

Table 7. Task, Topic, Interdisciplinary Stakeholder, Activity, and PMBOK Terms

Task	Topic	Interdisciplinary Stakeholder	Activity	PMBOK Terms
1	Project	Owner, Stakeholders	Due Diligence, i.e.: POR, Pro-Forma, Indirect Costs, Funding Profile, Schedule of Values, Application for Payment Form, Risks, Zooning, Project Delivery System Selection, Design and GC Selection, Finance, Permits, Site Survey, Property Title, Original Budget, Original Schedule, Project Start and End dates	58
2	Site	GC, Superintendent and Project Manager	Site logistics plans for different project phases, risk analysis	4
3	SWPPP	GC, Superintendent and Project Manager	OSHA, list, cost, and time, risk analysis	4
4	Safety	GC, Superintendent and Project Manager, Safety Officer, Subcontractors	OSHA, list, cost, and time, risk analysis	23
5	Demolition	GC, Superintendent and Project Manager, Demo Subcontractor	List, cost, time and sequence, risk analysis	4
6	Civil	Architect design team, Civil Engineer, Surveyor, Facilities Manager, Utilities	Utilities, Storm, Waste, Power, list, cost, time	
7	Landscape	Landscape Architect	TAMUS' requirements, list, cost and time	

8	Foundation	Architect design team, Structural Engineer, Geotechnical Report	Geotechnical soil bearing and shear values, coordinate with structures, preliminary design, cost and time	
9	Structure	Architect design team, Structural Engineer, GC, Superintendent and Project Manager	Structural coordination and preliminary column location design per selected floor slab type, cost and time	
10	Elevations	Architect design team, GC, Superintendent and Project Manager	Exterior Envelope, material cost and time	
11	Roof	Architect design team, Structural, Mechanical and Plumbing Engineers, GC, Superintendent and Project Manager	Specification coordination, area rainfall data, preliminary design, mechanical coordination, structural coordination, cost and time	
12	Interior Finishes	Architect design team, GC, Superintendent and Project Manager	Specification coordination, suppliers and vendor verification, preliminary design, cost and time	
13	Mechanical/ Plumbing	Architect design team, Mechanical and Plumbing Engineers, GC, Superintendent and Project Manager	Specification coordination, structural coordination, civil coordination, preliminary design, cost and time	
14	Electrical	Architect design team, Electrical Engineers, GC, Superintendent and Project Manager	Facilities and Utilities coordination, Specification research, preliminary design, cost and time	
15	Conceptual Estimate	GC, Senior Estimator, Superintendent and Project Manager	Conceptual to Budget Cost to Estimate to Actual Cost Estimate to Actual cost progression, Direct Costs, Funding Profile, Schedule of Values, Application for Payment Form, Risks	87
16	Cost Loaded Schedule	GC, Senior Estimator, Senior Scheduler, Superintendent and Project Manager	Cost and time coordination, conceptual schedule to critical milestones, to time estimate, to actual time analysis	235
17	Subcontractor Selection	GC, Project Executive, Superintendent and Project Manager	Human Resources coordination, decision support system creation, cost and schedule analysis	49
18	QA/QC & Commissioning	GC, Superintendent and Project Manager, Architect design team, Mechanical Engineer	Specification coordination, Mechanical coordination, cost and time	16
19	Lean Construction	GC, Superintendent and Project Manager, All Subcontractors' Crew Leaders or Foremen	Schedule coordination, advanced project management theories and practices, risk mitigation, waste reduction	31

20	BIM	GC, Superintendent and Project Manager, Architect design team, Subcontractors	BIM 360, AutoDesk, Builder'sBox, ProCore, Coordination with all project Tasks	4

Capstone Expanded Definition:

Capstone is a team experience in which you learn with and through, your peers. The collaborative and individual Tasks, project and deliverables are designed to challenge you to research, think, analyze, evaluate and practice learning in a group or individual setting, as you will do for the rest of your career. **Learning how to learn** may make you uncomfortable and that is understandable, but once you graduate that is what you will be doing. Student work, comments and feedback may be used, with permission, to promote commercial capstone coursework. Below are comments from past students and jurors:

> "Dr. Solis, you changed my perspective on business and construction. You are one of the great educators in our department and a legacy builder. I am proud to be part of that legacy." **David Haggerty C17**

> "Dr. Solis, I want to thank you for a wonderful semester. The new structure of our capstone class is a great learning experience for my peers and me. I enjoy your enthusiasm and passion for Texas A&M University, The Department of Construction Science, and for continuing to pursue our department's betterment with the Francis Hall addition. Incorporating a visible and tangible project, such as the addition, to the department's academia is a great teaching method that should be continued in the future." **John Darling – B19**

> "I learned so much in your commercial capstone class. I did pick topics I was passionate about, as a whole, but that does not mean I did not learn much. I learned how to conflict resolution with someone in authority. I learned how to work in a team. I improved my public speaking skills, but more than anything, I gained insight on the process of construction. Thank you for the course. I like the edits you are making, and I would not change a thing." **Nathan Brown – B19**

> "Commercial capstone class set-up allowed me to pick Task and presentation topics that I thought would challenge me and help me learn a little bit more before I go into industry. I also enjoyed getting to change up the teams and choose my team every week so I could get to know more people and see how everyone contributes to the different Tasks." **Michael Newmann – B19**

> "Based on what I heard from previous classes, this summer session has been the most realistic capstone experience. I really enjoyed working on the Tasks and learning about things that need to be thought of during construction." **Reid Schiffbauer B19**

Anonymous

A. "I selected Tasks that I know little about so that I would learn more, and being in different teams helped me appreciate how diverse our industry is and the excellent contributions made by my classmates' contributions."
B. "I learned nothing, I selected the Tasks that I knew most about and stayed with the same group of students throughout. I just want to graduate and get to work!"

*<u>Professor's comment: If you were to hire one person, which one **A** or **B** would you prefer to hire?</u>*

Table 8. Typical Calendar of Activities (Summer II 2020 Sessions)

COSC 442 – 930 – ZOOM – 10:00 AM – 11:35 AM
COSC 442 – 931 – ZOOM – 12:00 PM – 1:35 PM
B20 - CALENDAR OF ACTIVITIES AND MAJOR TASKS

(This is a tentative schedule and is subject to change at the discretion of the instructor.)

Dates	Topics	SLO
Lecture #1 T – 30 JUNE	Introductions, course overview, expectations, walk the building inside and out. **Select Task 1 to 20 leaders and Task 20 team; Tasks 1 to 5 team formation.** Class selects a company submittals **coordinator**, i.e. formatting, font type and size, colors, etc. **Tasks 1 – 5 topics & (Zoom) workshops (cover, site, erosion, safety, demo)**	**9 (R)**
Lecture #2 W – 1 JULY	**Tasks 1 - 5 topics & (Zoom) workshops**	**9 (R)**
Lecture #3 R – 2 JULY	**Tasks 1 - 5 topics & (Zoom) workshops**	**9 (R)**
Lecture #4 F –3 JULY	**Tasks 1 - 5 topics & (Zoom) workshops**	**9 (R)**
Lecture #5 M – 6 JULY	**Tasks 1 to 5 topics Zoom PPT oral presentations and peer/faculty critique, comments, and suggestions (Task team assessed)** Tasks 6 to 10 team formation.	**2 (A)** **9 (A)**
Lecture #6 T – 7 JULY	**Tasks 6 - 10 topics & (Zoom) workshops (civil, landscape, foundation, structure, elevations)**	**9 (R)**
Lecture #7 W – 8 JULY	**Tasks 6 - 10 topics & (Zoom) workshops**	**9 (R)**
Lecture #8 R – 9 JULY	**Tasks 6 - 10 topics & (Zoom) workshops**	**9 (R)**
Lecture #9 F – 10 JULY	**Tasks 6 - 10 topics & (Zoom) workshops**	**9 (R)**
Lecture #10 M – 13 JULY	**Tasks 6 - 10 topics Zoom PPT oral presentations and peer/faculty critique, comments, and suggestions (Task team assessed)** Tasks 11 to 15 team formation	**2 (A)** **9 (A)**
Lecture #11 T – 14 JULY	**Tasks 11 - 15 topics & (Zoom) workshops (roof, finishes, mechanical, electrical, conceptual estimate)**	**9 (R)** **4 (R)**
Lecture #12 W – 15 JULY	**Tasks 11 - 15 topics & (Zoom) workshops**	**9 (R)** **4 (R)**
Lecture #13 R – 16 JULY	**Tasks 11 - 15 topics & (Zoom) workshops**	**9 (R)** **4 (R)**
Lecture #14 F – 17 JULY	**Tasks 11 - 15 topics & (Zoom) workshops**	**9 (R)** **4 (R)**
Lecture #15 M – 20 JULY	**Tasks 11 - 15 topics Zoom PPT oral presentations and peer/faculty critique, comments, and suggestions (Task team assessed)** Tasks 16 to 20 team formation	**2 (A)** **9 (A)**
Lecture #16 T – 21 JULY	**Tasks 16 - 20 topics & (Zoom) workshops (schedule, sub/HUB, QA/AC, lean, BIM)**	**9 (R)** **5 (R)**

Lecture #17 W – 22 JULY	**Tasks 16 - 20 topics & (Zoom) workshops**	**9 (R) 5 (R)**
Lecture #18 R – 23 JULY	**Tasks 16 - 20 topics & (Zoom) workshops**	**9 (R) 5 (R)**
Lecture #19 F – 24 JULY	**Tasks 16 - 20 topics & (Zoom) workshops**	**9 (R) 5 (R)**
Lecture #20 M – 27 JULY	**Tasks 16 - 20 topics Zoom PPT oral presentations (Zoom) and peer/faculty critique, comments, and suggestions (Task team assessed) Week look ahead: are individual Task 1 – 10+ and 11 – 20+ presenters ready? Presenters must create an introduction that establishes why the topic is critical.**	**9 (R) 5 (R)**
Lecture #21 T – 28 JULY	**Final Tasks 1 – 7 (see week look ahead) topics & Zoom PPT presentations and peer/faculty ** evaluations (Task leader assessed)**	**2 (A) 9 (A)**
Lecture #22 W – 29 JULY	**Final Tasks 8 – 14 (see week look ahead) topics & Zoom class PPT presentations and peer/faculty ** evaluations (Task leader assessed)**	**2 (A) 9 (A)**
Lecture #23 R– 30 JULY	**Final Tasks 15 – 20 (see week look ahead) topics & Zoom PPT presentations and peer/faculty ** evaluations (Task leader assessed)**	**2 (A) 9 (A)**
Lecture #24 F – 31 JULY	**Float day for any additional rehearsals if requested by leaders or teams**	**2 (A) 9 (A)**
Lecture #25 M – 3 AUG	**During class time: Zoom presentation – class, industry and faculty evaluated**	**2 (A) 9 (A) 1 (R)**

Chapter 2 – Learning How IPBL and AL Works (Lectures 1 to 5)

Overview:

Chapter 2 introduces the students to the IPBL and AL process using Tasks 1 to 5 in five lessons. The outcome is a peer evaluated presentation by all students on the work they have done. These Tasks are relatively easy in comparison with later Tasks. The following chapters build on the knowledge of how this process and novel pedagogy works.

Learning Objectives:

Commercial Capstone has a novel set up, information format, and pedagogy with Project Based Learning, as well as, Active Learning. Students are introduced to the syllabus pointing out the differences of this class set-up with previous classes, detailed information on IPBL and the set up for AC. They are given, via email and gone over in class, the Francis Hall Virtual Project (FHA) Scope of Work, Statement of Needs, and Program of Requirements – POR, (see Addendum A). The project information, the IPBL and the AL pedagogy to be assimilated, is understood and feed-back is given in the oral presentations, (see Addendum B, item 3). The students also receive, via email, a Power Point Presentation (PPP) containing instructions to the students and a template on how the presentation needs to be submitted, (see Addendum B, items 1 & 2).

Lecture #1 Introduction, Course Overview

Capstone topics are designed to cover material that the students had in previous classes, as well as, provide new material and insights on the topics. For example, most students had estimating and scheduling, but they have not learned how to establish budgets when there are no documents such as in the pre-construction conceptual phase. This exercise builds on what they know but requires critical thinking in finding project related information from sources that can be used at a macro level to establish budgets. Budgets are different than quantitative takeoffs. Budgets are used to frame the upper and lower limits for each system that a designer needs to work towards in order to stay within the limits prescribed.

Students are encouraged to share contact information with those in their Task group, determine the platform they will use to collaborate with their peers, as well as, share data, and drawings. In addition, students are encouraged to establish a regular meeting schedule after class time to work in their group, as well as, individually. The students' serious responsibilities to self, the team and the class are essential components of IPBL / AL and are tracked and measured by peers.

Team Formation

The main highlight of the course Active Learning, is the formation of groups that will work in teams for five lessons and then regroup. As faculty, I will point out that every project is done by differing teams, and that within a project, the team is dynamic with subcontractor teams entering and exiting all the time. The variety of talent in a collaborative setting provides value and expertise to the project. The students are asked to deliberately work with others that they have not worked with in the past.

For example, the first Task is to select the leaders of each Task, see Table 9.

Task 1 to 20 Leader's Signup

Each Task topic and the deliverables (see Addendum B, item 4 to 7) is explained. Students are asked if they have any questions at this time. Instructions are given as to what is required of a Task leader; their role and responsibilities. The leader should be a student that not only has an interest in the topic, but also is willing to guide the team in finding the required information. Furthermore, the leader will record the information in the template as indicated, and lead the team on the oral presentation of the Task's work. Ultimately, the leader needs to capture all the nuances and critical items and present them first to the class and then to a panel of jurors.

Table 9 captures a class of 23 students. The students (represented by numbers) have volunteered to be leaders (highlighted in yellow) for the Tasks.

Tasks 1 to 5 Team Members Formation

Instructions for the team members and leaders are different. Students are asked to join a group, not based on being with their buddies, but based on topics on which they have some knowledge, either in class or in practice, and where they want to learn more. The first five Tasks volunteers are highlighted in green.

Table 9. Task 1 – 20 Leader and Team Selection

COSC 442 – 931 Dr. Solis – Task 1- 20 Team & Leader																					
Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1																					
2																					
3																					
4																					
5																					
6	Coordinator																				
7																					
8																					
9																					
10																					
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22																					
23																					

1. Cover
2. Site logistics
3. SWPP
4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

11. Roof
12. Arch. Finishes
13. Mechanical
14. Electrical
15. Estimate (2)

16. Schedule
17. Sub & HUB
18. QA/QC
19. Lean
20. BIM (2)

Site Walk Through:

The following items are pointed out at FHR 2014 site walk-through when classes are F2F.

- Fire controller annunciator panel, and command station, see Figure 1. Will the addition have its own annunciator panel and command station or will the added system tie in to existing ones? A good question for the Fire Marshall and University Facilities.

Figure 1. Fire Controller and Command Station at FHR 2014 South West Stair

- Building expansion joint, see Figure 2. This is a must have and separates all the floors and roof. Students can learn how to by paying attention to detail on how it was done in FHR 2014. This requires finding all the drawings, elevations, sections and details, as well as, information on the specification on products used.

Figure 2. Building Expansion Joint between FH original and Addition

- FHR 2014 on the first floor has a plaque commemorating the project design and construction team, see Figures 3, 4 and 5. This is useful information as it is likely that the architect will be a very good candidate to perform the FHA. Although, as in construction, we can expect to have differing teams of consultants, a plaque also provides information on how GC personnel were involved and their roles. The plaque also shows who were the subcontractors involved in FH 2014 Renovation project. This is useful information when calculating FHA GC staffing and subcontractor selection.

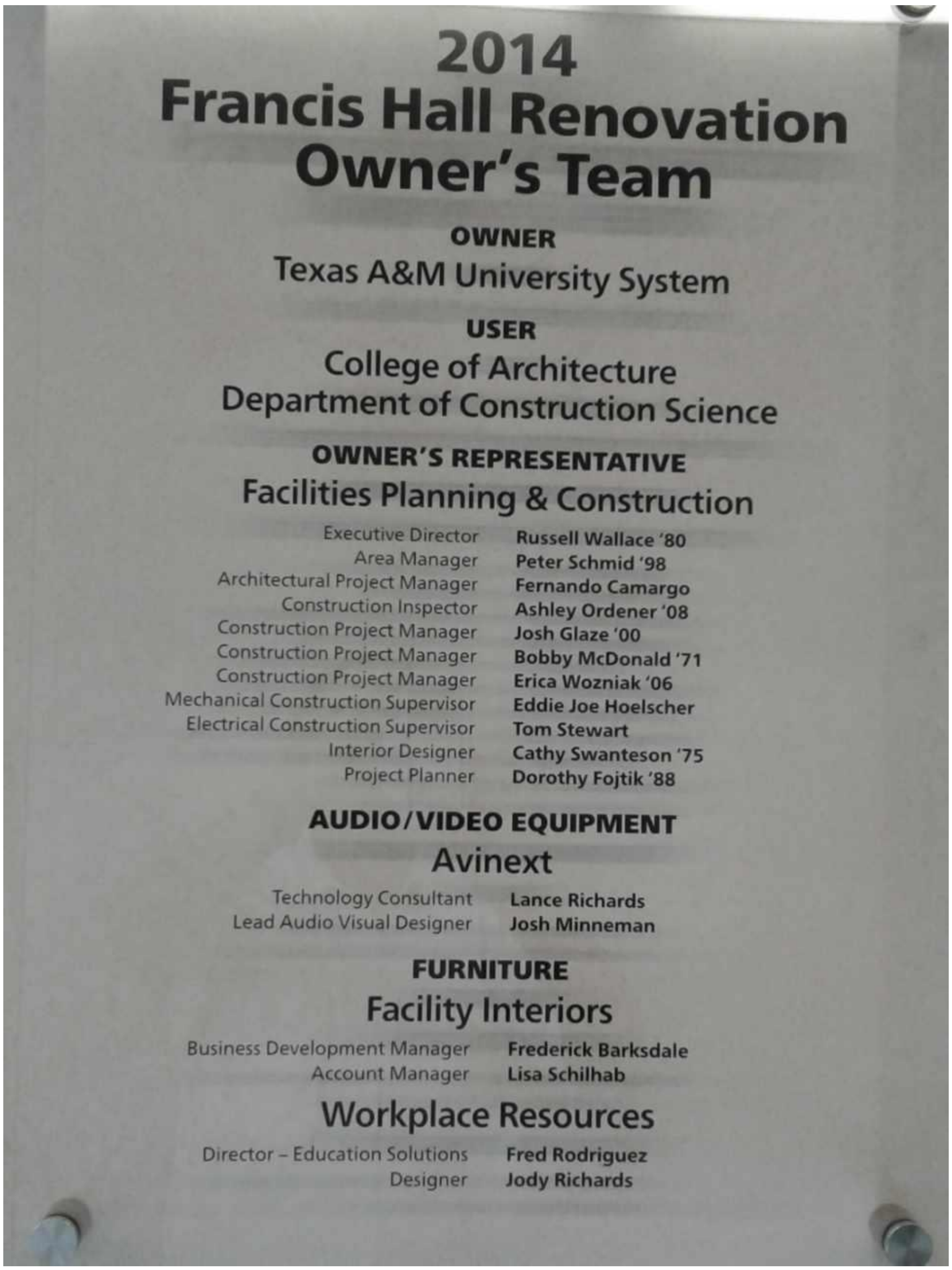


Figure 3. FHR 2014 Owner's Team

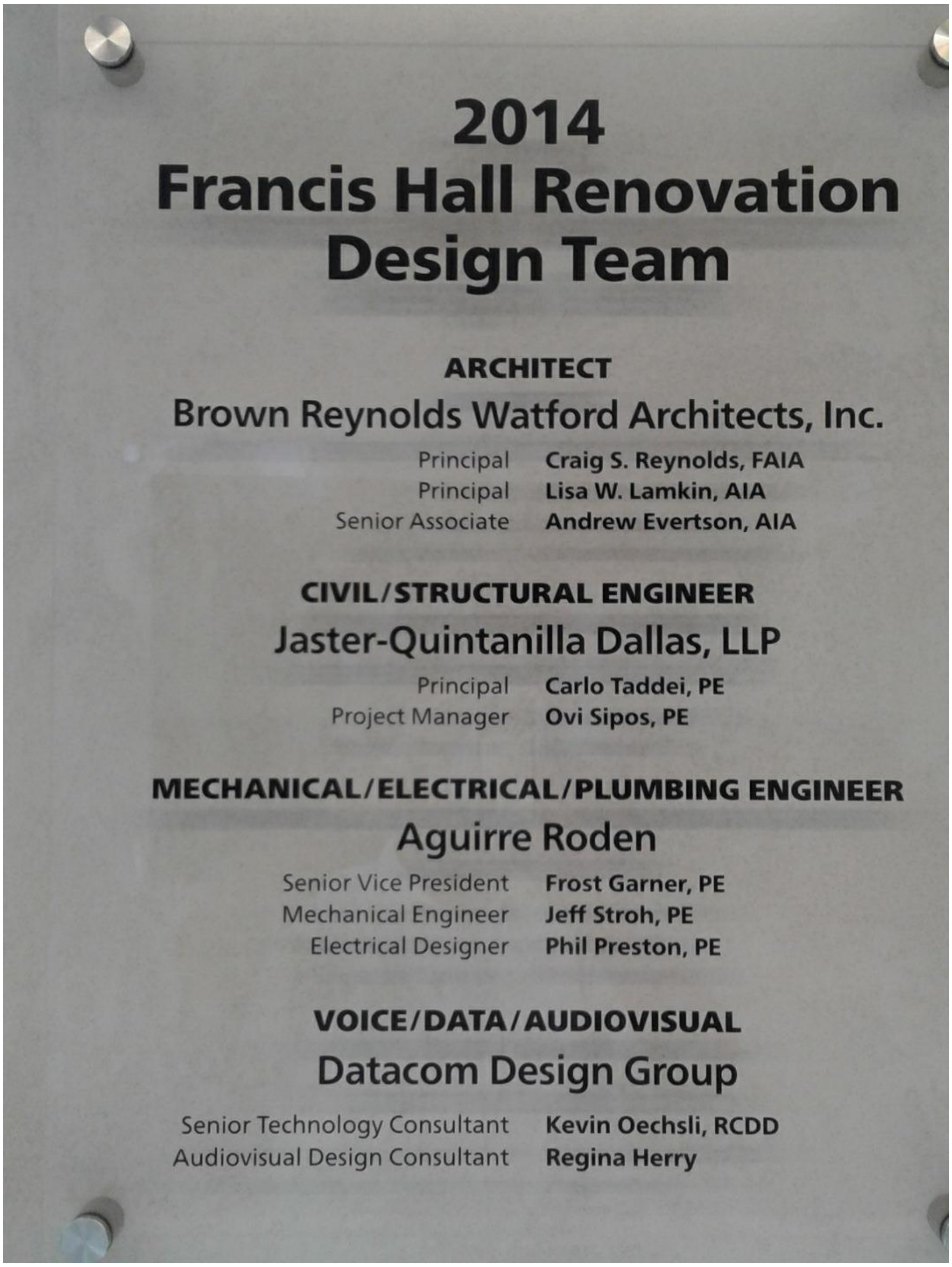


Figure 4. FHR 2014 Design Team

Figure 5. FHR 2014 General Contractor and Subcontractor Teams

- FHR 2014 civil drawings show the location of all manholes and inverts in the area, see Figure 6. This is excellent information for the civil Task where manholes have to be relocated. These drawings also give an idea of scope and cost. Inverts information is useful for the SWPPP plan to protect the site. Drawings also show ground slope, hence, surface drainage patter that will require thoughts on how to guide the water and protect the run-offs.

Figure 6. Site Showing Ground Slope, Manhole Locations and Tree Locations

- FHR 2014 has a basement six feet below the bottom of the first-floor structure. The ground is of parched concrete in places and thin concrete in others. This is useful information for deciding what to do for the FHA basement.
- In previous classes, we were able to visit the basement for the students to trace the plumbing and roof drain pipes, as well as, pipes incoming from utilities. This is no longer possible, but was helpful for the students to figure out what utilities needed to be caped, removed or relocated. It also provided an idea of current drain pipe capacity and if additional volume required an increase. This information tested the student's attention to detail and their response to the Civil Tasks.
- The basement visits also provided information on how the power was routed to desks with under-floor cabling and the very expensive fire caulking. This information was very valuable later-on in gauging the attention the students were paying when completing the Electrical Tasks. FHR 2014 Civil Drawings show land contours, the architectural elevations and building

sections have floor elevation marks based on first floor 0.0'. From these information sources, the students can calculate the quantity of soil that will have to be removed to keep a clear basement height.

- The basement requirement also raised two questions: 1. How to drain the dug basement when it rains. 2. Where is the best way to direct the excess water and silt. This was tested in the Civil and SWPPP Tasks. The amount of rain water expected for College Station will be calculated in the Roof Task. The students are required to coordinate new information and incorporate it in their responses as in real life. Their team work is dynamic.
- The site walk through provides a good visual of the north exit landing and the steps that are needed to be replicated. The exterior elevation visit provides information on the character of the historical building, plus, it tests how well the students are paying attention to the details and the narrative. The character of the historical building needs to be captured on the Exterior Envelope Tasks and the BIM Tasks.
- The site visit also provides information on where FHA will tie into the existing building, how many windows will have to be removed and how to preserve building positive pressure at all times. The Chill-beams do not tolerate negative pressure that will allow an increase in humidity loads. These issues will be tested in the Demolition Tasks, and Mechanical Tasks down the road.
- The site visit also points out FHR 2014 foundation and how new foundation must be separate and away from the existing building so that it does not undermine the soil bearing capacity. This information will be tested in the student's attention to detail in the Foundation Tasks, as well as, Structure Tasks when the students determine column locations and pass the information onto the Foundation team.
- The site visit points out how Francis Hall had to be abandoned because of water intrusion from the roof causing black mold on top of asbestos and the multiple usage of lead paint on the interior finishes. These factors, mold, asbestos and lead paint, required extensive and costly remediation. Although remediation is no longer required, attention to detail of the capstone over the expansion joint of the existing building and the new parapets in the addition is critical and must be tested in the Roof Tasks.
- The site visit provides information on entrances and exits to the site that will be needed in deciding a viable Site Logistics Plan in that Tasks, as well as, where to locate trailers and other items per general condition. Students will be asked to make a list of all general condition items that need to be indicated in the Site Logistics Plan. This plan changes according to the construction phases so there is more than one Site Logistics Plan that needs to be considered and tied to the Master Schedule according to the envisioned milestones.
- The students are made aware that the Site Safety Plan (Tasks) will also have items that will impact the Site Logistics Plan, and hence, will require accommodation and plan revisions.
- The site visit also points out the location of trees and other structures that need to be considered in Site Logistics Tasks and Demolition Tasks. The students are made aware that the University has strict rules on tree removal and are instructed to find the information either by contacting the University Architect or online, see Figure 7. Both Tasks have to coordinate the replacement plan and may change once other items are taken into consideration such as building footprint, type of material used in structure (Structure Tasks)

type of mechanical equipment loads (Mechanical Tasks), and hence, type of equipment needed.

Figure 7. Structures and Trees to be Removed

Tasks 1 to 5 Topics, Workshops:

The faculty describes in greater detail each Task, points out the deliverables, and notes where to find the information. The instructions indicate possible sources such as:

- TAMU Architect
- Building Code Officials / Permit
- TAMU Transportation & Services
- TAMU Facilities Services
- TAMU Utilities & Energy Services
- FHR 2014 Design Team
- Internship Network (GC & Subs)
- Faculty (previous courses)
- Francis Hall Renovation 2014 100% Construction Drawings & Specifications

Francis Hall Renovation Drawings and Specifications 2014, is the main book-like source of information. Since the addition will mirror existing conditions as requested by the University Architect for historical buildings, the information is pertinent but vast. The student's challenge is to find the Task pertinent information within the documents. This is a very practical pursuit and one that they will be doing throughout their careers. The pursuit answers these questions: what is needed in this Task, where to find the information, cost, time spans, how to apply the found information on the specific site and project. Students will we need to know how their Task fits the total project logistics, cost and schedule. Furthermore, how it all fits within the Owner's POR, the Pro-Forma's overall budget. In other words, students need to be clear how everything is linked with Tasks that precede it and Tasks that follow it.

Instructions also indicate that this first of five Tasks centers around site conditions and the process as follows: *Frame the significant questions that need research and answers, as well as, the critical issues that the Task must address.*

The site visit provided a good start on the questions and issues that the students will need to research and address in their RFP response. This first lesson, once the teams are formed and grouped, also provides the following insights on work to be done by Tasks:

> *Task #1 Cover page with project image and name, team participation by Tasks, project title and information, owner information, table of contents, enforced codes and dates, FHR building date of completion, FH building existing and proposed addition, student and faculty population, plus, total square footage (including roof). Oral presentation will require an interesting story on FH existing building and proposed addition with project information added.*

Task #1 Introduction to the Virtual Company RFP Response

Typically, this is done by a principal of a company or a project executive officer. An executive team member establishes a deep understanding of the project's Program of Requirements, the boundaries set by the Pro-Forma, the project needs and wants, as well as, an understanding of the owner's hot buttons. The project executive analyzes the Pro-Forma for overall target total project budget, total construction budget, expected project notice to proceed for design and expected notice to proceed for construction. However, most importantly, the project executive analyses the required date for the final certificate of occupancy (CO) as this is a critical date that must be met or monetary consequences will be incurred per the POR. An owner occupies the partially finished building at the temporary certificate of occupancy, which is another milestone to keep track of and aim for in a timely manner.

The salient features of the POR are presented such as number of students and faculties that will be accommodated by the addition. This should be done in the context of an exciting but short story of the State, University, Construction Industry Advisory Council (CISAC) needs and wants for additional student graduates from our program.

This Tasks also requires clear and precise articulation of the major project risks. For example, in education facilities used by students, time is of the essence and the POR typically has late fees, as well as, consequential damages. The officer needs to acknowledge these or the company is considered non-responsive.

The leader presenting Task #1 is required by instructions to acknowledge how the company came up with its RFP using Project Based and Active Learning. Therefore, the leader must have paid attention to what the others in the team presented and create a summary that captures all the work done by the Task team.

Pertinent and enforced Building Code information must be presented acknowledging what will drive both the design and the construction team.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

Task # 2 Site Logistics Layout Plan and Details

The leader and team of Task #2's first objective is to find answers to the questions and issues from previous classes, such as Project Management, and Project Safety. In this lesson, the students start identifying what is needed for this project Site Logistics plan.

After this meeting the Task #2 team will create a list of items that the project and general conditions require in order to support the project. Other items to be addressed are the circulation pattern and route for deliverables, the allowable times of delivery, the road traveled capacity – brick pavers – so that heavy loads can be accommodated, coordination for deliveries with TAMU transportation department, dumpsters logical locations, deliveries and extraction, security, fencing, porta potties, workers' rest tent and other items.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

Task #3 Pollution Control Plan (SWPPP) and Details

The leader and team of Task #3's first objective is to find out from previous classes, what is needed for a comprehensive Pollution Control Plan. Credible sources such as Project Managers, Superintendents, as well as, internship experiences should be used.

After this meeting, the Task #3 team will create a list of SWPPP site related specific items that the project and general conditions require in order to support the project. As mentioned in the site visits, the students need to explain how to drain an excavated and water-logged pool-like basement hole without violating SWPPP and Occupational Safety and Health Administration (OSHA) inspections.

Students are questioned on OSHA requirements and penalties during this lesson.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

Task #4 Site Safety, and Evacuation Plan and Details

The leader and team of Task #4's first objective is to find from previous classes, (such as Project Management, and Safety), as well as, from internship experiences and other credible sources (such as consulting with Safety Ann) what is needed for a comprehensive project specific Safety Plan.

After this meeting, the Task #4 team will create a comprehensive list of items that must be considered during the different phases of the project. This list changes as the project dynamics changes. The students must be able to acknowledge and articulate the changes.

Before class ends, I will ask the students to share any experience they gained or heard in their internship on the topics in this Task.

Task #5 Demolition Drawings (ground and vertical) and Details

The leader and team of Task #5's first objective is to find from previous classes, (such as Project Management), as well as, from internship experiences and other credible sources (such as demolition companies in the area), what is needed for a comprehensive project specific Demolition Plan.

After this meeting, the Task #5 team will create a comprehensive list of items that must be considered during the different phases of the project. Particular attention must be placed on the issue of exiting building positive pressure requirement to assure that the Chill-beams system works properly and why this is important. Demolition schedule is essential and students are prompted to discuss which is the best time to demolish the existing building and connect the new addition: after the structure is up or after the addition is enclosed and pressurized?

TAMU architects require that the addition has the look of the existing building. Debate is encourage on what materials are salvageable, can be reused, and at what cost and impact to the project schedule.

Commercial windows, such as the ones in FHR 2014, are very expensive. Are the windows that are being removed the right size for possible re-use? This requires students to study what window types are needed for the addition and if the removed ones are a fit. A plan for removing and protecting any material or items that will be reused must be identified and thought through carefully.

Demolition of physical items such as slabs, benches, walls, and trees must be identified during this lesson.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

Task #20 BIM

This is an ongoing Task every week. The students volunteering for this Task must gather and coordinate all the information that is required for a BIM model. The students present their work along with other teams during the fifth lecture and are peer evaluated by the entire class.

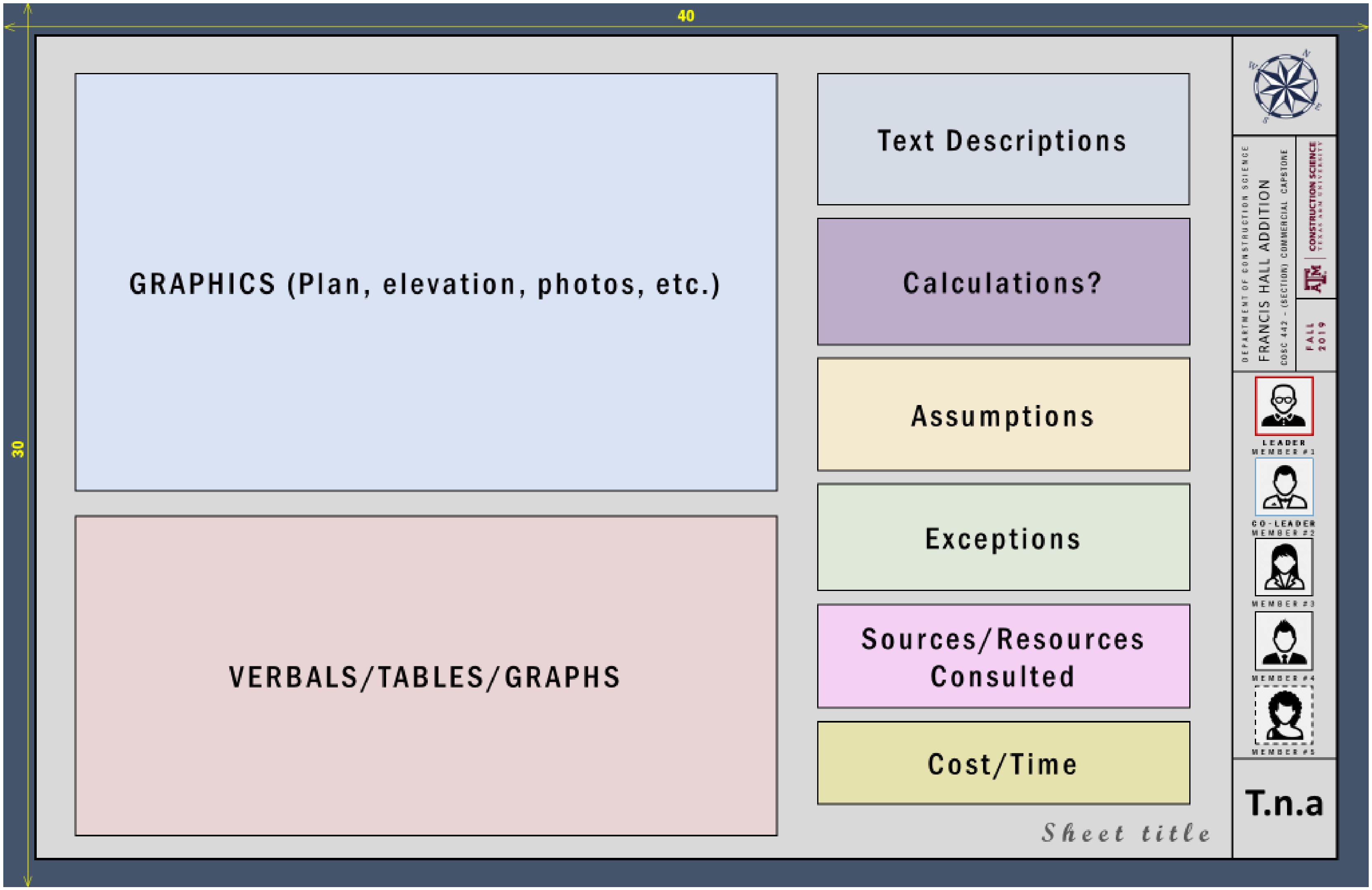
Company Coordinator Selection

At the end of Lecture #1 or beginning of Lecture #2 if time does not allow, the students are asked for volunteers to be the company quality assurance and quality control coordinator in charge of the written and oral PPT presentations. The company then selects one person, (or if one-person volunteers then appointed) to be the coordinator. Further instruction on the coordinator QA/QC work will be given later, but the charge is that the company works in a common data base, and the coordinator makes sure that the documents are correct, complete, timely and unambiguous as required.

Deliverables

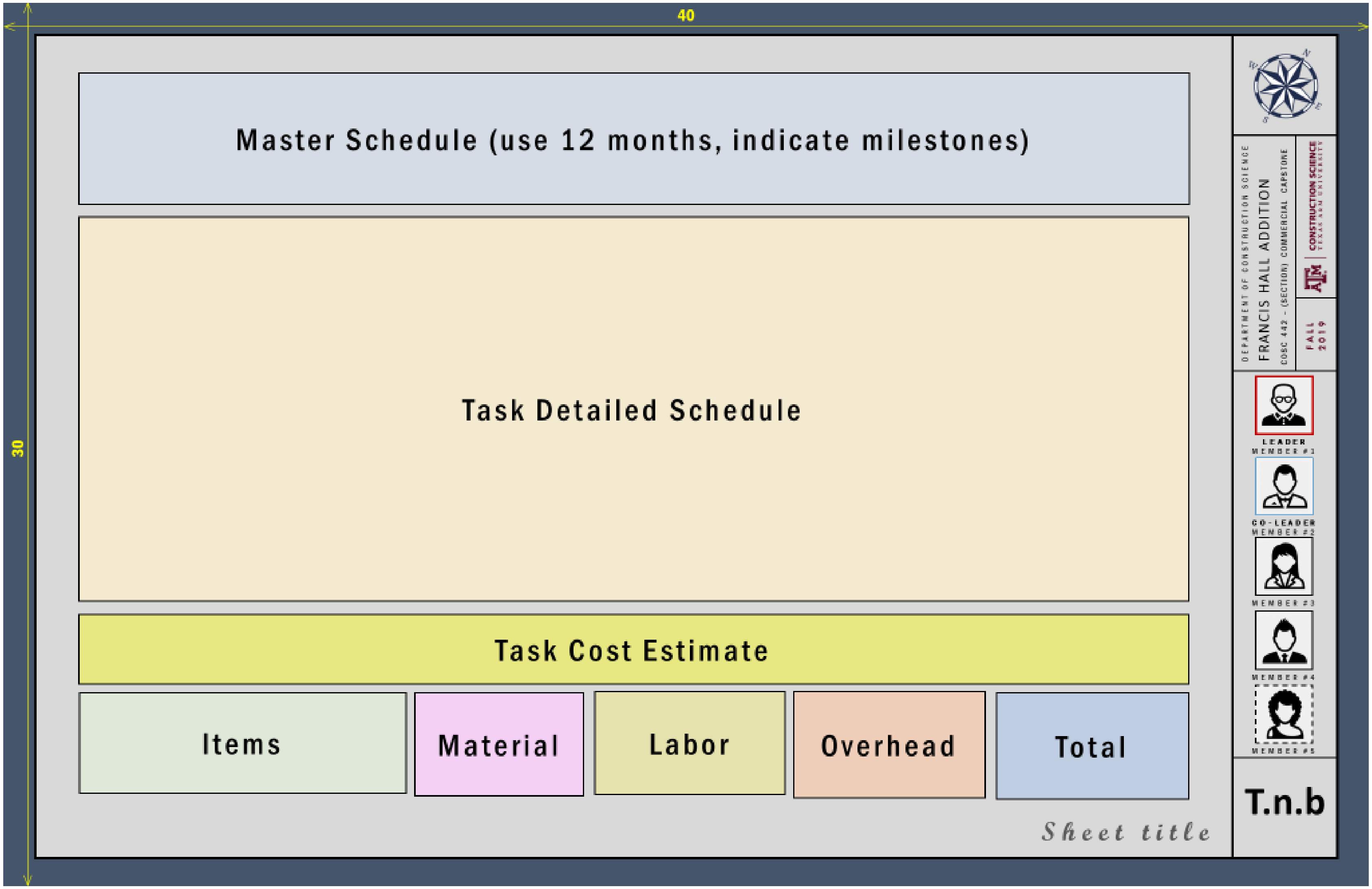
Students are reminded of two deliverables per Task as noted on the Project Instructions PPT. The first deliverable is **T.n.a** where the T stands for Task, the n for the number of the Task and the a is for the first deliverable, see Table 10. Calculations could be on a or b.

Table 10. Project Instruction Oral Presentation Deliverable Template T.n.a



The second deliverable **T.n.b** is the back-up information that later on will be rolled into the calculated schedule and cost of the project, see Table 11.

Table 11. Project Instruction Oral Presentation Deliverable Template T.n.b



NOTE: FHA within the TAMU System is a special project. Typical commercial projects will have additional items that need to be considered by upper management such as:

- Is the proposed project within the scope of projects that we have experience?
- Is this a project type in market that our strategic plan indicates we should enter and take a calculated risk?
- Does the owner have experience with this type of project? Or is it a new project for an owner that is not experienced, hence a higher risk potential?
- Does the owner have a professionally prepared Program of Requirements?
- Does the owner have a professionally prepared Pro-Forma?
- Does the owner have clear title to the land?
- Has the owner done due diligence securing the proper zoning for the project type and has the documents at hand?
- Has the owner's due diligence secured a certified Plat Survey?
- Has the owner's due diligence secured an Engineer's Geotechnical Report, as well as, Environmental Protection Agency (EPA) I and EPA II reports?
- Has the owner verified funding availability including 30% for Furniture, Fixtures & Equipment (FF&E) and owner's items (survey, permits, designer and consultant fees, insurance, bonding, etc.)?

Just like the owner qualifies an architect and a general contractor, and the general contractor in turn qualifies the subcontractors, a general contractor should always qualify an owner and the owner's due diligence. There are cases that the best project is the one you passed on the opportunity for doing.

Before class ends, I will share a personal experience at PFVS Architects where I was the VP Director of Contract Administration in charge of major clients.

Lecture #2 - Tasks 1 to 5 Topics and Workshops

The students present their initial findings, plus, create additional questions and issues that need to be addressed by the Task group with the feedback and involvement of the entire class as guided by the instructor. Students are asked to visit the PMBOK List of Terms Applicable to Tasks 1 to 5, (found at the end of this chapter) for insight on the type of information needed and as a review of what they may have learned in previous classes.

In the past class offerings, students are reticent to do their assigned work. They are accustomed, by previous class experiences, that if they wait another student will do the work for them. This is a good opportunity to introduce in detail the peer review system and the consequences when they receive an 80% average grade from the diverse team peers and what it does to their own grade. Say you have a very good 95%, an A but your peers observe that you do not work well with them, your work when graded by the rubrics is not correct, complete, timely and unambiguous. The team gives you an 80% that translates into a 0.80 modifier. 95 x 0.80 = 76 a solid C, barely passing. This is also a good opportunity to address the second modifier, attendance. The syllabus notes that everyone has two unexcused attendances. These should be used for company interviews but can be used for any eventuality. There are no other exceptions.

Typically, students begin participating more actively and engaging with their team and class. Exceptions are dealt with by the faculty's one-on-one progress report meeting at midterm or before if merited.

Task #1 Project Information RFP Response

Students in this Task elaborate on the work they have done in understanding and deciphering the POR, Pro-Forma and team formation.

The leader presents a draft of the RFP, use of Interdisciplinary Project Based, and Active Learning as the entire class comments and critiques

Another student presents the work in discovering pertinent and enforced Building Codes.

At this time, the questions regarding building permits comes up for the students to research and report on by the next class:

- What jurisdiction issues the building permits, address, and contact information?
- Who submits the building permits: the 0wner, architect or general contractor?
- How are the building permits' fees calculated?
- What documents are required when submitting for a building permit?
- What is meant by an "expeditor"? Are they allowed in this jurisdiction? How much do they charge? Why projects use expeditors?
- How long does it take for a jurisdiction to review and approve building permits?
- What is the question you must ask of a building permit officer before you leave a meeting?

The students have found the applicable building codes, but, typically, they are missing two very important pieces of information: 1. What is the year of each enforced code? 2. Are there any Addenda that need to be considered? This requires re-visiting with building code officials and securing all the required information for the RFP response.

Before class ends, I will share work experience at PFVS architects as VP Director of Contract Administration in securing building permits from the Nation's reputed toughest jurisdictions at that time, West Palm Beach and Reston Virginia.

Task # 2 Site Logistics Layout Plan and Details

The leader and team of Task #2 present a draft of the list of items and information gathered to make a realistic Site Logistics' Plan.

A student presents the circulation pattern and route for deliverables, the allowable times of delivery, the road traveled capacity – brick pavers – so that heavy loads can be accommodated, coordination for deliveries with TAMU transportation department, dumpsters logical locations, deliveries and extraction, security, fencing, porta potties, workers' rest tent and other items.

The question of eighteen wheelers turning radius is raised as the site delivery entrance at one end presents challenges in turning and overcoming a steep rise and drop of elevation. These challenges need to be considered and resolved.

Detailed information on the number and types of dumpsters, frequency of pickup and delivery is raised and discussed.

Heavy truck and concrete truck deliveries are examined and questioned as the tight site does not have laydown space. This fact will need to be further examined in the following Tasks. Students must address the types of equipment that will be needed for the work, the rental rates and the expected duration at the worksite. This information will be noted on **T.n.b**.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

Task #3 Pollution Control Plan (SWPPP) and Details

The leader and team of Task #3 present a list of items for the Erosion Control Plan.

A student presents ideas and options on how to drain an excavated and water logged pool-like basement hole without violating SWPPP and OSHA inspections.

A student discusses OSHA requirements and penalties.

This Task is ideal for contacting field personnel from the student's field experiences and for sharing their findings as every company has their favorite SWPPP technology, device and approach based on experience.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

Task #4 Site Safety, and Evacuation Plan and Details

The leader and team of Task #4 present a draft list of items to be considered for a comprehensive project specific Safety Plan.

A student discusses how the plan will change as the project dynamics changes.

This Task is ideal for contacting field personnel from the students' field experiences and forsharing their findings as every company has their Safety Plan, and approach based on experience.

TAMU, after Kyle Field, has implemented more stringent safety requirements on all projects. Students are asked to become familiar with these safety requirements, then discuss their implementation with safety officers working on current on-campus projects or from officers they met in their internship. Therefore, there needs to be more than one initial Safety Plan discussed and shown in the final presentations.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

Task #5 Demolition Drawings (Ground and Vertical) and Details

The leader and team of Task #5 present ideas and a list of items to be considered for a comprehensive project specific Demolition Plan.

Students discuss the issue of exiting building positive pressure requirement to assure that the Chill-beams system works properly and why this is important.

Students discuss preliminary ideas on the demolition schedule. The discussion should be informed by talk with a demolition company so that project specific and viable solutions can be presented for evaluation. This aids in the selection of the best value alternative.

TAMU architect should have been consulted concerning TAMU's historical building preservation requirements.

Students should present ideas for reusing windows including where they are to be used.

Students should discuss the pros and cons of removing and protecting any material or item such as bricks that will have a waste and a cost factor.

Students should identify, and quantify the demolition of physical items such as slabs, benches, walls and trees. Earth removal and truck loads should be quantified by this lesson or the next.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

Lecture #3 - Tasks 1 to 5 Topics and Workshops

Discuss any findings/queries that evolve with the instructor and the class. Students asked how they applied the PMBOK List of Terms Applicable to Tasks 1 to 5.

By this lecture, students have settled within their groups, have exchanged contact information, have participated in group division of work and assigned Tasks and deliverables within a timeline.

Task #1 Project Information RFP Response

Students in this Task elaborate on the work they have done in understanding and deciphering the POR, Pro-Forma and team formation.

The leader presents a draft of the short story of the State, University, and Construction Industry Advisory Council needs and wants for the additional student graduates from our program and the team. The entire class comments and critiques. The objective is to have a well-crafted short presentation that captures the project motivation and risks hot buttons.

The leader presents a draft of the RFP, use of Project Based and Active Learning as the entire class comments and critiques

Another student presents the work in discovering pertinent and enforceable Building Codes.

The following questions regarding building permits are raised for the students to research and report by the next class:

- What documents are required when submitting for a building permit?
- What is meant by an "expeditor"? Are they allowed in this jurisdiction? How much do they charge? Why projects use expeditors?
- How long does it take for a jurisdiction to review and approve building permits?
- What is the question you must ask of a building permit officer before you leave a meeting?

The students found the applicable building codes, but, typically, they are missing two very important pieces of information: 1. What is the year of each enforced code? 2. Are there any Addenda that needs to be considered and date of the Addenda? This requires re-visiting with building code officials and securing all the required information for the RFP response.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task. I have a pertinent story from my time at Niles Bolton and Associates on securing building permits in Reston, Virginia, that I will share with the students.

Task # 2 Site Logistics Layout Plan and Details

The leader and team of Task #2 presents a draft of the list of items and information gathered to make a realistic Site Logistics Plan.

A student presents the circulation pattern and route for deliverables, the allowable times of delivery, the road traveled capacity – brick pavers – so that heavy loads can be accommodated, coordination for deliveries with TAMU transportation department, dumpsters logical locations, deliveries and extraction, security, fencing, porta potties, workers' rest tent and other items.

Detailed information on the number and types of dumpsters, frequency of pickup and delivery is discussed.

The streets feeding into the area are brick paved and may have load restrictions that the students need to investigate. Heavy trucks and concrete truck deliveries are examined and questioned. The site is tight and does not have laydown space.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

Task #3 Pollution Control Plan (SWPPP) and Details

The leader and team of Task #3 present a list of items for the Erosion Control Plan.

A student presents ideas and options on how to drain an excavated and water logged pool-like basement hole without violating SWPPP and OSHA inspections.

A student discusses OSHA requirements and penalties.

This Task is ideal for contacting field personnel from the student's field experiences and sharing the findings as every company has their favorite SWPPP technology, device and approach based on experience.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

Task #4 Site Safety, and Evacuation Plan and Details

The leader and team of Task #4 present a draft list of items to be considered for a comprehensive project specific Safety Plan.

A student discusses how the plan will change as the project dynamics changes.

This Task is ideal for contacting field personnel from the students' field experiences and sharing their findings as every company has their Safety Plan, and approach based on experience.

TAMU, after Kyle Field, has implemented more stringent safety requirements on all projects. Safety plans change as the project dynamic changes. Therefore, there needs to be more than one initial safety plan discussed and shown in the final presentations.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

Task #5 Demolition Drawings (ground and vertical) and Details

The leader and team of Task #5 present ideas and a list of items to be considered for a comprehensive project specific Demolition Plan.

Students discuss the issue of exiting building positive pressure requirement to assure that the Chill-beams system works properly and why this is important.

Student discuss preliminary ideas on the demolition schedule. The discussion should be informed by talk with a demolition company so that a project specific and viable solution can be presented for evaluation and selection of best alternative.

Students should present ideas for reusing windows including where they are to be used.

Students should discuss the pros and cons of removing and protecting any material or item such as bricks that will have a waste and a cost factor.

Students should identify and quantify the demolition of physical items such as slabs, benches, walls, and trees. Earth removal and truck loads should be quantified by this lesson or the next.

Before class ends, I will ask the students to share any experience gained or heard in their internship on the topics in this Task.

NOTE: At the end of this lecture, students are made aware that the next lecture (#4) is their last chance to present their work, and that it should be 95% complete. We are nearing Lecture #5 where groups will be presenting their Task, and each one is required to present their own work within the team in a coordinated way.

Students are reminded of two deliverables per Task as noted on the Project Instructions PPT. The first deliverable is **T.n.a** where the T stands for Task, the n for the number of the Task and the a is for the first deliverable. The second deliverable **T.n.b** is the back-up information that later on will be rolled into the calculated schedule and cost of the project. Grading is based on how correct, complete, timely and unambiguous the information is on both deliverables. For example, demolition must have total volume of bricks that will be removed and that will be salvageable along with an estimate of the cost and time for this work versus just demolition and removal of all bricks. In addition, they must address detailed information on how the existing building pressure will be maintained while classes continue, since no class disruption is allowed. Students must create a detailed plan for phasing in new construction while pressure is maintained with a commissioning plan.

Lecture #4 - Tasks 1 to 5 Topics and Workshops

Finalize the Task solutions and discuss them in class with feedback from the entire class and instructor.

Task 1 to 5 in Lecture #4 are like in Lecture #3

At the start of the lecture, I will inform the students that we are one company, and that from now on, I am acting as a senior executive attending a company project report meeting. Most students have experienced this type of meeting where each Task group report their findings. I require that every student participate by individually sharing the work they have done. Once the Task presentation is complete, I will ask the rest of the company if they feel there has been enough progress by the presenter by signaling thumbs up, level, or down. This light touch effort brings a level of responsible behavior towards the whole company and peers. It is a prelude to the peer evaluation that takes place at the next lecture when the Tasks presents their work in the two slides allowed by the instruction template.

Student work at this lecture should be 95% complete, and their information should be 15 to 25% already entered into the slides that will be used for the presentation.

Lecture #5- Tasks 1 to 5 Topics – Team Oral Presentations

Students, in a Task team, present their solution and receive final critique and suggestions from the entire class and faculty. This presentation is peer graded. Students may discover additional information and solutions in subsequent Task presentations and may modify their Task solution.

Each student presents the work they personally did in conjunction with other team members. The class as a whole critiques and peer evaluates the presentation but not their own.

Class critique and peer assessment (Rubric B – Tasks 1 to 5 only). The peer evaluation ends in a group grading system. Although each student in the group receives the same grade for their Task presentation, the fact that the next group formed will have different members and the group peer evaluation is a modifier no student has the same ongoing grade with others.

The first template (**T.n.a**) information (see Table 10) required for each Task is prescribed in the instructions and is easily verified if it is there or not, is it correct and complete and unambiguous. This first template is about the quality of the information. The second template (**T.n.b**) is about cubic yards, truck loads, concrete truck loads, water and waste pipe sizes, labor cost and time, material cost, storing, insurance, etc. This second template (see Table 11) is quantitative and uses lessons learned in estimating, scheduling, and internship and information gathered from reliable sources from our industry.

The instructions for Tasks 1 to 5 require the Task presentation contents shown in Table 12.

Class Critique and Peer Assessment

The team assesses each other's performance within the Task team using the syllabus rubric, see Addendum Rubric B – Tasks 1 to 5 only. Table 13 is a team representative assessment, (typical numbers but not actual)

This first set of presentation grades are typically lower than following peer evaluations. I attribute this to the fact that the students are figuring out the work to be done and coordinating their efforts.

Table 12. Task 1 – 5 Presentation Instructions

1	**Cover page and narrative:** **Need for Francis Hall Addition** **Class teaming process** **– Project based teaching** **– Active learning**	1. Design a template which shall be consistent in all drawings. The template must include -project title, sheet title, sheet number, class designation (with department name), team members name (and photo), team and department logo. 2. Cover page should include - project image, project title and information, table of contents, team participation by tasks, owner information, building code information, accessibility information. 3. Include key information FH buildings 1 and 2 dates of completion, FH building 4. Existing and proposed addition student, faculty population and total square footage (including roof). 5. Provide the contract month, construction documents month, NTP month and certificate of occupancy month. 6. List (and describe) alternates.
2	**Site logistics layout plan and details**	1. In the site plan provided, prepare a site logistics plan. 2. Prepare a project boundary to start with, and then place the elements for the logistics with legends. 3. Think about delivery routes and how it will affect the campus. 4. Include any assumptions/exceptions made while developing the plan. 5. Contact concerned authorities to ask about TAMU regulations for construction.
3	**Erosion control plan (SWPPP) and details**	1. In the site plan provided, prepare a erosion control plan. 2. Identify the locations of existing inlet, and justify how to protect them. 3. Think about incoming vehicles with construction materials. 4. Include any assumptions/exceptions made while developing the plan.
4	**Site safety & evacuation plan and details**	1. In the site plan and floor plans provided, prepare a site safety and evacuation plan. 2. Research what a site safety plan should include and show them in the site plan and floor plans. 3. Indicate muster points, egress paths, travel distances, etc. 4. Include emergency contacts and their response distance and time. 5. Include any assumptions/exceptions made while developing the plan.
5	**Demolition drawings (ground and vertical) and details**	1. Using the drawings provided to explain how demolition will be carried out in this project. 2. Calculate the quantities of materials to be demolished along with vehicles for transportation of materials. 3. Highlight in the drawings which part will be demolished. 4. Calculate the budget and time frame required for this process. 5. If the demolition jobs are divided into phases, explain how that will work.

Table 13 is an example of peer Task evaluations:

Table 13. Class Critique and Peer Assessment Evaluations

Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10
1						91					
2				81							
3					89						
4			87								
5					89						
6	Coordinator				89						
7			87								
8		85									
9			87								
10					89						
11	BIM										
12					89						
13		85									
14			87								
15		85									
16						91					
17	BIM										
18		85									
19				81							
20				81							
21			87								
22				81							
23				81							

1. Cover
2. Site logistics
3. SWPPP
4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

Comments:

The Task team oral presentation with comments, suggestions and critique wraps up this set of Tasks. The work will be continued and modified as more information is received from following Tasks.

Teamwork Assessment (Rubric C)

Each Task team peer assesses each other's presentation using Rubric C. Table 14 tabulates typical results (not actual). The first set of teamwork grades are typically lower than following peer evaluations. I attribute this to the fact that the students are figuring out the work to be done and coordinating their efforts. The range of this peer assessment is in the rubrics, explained in class, before each assessment exercise and any questions answered. I like to give guidelines of what is fair and expected. I also emphasize that this is an opportunity to send a message to someone that is not collaborating and contributing to the task effort. The earlier this message is strongly given by several, the better the chance that the student will pick up the pace and act responsibly.

Note: Find out what a student's real earned grade is by doing the following math: Multiply a student common grade by the factor of the same student teamwork performance!

Table 14. Team Peer Assessment Evaluations as a Ratio

Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10
1						.99					
2				.88							
3					.89						
4			.89								
5					.93						
6	Coordinator				.94						
7			.93								
8		.97									
9			.88								
10					.99						
11	BIM										
12					.92						
13		.89									
14			.91								
15		.89									
16						.95					
17	BIM										
18		.92									
19				.86							
20				.89							
21			.98								
22				.87							
23				.93							

1. Cover
2. Site logistics
3. SWPPP
4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

PMBOK List of Terms Applicable to Tasks 1 to 5

Received permission to share from Project-Management.com

Task 1 Project Information

Acquisition Strategy – determining the most appropriate means of procuring the component parts or services of a project

Action Item – something agreed to be done by a person as a result of a discussion at a meeting and usually recorded in the minutes or log of the meeting

Actual Finish Date (AF) – the point in time that work actually ended on an activity (Note: In some application areas, the activity is considered "finished" when work is "substantially complete")

Actual Start Date (AS) – the point in time that work actually started on an activity

Business Case – information necessary to enable approval, authorization and policy making bodies to assess a project proposal and reach a reasoned decision

Client or Customer – the party to a contract who commissions the work and pays for it on completion

Close Out – the completion of work on a project

Completion Date – the date calculated by which the project could finish following careful estimating

Concurrent Engineering – an approach to project staffing that, in its most general form, calls for implementers to be involved in the design phase. Sometimes confused with fast tracking

Contract – a mutually binding agreement which obligates the seller to provide the specified product and obligates the buyer to pay for it

Contracts, other than the negotiated ones, generally fall into one of three broad categories:

- Fixed price or lump sum contracts — This category of contract involves a fixed total price for a well-defined product. Fixed price contracts may also include incentives for meeting or exceeding selected project objectives such as schedule targets
- Cost reimbursable contracts — This category of contract involves payment (reimbursement) to the contractor for its actual costs. Costs are usually classified as direct costs (costs incurred directly by the project such as wages for members of the project team) or indirect costs (costs allocated to the project by the performing organization as a cost of doing business such as salaries for corporate executives). Indirect costs are usually calculated as a percentage of direct costs. Cost reimbursable contracts often include incentives for meeting or exceeding selected project objectives such as schedule targets or total cost

- Unit price contracts — The contractor is paid a preset amount per unit of service (e.g., $70 per hour for professional services or $1.08 per cubic yard of earth removed) and the total value of the contract is a function of the quantities needed to complete the work

Customer – any person who defines needs or wants, justifies or pays for part or the entire project, or evaluates or uses the results

Deliverables – end products of a project or the measurable results of intermediate activities within the project organization. Note: deliverables may be in the form of hardware, software, services, processes, documents, or any combination thereof

Handover – the formal process of transferring responsibility for and ownership of the products of a project to the operator or owner

Integration – the process of bringing people, activities and other things together to perform effectively

Lead Contractor – the contractor who has responsibility for overall project management and quality assurance

Letter of Intent – a letter indicating intent to sign a contract, usually so that work can commence prior to signing that contract

Matrix Organization – any organizational structure in which the project manager shares responsibility with the functional managers for assigning priorities and for directing the work of individuals assigned to the project

Mission Statement – brief summary, approximately one or two sentences, that sums up the background, purposes and benefits of the project

Negotiated Contract Cost – the estimated cost negotiated in a cost-plus-fixed-fee contract or the negotiated contract target cost in either a fixed price-incentive contract or a cost-plus-incentive-fee contract

Objectives – predetermined results towards which effort is directed

Organizational Breakdown Structure (OBS) – hierarchical way in which the organization may be divided into management levels and groups for planning and control purposes and to relate work packages to organizational units

Organization Designs – the design of the most appropriate organizational design for a project

Organizational Planning – identifying, documenting, and assigning project roles, responsibilities, and reporting relationships

Original Budget – the initial budget established at or near the time a contract was signed or a project authorization, based on the negotiated contract cost or management's authorization

Original Duration – the duration of activities or groups of activities as recorded in the baseline schedule

Other Direct Costs (ODC) – a group of accounting elements which can be isolated to specific Tasks, other than labor and material. Included in ODC are such items as travel, computer time, and services

Parties (to a contract) – the persons or companies who sign a contract with one another

Prime or Lead Contractor – a main supplier who has a contract for much or all of the work on a contract, also known as a general contractor

Process – set of interrelated resources and activities which transform inputs into outputs

Procurement – the securing of goods or services

Procurement Planning – determining what to procure and when

Project – the application of resources to a unique set of coordinated activities, with a defined start and finish that are undertaken to meet specific objectives within defined cost and performance parameters

Project Appraisal – the discipline of calculating the viability of a project

Project Base Date – reference date used as a basis for the start of a project calendar

Project Definition – a report defining a project, i.e. Why it is required? What will be done? How when and where it will be delivered? The organization and resources required the standards and procedures to be followed

Project Director – the manager of a very large project that demands senior level responsibility or the person at the board level in an organization who has the overall responsibility for the management of projects

Project Evaluation – a documented review of the project's performance produced at the project closure

Project File – a file containing the overall plans of a project and any other important documents

Request for Change – a proposal by the project manager for a change to the project as a result of a project issue report

Request for Proposal (RFP) – a type of bid document used to solicit proposals from prospective sellers of products or services. In some application areas it may have a narrower or more specific meaning

Request for Quotation (RFQ) – generally, this term is equivalent to request for proposal, but with more specific application areas

Requirements – a negotiated set of measurable customer wants and needs

Sponsor – the executive responsible for the overall project delivery including management, monitoring, and funding

Sponsors must be in a position to solve problems at a higher level when necessary for a project manager

Staff Acquisition – getting the human resources needed assigned to and working on the project

Success Criteria – criteria to be used for judging if the project is successful

Success Factors – critical factors that will ensure achievement of success criteria

Tender – a document proposing to meet a specification in a certain way and at a stated price (or on a particular financial basis), an offer of price and conditions under which the tenderer is willing to undertake work for the client

Termination – completion of the project, either upon formal acceptance of its deliverables by the client and/or the disposal of such deliverables at the end of their life

Users – the group of people who are intended to benefit from the project

Value – a standard, principle, or quality considered worthwhile or desirable

Task 2 Site Logistics Plan

Risk Analysis – systematic use of available information to determine how often specified events may occur and the magnitude of their likely consequences (a technique designed to quantify the impact of uncertainty)

Risk Assessment – the process of identifying potential risks, quantifying their likelihood of occurrence and assessing their likely impact on the project

Risk Avoidance – planning activities to avoid risks that have been identified

Risk Evaluation – process used to determine risk management priorities

Task 3 SWPPP Plan

Risk Analysis – systematic use of available information to determine how often specified events may occur and the magnitude of their likely consequences (a technique designed to quantify the impact of uncertainty)

Risk Assessment – the process of identifying potential risks, quantifying their likelihood of occurrence and assessing their likely impact on the project

Risk Avoidance – planning activities to avoid risks that have been identified

Risk Evaluation – process used to determine risk management priorities.

Task 4 Site Safety Plan

Risk Analysis – systematic use of available information to determine how often specified events may occur and the magnitude of their likely consequences (a technique designed to quantify the impact of uncertainty)

Risk Assessment – the process of identifying potential risks, quantifying their likelihood of occurrence and assessing their likely impact on the project

Risk Avoidance – planning activities to avoid risks that have been identified

Risk Identification – determining which risk events are likely to affect the project

Risk Management Plan – a document defining how project risk analysis and management is to be implemented in the context of a particular project

Risk Matrix – a matrix with risks located in rows and with impact and likelihood in columns

Risk Prioritizing – ordering of risks accordingly first to their risk value, and then by which risks need to be considered for risk reduction, risk avoidance, and risk transfer

Risk Quantification – evaluating the probability of risk event occurrence and effect

Risk Ranking – allocating a classification to the impact and likelihood of a risk

Risk Reduction – action taken to reduce the likelihood and impact of a risk

Risk Response – contingency plans to manage a risk should it materialize (action to reduce the probability of the risk arising, or to reduce the significance of its detrimental impact if it does arise)

Risk Sharing – diminution of a risk by sharing it with others, usually for some consideration

Risk Transfer – a contractual arrangement between two parties for delivery and acceptance of a product where the liability for the costs of a risk is transferred from one party to the other

Safety Plan – the standards and methods which minimize to an acceptable level the likelihood of accident or damage to people or equipment

Task 5 Demolition Plan

Risk analysis – systematic use of available information to determine how often specified events may occur and the magnitude of their likely consequences (a technique designed to quantify the impact of uncertainty)

Risk assessment – the process of identifying potential risks, quantifying their likelihood of occurrence and assessing their likely impact on the project

Risk avoidance – planning activities to avoid risks that have been identified

Risk Evaluation – process used to determine risk management priorities

Comments:

Teams will do well if they have strong leadership, group motivation and hold each other accountable for deliverables. Practicing these traits in a commercial capstone class gives them a benevolent environment in which to practice with one another communication and leadership skill sets that will be useful during their entire careers.

Chapter 3 – Deeper Critical Thinking

Overview:

Students have by now experienced the process flow and the type of information expected to be delivered. The focus of these next sets of Tasks is to require deeper critical thinking on the Tasks. Tasks 6 to 10 are more demanding and require greater amount of detailed research, consultation, coordination and information gathering.

Learning Objectives:

These sets of Tasks requires that the students find and sift through more detailed information from the FHR 2014 documents and think critically on how to apply it to the project. The students have gone through one iteration and either have bought into the different class format (IPBL / AL) or not. The group leaders typically are enthusiastic and now have to work with recalcitrant players, just as in real life. The objectives are practicing to work with different motivated players, as well as, getting the work done to receive peer approval and eventually for the class to win the project.

Lecture #6 - Tasks 6 to 10 Topics and Workshops

The students select which Task group to work with the established Task leader, see Table 15. Students are reminded to select a topic that they like to work on and want to learn more information about, and not because their buddies are on it. We discuss the topic, content and deliverables on each Task so that the students have a better idea which one to choose.

Note: Students have indicated that they have no or very little experience in Civil and Utilities topic. Although they also have no experience with Landscape, the topic appears easy to them, and is a popular one. Later on, they find it requires just the same amount of work as the other topics in this set. Foundations is an enigma to them as they report it, this is a topic not dealt with in Structures in detail. Structures is a topic that most avoid with a passion, but those that embrace it do an excellent job. Exterior Envelope is a neutral topic that appears easy but actually has a high level of detail and complexity. They soon find this out.

Table 15. Tasks 6 to 10 Team Members Formation

Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10
1											
2											
3											
4											
5											
6	Coordinator										
7											
8											
9											
10											
11	BIM										
12											
13											
14											
15											
16											
17	BIM										
18											
19											
20											
21											
22											
23											

1. Cover
2. Site logistics
3. SWPPP
4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

Task #6 Civil, Drainage, Utilities

- This Task requires that the students use FHR 2014 drawings to find where all the underground utilities are located. The drawings prepared for FHR had to locate the utilities by University's requirement, but in reality, four of them were not located with precision because the renovation did not involve moving them. The students are tasked to talk with TAMU Facilities and to find out any available additional information concerning the University process for locating and re-locating Utilities and Civil work.
- Construction requires tapping into existing utilities for temporary meters and making provisions for adding capacity to the services. FHR has a transformer which may or may not have sufficient capacity to serve the addition. Students are tasked to look up FHR 2014 drawings and specifications that indicate existing transfer, main panel disconnect and circuit layout to determine what is the current service and use of power. They are also tasked to contact utilities in order to find out their position and ideas on either tapping onto existing transformer or adding another. For this preliminary exercise students can roughly calculate the total power available for use at FHR, divide it by the amount of square feet served and with an idea of FHA square footage, determine what is a likely load for the addition.
- Water use and plumbing in the addition is minimal as one bathroom is envisioned by the POR, but the tie in to existing utilities has to be worked out.

Task #7 Landscape, and Irrigation Plan and Details

- TAMU stipulates that any tree removed must be replaced. Students need to find this requirement and abide by it. Companies that do not abide by University requirements show lack of due diligence and in an RFP are immediately disqualified. This is one tripping wire the University uses to determine how well companies understand the owner and if it will be easy or difficult to work with.
- Students are advised to seek help from our College of Architecture Landscape Architects for ideas and suggestions.
- Landscape can be intensive and extensive or light. This is one of the last items to be done after equipment is gone. Typically, if there are unused funds, landscape can be enhanced. Students are asked to submit alternates for owner decision in case funding is available. The alternates must have drop dead decision date, cost and time to perform.

Task #8 Foundation and Basement Plans and Details

- Foundation package, along with Civil and Utilities, are one of the firsts to be released for permit and building. This requires an understanding of soil composition through a geotechnical report. The Geotechnical report provides soil bearing and friction allowable pressure. FHR2014 drawings and specs have that report, and are not easy to find. The report borings are around FH, and we can assume that the soil composition has not changed. The students are first challenged to find the report and capture the bearing and friction pressure.
- The point loads or columns cannot be ascertained at this point because the next Task, Structure has not determined the column grid line and column locations. Hence, this group will have to coordinate with Structure once the information is available.

- However, building types and space usage are design by code live and dead load bearing allowances along with other modifiers such as wind, snow, water, etc. FHR 2014 has all this data and students at this time are challenged to find and capture the data for later use.
- Design of continuous footings can replicate those existing in FH, and hence, concrete and reinforcement calculations of cost and time can be made. Concrete formwork must also be included along with any specialty concrete finish such as on floors!

Note: This Foundations and Structure are my favorite Tasks.

Task #9 Structure and Stair Design

- Students are guided to look at the type of slab used in FH's original drawings, and suggest the best type for this project. Is a pan system the best or post tensioned slab or two-way slab or beam and girder composite? Students should contact our faculty teaching structure and create a matrix with the different systems with pros and cons for each. This type of matrix is a Decision Support System, one used to gather information and data that informs a decision, whether it is best value or least cost, or easiest to build, or what is most available in the area, and hence, local expertise is available.
- The students must refer to FHR 2014 drawings for column lines references and create a similar but not necessarily identical one for the addition. Once the column line grid and columns are located, based on what type of slab they proposed to use, the information and grid are passed to Foundation Task for them to replicate and locate peers and continuous wall footing at the perimeter.

Note: This Task typically takes two lessons to complete with strong guidance from faculty and instructor.

Task #10 Elevations, Window Schedule

- The building is cladded with bricks and windows that mirror existing, per conceptual elevations provided to all students with the POR. Students must calculate how many types of windows and doors there are on the façade and all the items on the elevations such as downspouts, lintels, coping, architectural stonework, etc. Students not only quantify the material, but also calculate cost and labor.
- The architectural envelop, along with scaffolding, lifts, and cranes must be identified on the master schedule and coordinated with all other Tasks that precede and follow it.

<u>Lecture #7 - Tasks 6 to 10 Topics and Workshops</u>

The students present their initial findings, create additional questions and issues that need to be addressed by the Task group with the feedback and involvement of the entire class as guided by the instructor.

Before class ends, I will share work experience at Weems & Pharr as a junior engineer (the only one) doing all the work for these two senior engineers that just formed their structure and civil partnership. For two years, as junior and senior at GA Tech, I had the privilege of working on more than 250 small and large projects with them. The most enjoyable Task was to get peanuts and beer at 3 pm on Fridays and kick back in the office!

This lecture is in the form of a company executive progress report meeting.

Each Task is asked to present the work done.

Everyone is asked to make suggestions, comments, share a pertinent story from life, career or recent internship with all. What is missing? What can be improved? What could be done differently? This is your company going after a project, sitting back is not an option. If everyone has a valuable contribution, the team will become stronger and the project more valuable to all the stakeholders.

The instructor will ask prodding questions and point to items that need further definition or discovery. At this point, each Task has work to be done. Students are encouraged to start putting the information on the template presentation PPT and sharing them with others.

During this lecture, I will work with the Structural students in finalizing column locations based on slab decision. I will assist students to identify the most critical interior and exterior columns by tributary areas. I will work with foundations Task students on calculating for the most critical interior and exterior columns, the roof, and floor live and dead loads per code that they have identified.

The instructor points out information that needs to flow from one Task to another so that work can continue smoothly towards a quality product. This is another lesson learned from real practice that will serve the students well once they graduate.

The class coordinator is charged to ascertain that everyone is using the same fonts, sizes, colors and looks so that the presentations are tight, as from one source, the company and not individuals. Tasks 1 to 5 will have to be revised so that they meet the established quality controls.

The rest of the class then evaluates with thumbs up, level, or down if sufficient and credible progress was made.

Lecture #8 -   Tasks 6 to 10 Topics and Workshops

The students present their initial findings, and create additional questions and issues that need to be addressed by the Task group with the feedback and involvement of the entire class as guided by the instructor.

This lecture is in the form of a company executive progress report meeting.

Each Task is asked to present the work done.

This lecture proceeds like #7 but with an emphasis on better student research and information finding activities. The instructor points out that the presentation should have 50% to 75% of the information posted.

During this lecture, I will assist Structural students with any questions they may have on the structural design, and cost and time calculations. I will work with foundations Task students on calculating the size of caissons for the most critical interior and exterior columns based on total loads, plus, the Building Code stipulated structural safety factor. The caissons are calculated by bearing and friction allowable pressure that the students have identified from FHR 2014 documents. Students are directed to find steel and concrete quantities, material and labor costs and duration for both foundations and structure. The structure team is asked to coordinate with the site logistics team, the type of crane and other equipment that will be needed. Work on the master schedule must be shown during the team presentations.

The instructor will ask if any Task needs information from other Tasks and how they are going to collaborate. The purpose of this lecture is to find obstacles and missing information emails.

Lecture #9 - Tasks 6 to 10 Topics and Workshops

This is another executive project progress report with faculty and student feedback as in Lecture #8. Students should be 80 to 90% complete with information on the two boards or PPT's (see Tables 9 and 10).

Lecture #10 - Tasks 6 to 10 Topics – Team Oral Presentations

Students will present their solution and receive final critique and suggestions from the entire class and faculty. This presentation is peer graded. Students may discover additional information and solutions in subsequent Task presentations and may modify their Task solution.

Each student presents the work they personally did in conjunction with other team members. The class as a whole critique, and peer evaluate the presentation but not their own.

Class critique and peer assessment (Rubric B – Tasks 1 to 5 only). The peer evaluation ends in a group grading system. Although each student in the group receives the same grade for their Task presentation, the fact that the next group formed will have different members and the group peer evaluation is a modifier, no student has the same ongoing grade with others.

The first template (**T.n.a**) information required for each Task is prescribed in the instructions and easily verifiable if it is there or not, if it is correct, complete, and unambiguous. This first template is about the quality of the information. The second template (**T.n.b**) is about cubic yards, truck loads, concrete truck loads, water and waste pipe sizes, labor cost and time, material cost, storing, insurance, etc. This second template is quantitative and uses lessons learned in estimating, scheduling and internship, as well as, information gathered from reliable sources from our industry.

The instruction for Tasks 6 to 10 require the following presentation contents:

Table 16. Task 6 to 10 Presentation Instructions

6	**Civil, drainage, temporary and permanent utilities (locate both in plan)**	1. Locate existing utilities surrounding the project area. 2. Show for temporary utilities. 3. Elaborate how the addition would be connecting the existing utilities. 4. Calculate the budget and time frame required for this part. 5. Include any assumptions/exceptions made while developing the plan.
7	**Landscape, and irrigation plan and details**	1. Develop a landscape plan in the site plan provided. 2. Think about new plantation locations. 3. Elaborate about materials used. 4. Calculate the budget and time frame required for this part. 5. Include any assumptions/exceptions made while developing the plan.
8	**Foundation design, basement plans and details**	1. Suggest foundation design to use in the addition. 2. Utilize the load calculation imposed on the building from the structure team to design the foundation. 3. Use the basement and/or foundation plan to show the foundation design. 4. Show summary of calculations and any details (column & pier details/, connection details) if necessary. 5. Calculate the budget and time frame required for this part. 6. Include any assumptions/exceptions made while developing the plan.
9	**Structure and stair design, plans and details**	1. Suggest structural system for the addition. (mention why) 2. Calculate all live and dead load for all levels, calculate total column loads and girder loads, propose a floor slab design. 3. Locate the column positions(if framed structure is proposed). Columns should be in same position throughout all plans. 4. Provide typical column details, identify critical locations. 5. Calculate the budget and time frame required for this part.. 6. Include any assumptions/exceptions made while developing the plan.
10	**Elevations and window schedule**	1. Use the same template as designed by the cover team. 2. Create an opening schedule containing the number and types of opening used. 3. Calculate the budget and time frame required for this part. 4. Include any assumptions/exceptions made while developing the plan.

Table 17 is an example of peer Task evaluations. The team assesses each other's performance within the Task team using the syllabus Rubric B for Tasks 6 to 10 in Table 16. Table 17 each team assesses each other performance in a ratio using syllabus Rubric C. Below is a team representative assessment values are typical but not actual.

Table 17. Class Critique and Peer Assessment (Rubric B – Tasks 6 to 10)

Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10
1						91			95		
2				81			92				
3					89						93
4			87					94			
5					89					97	
6	Coordinator				89				95		
7			88				91				
8		85							95		
9			87							97	
10					89		92				
11	BIM										
12					89		92				
13		85							95		
14			87						95		
15		85						94			
16						91					93
17	BIM										
18		85								97	
19				81							93
20				81						97	
21			87								93
22				81				94			
23				81							93

1. Cover
2. Site logistics
3. SWPPP
4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

Table 18. Task Team Peer Assessment Ratios (Rubric C – Task 6 to 10)

Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10
1						.99			.93		
2				.88			.91				
3					.89						.94
4			.89					.91			
5					.93					1.0	
6	Coordinator				.94				.97		
7			.93				.99				
8		.97							.92		
9			.88							.99	
10					.99		.94				
11	BIM										
12					.92		.92				
13		.89							.89		
14			.91						.93		
15		.89						.98			
16						.95					.95
17	BIM										
18		.92								.95	
19				.86							.97
20				.89						.97	
21			.98								.92
22				.87				.93			
23				.93							.94

1. Cover
2. Site logistics
3. SWPPP
4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

PMBOK List of Terms Applicable to Tasks 6 to 10

Received permission to share from Project-Management.com

Risk Assessment – the process of identifying potential risks, quantifying their likelihood of occurrence and assessing their likely impact on the project

Risk Avoidance – planning activities to avoid risks that have been identified

Risk Evaluation – process used to determine risk management priorities

Comments:

A student's level of performance is creating a trend by both team grade and teamwork peer assessment. As expected, the team grades have increased with the student's better grasp of what is expected. Teamwork assessment has also increased.

Any student grade is by the addition of the common grade multiplied by the average of the teamwork peer evaluation. Out of 200 points say a student has 185 and an average of .93 the resultant running grade is: (185/200) x .93 = 86.0.

The grade is a credible representative of the effort and work at this point of the semester.

Chapter 4 – Deeper Active Learning

Overview:

The students have by now become familiar with the second set of presentations and peer assessment. There is some gaming on the scores but the system allows for this logical attitude. The challenge is to keep students focused on the learning process and not the assessment, scores or grades. I reaffirm that they will receive a fair grade for their effort and to keep their eyes on the ball of active learning. Most of them understand and place confidence on the process. Students have researched what kinds of grades have been given in this class before, and they trust in the fairness of the class grades. If anything, students become more critical of those that tend not to perform in their group. This peer monitoring is more effective than what a faculty could have achieved.

Learning Objectives:

In this set of lectures and workshops, the students hone-in their ability to grasp critical items and discover who has the information to resolve the gaps of knowledge. Students are familiar with part of estimating, but Task #15 Conceptual Estimating is a new approach that pikes student interest. To some this is novel and not a credible topic, because it is not based on counting material parts and figuring costs of material and labor. Conceptual estimating is done in a company at the pre-construction stage by experienced personnel to establish a realistic project budget. Typically, if a faculty has not worked at an executive level, more than likely the student has not experienced pre-construction. Pre-construction is part of Construction Management at Risk and Design Build procurement processes where an owner wants to know before the start, how realistic are the numbers in the project Pro-Forma, and hence, the project feasibility to be constructed within a prescribed budget.

Note: Task #15 Conceptual Estimate brings the student to thinking at a company executive strategic level.

Lecture #11 - Tasks 11 to 15 Topics and Workshops

The lecture workshop covers the required deliverables in detail, suggesting sources of information and posing questions:

Table 19. Tasks 11 to 15 Team Members Formation

Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1																
2																
3																
4																
5																
6	Coordinator															
7																
8																
9																
10																
11	BIM															
12																
13																
14																
15																
16																
17	BIM															
18																
19																
20																
21																
22																
23																

1. Cover
2. Site logistics
3. SWPPP
4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

11. Roof
12. Arch. Finishes
13. Mechanical (2)
14. Electrical
15. Estimate (2)

Task #11 Roof Plan

- Calculate the roof rain water run-off and size of down spouts per plumbing code. (Assume roof sloping East-West)
- Suggest the location for down spouts (see existing) – **Main and overflow roof drains.**
- Locate any mechanical through-the-roof openings and suggest the location for equipment (if any).
- Calculate the budget and time frame required for this part.
- Include any assumptions/exceptions made while developing the plan

Students must consult FHR 2014 drawings for roof flashing, coping and penetrations details and select the ones that apply if they are to use the same system. The system is found on the specifications, requiring a search through pages of documents. Roof membranes are constantly being updated, and the ones used in 2014 may no longer exist. Students must contact the sources that can help to provide pertinent Task information.

Task #12 Architectural Finishes

- Provide the finishes for both the interior (wall, floor, base, ceiling, etc.) and the exterior (façade, windows, doors, etc.) of the addition. *Look up the existing finishes for reference and also include product description.*
- Showcase the finishes with legends in floor plans and elevation.
- Add details (if any). Indicate Sound Transmission Class (STC) ratings & wall types for hall, classrooms, faculty rooms, etc.
- Calculate the budget and time frame required for this part.
- Include any assumptions/exceptions made while developing the plan

Students are made aware that finishes and materials used in 2014 may or may not be available. Most suppliers and vendors change products or upgrade them to different designs. Students are referred to specifications where material and product information used in FHR 2014 and company contact information, see Figure 5.

Task #13 Mechanical and Plumbing Plans

- Calculate the mechanical loads, plus, ductwork, and design the system.
- Calculate fixture count for the new population based on the currently enforced plumbing code.
- Calculate roof rain water run-off and size of downspout.
- Calculate the budget and time frame required for this part.
- Include any assumptions/exceptions made while developing the plan

Students are instructed to maintain FHR 2014 Chill-beam design. This system uses chilled water and steam water along with power. Students need to investigate if the current system has sufficient capacity without any pressure drop with the additional runs, valves and turns to accommodate the new design, or if the University utilities have to be tapped, and a separate system installed. Students can reach out to the FHR 2014 MEP design firm for consultation, as well as, University Facilities and Utilities.

Task #14 Electrical Plans and Details

- The addition will bring an increase in data and visual load to the existing building. Students need to find from the past service provider if there is capacity in the system to accommodate the new load.
- Fire protection equipment is a real challenge. Either the addition ties in to the existing building, if there is capacity, or it will need to have a separate system. Students are tasked to talk to a Fire Protection Service provider and find out what is the best solution.
- Students need to investigate with the Fire Marshall what is an acceptable way to approach the annunciator panel. Fire Marshalls are very particular on how the system works and want to have a final word on the design.
- Calculate the electrical loads using the current Electrical Code for this type of building classification and space use.
- Show light fixtures with types, receptacles, exit signs, fire alarms, etc. in floor plans with legend.
- Think about connection to transformer (existing or additional).
- Calculate the budget and time frame required for this part.
- Include any assumptions/exceptions made while developing the plan.

Electrical loads will determine if the current transformer has the capacity for the increased load while maintaining University required excess capacity. Students need to research what is the excess capacity requirement from Campus Facilities and Utilities.

Task #15 Conceptual Estimate by Systems

- Collect historical data from recent TAMU constructions. Convert it to net present value (or future value).
- Create a conceptual estimate based on Tasks 2-14. The owner is interested in the **Total Project Cost (Construction in Place plus Direct, Indirect, Profit, Contingencies, and Soft).**
- Include FFE, contingencies, demolition, general conditions, profit, etc. along with the various building systems.
- Collect budget information from all previous teams and compare it to the number you have.
- Include any assumptions/exceptions made.

We are fortunate at TAMU with the number and quality of recent construction and the available data. However, the data needs to be analyzed, brought to net present value and used properly. Selected projects must be of typical or similar building type to the current project. Not only cost must be captured but also how long it took to build it, that is from Notice to Proceed (NTP) in construction to the Certificate of Occupancy (CO). Published information include the time it took to design and the project acquisition system available: Design Bid Build, Best Value, Construction Management at Risk, Public-Private-Partnership. The cost needs to be analyzed if it is construction only or total project cost that includes design and other owner expenses such as FF&E.

Lecture #12 - Topics and Workshops

This lecture is in the form of a company executive progress report meeting.

Each Task is asked to present the work done.

Everyone is asked to make suggestions, comments, and share a pertinent story from life, career or recent internship with all. What is missing? What can be improved? What could be done differently? This is your company going after a project, sitting back is not an option.

The instructor will ask prodding questions and point to items that need further definition or discovery. At this point, each Task has work to be done. Students are encouraged to start putting the information on the template presentation PPT and sharing them with others.

Task #11 Roof Plan

The existing and the new roof have critical details. What are those?

Almost all Task teams do not take into consideration the roof mounted bathroom exhaust fan, the plumbing vents and roof overflow drains.

The biggest cause of construction lawsuits in Texas is water penetration through the roof. The roof water penetration is only mitigated by having thorough knowledge of the type of roof to be installed, careful attention to the methods of attachment and special care to all through roof penetrations. This requires that the Mechanical Task identify roof penetrations and coordinates this information with the Roof Task that then has to provide details on how the roof will be installed.

Task #12 Architectural Finishes

This Task requires that students indicate in their plan, using a material legend, the floor finishes and room wall finishes. A reflected ceiling plan also needs to be created, as well as, a schedule for the doors and hardware. This is time consuming. Afterwards cost and time needs to be added to the items.

Task #13 Mechanical and plumbing plans

There is a challenge in this Task on purpose. The roof rain calculations and downspouts could be done by the roof Task team or by the Mechanical Task team. Once the area rainfall data and roof runoff calculations are found, the two Tasks need to agree on who will take responsibility to present the information. This is not different than what the industry faces on every bid from subcontractors, specialty contractors, suppliers and vendors.

Task #14 Electrical Plans and Details

Securing the information required on this Task is not easy. Some students have no trouble navigating and using the network of experts, others are not as successful. One student in the past was outstanding, and set the bar showing that it can be done.

Task #15 Conceptual Estimate by Systems

Conceptual Estimate looks at the typical cost at today's value of similar projects on campus to find the buckets of time and money that the project should consider as a conceptual budget. These are then refined into the buckets of cost and time for each system. Lastly, the system budget line item is compared with the student calculated system preliminary cost. If the preliminary cost is lower than the budget, the company should consider using the budget time and cost figures. If otherwise, then a more careful analysis is merited as to why.

These preliminary budgets done before the company is hired as CMAR will be used to keep the design team in line with the project's budget. The owner Pro-Forma total Project Cost includes the Conceptual Estimate Budget, plus, a contingency, and other owner cost (design fees, FF&E, permits, testing, insurance, bonding, etc.).

General conditions are calculated in systems thinking at 10% and include a typical 3% profit. Students have to generate a list of items that a project such as FHA will have and an estimate of the cost for each one and its duration.

Lecture #13 – Tasks 11 to 15 Topics and Workshops

"This lecture is in the form of a company executive progress report meeting.

Show me your progress."

Everyone is asked to make suggestions, comments, and share a pertinent story from life, career or recent internship. What is missing? What can be improved? What could be done differently? This is your company going after a project, sitting back is not an option.

The instructor will ask prodding questions and point to items that need further definition or discovery. At this point, each Task has work to be done. Students are encouraged to start putting the information on the template presentation PPT and sharing them with others.

Task #11 Roof Plan

- *What have you found out?*
- *Any obstacles?*
- *Any questions?*

Task #12 Architectural Finishes

- *What have you found out?*
- *Any obstacles?*
- *Any questions?*

Task #13 Mechanical and Plumbing Plans and Details

- *What have you found out?*
- *Any obstacles?*
- *Any questions?*

Task #14 Electrical Plans and Details

- *What have you found out?*
- *Any obstacles?*
- *Any questions?*

Task #15 Conceptual Estimate by Systems

- *What have you found out?*
- *Any obstacles?*
- *Any questions?*

This Task requires focused and dedicated work, but I have found that all students are focused and attentive at conversations.

Lecture #14 - Tasks 11 to 15 Topics, Workshops

The workshop approach is: *"This lecture is in the form of a company executive progress report meeting.*

Show me your progress. This is the last lecture before you present your work. You should be 95% complete with the information on your two boards"

The Task workshop flows the same as in lecture #13

Task #15 Conceptual Estimate by Systems

This Task continues to take most of the class as the students finalize the expected project conceptual construction cost. Conceptual costs are based on cost averages from similar projects in the area and calculated to reflect net present day values. Mr. Sam Latona, VP Turner Dallas and National Pre-Construction Director created a set of slides that are made available to the students for their use, see Table 20. The information is on systems percentage cost and time durations of typical commercial construction projects. This data is used to create system budget costs. Project time will be analyzed in more detail in the Tasks #16.

Students create a matrix using Mr. Latona 9 systems with the budget per system on one column and the class calculated budget estimate on another. The information is analyzed and conclusion generated such as: Is the conceptual system budget higher or lower than the class generated budget estimate?

Table 20. Sam Latona Conceptual Cost Ratios by Systems

Conceptual Estimating/Benchmarking to Historical Data

- **Building System %**

Sitework	8%
Foundations	5%
Structural frame	18%
Exterior envelope	15%
Interior finishes	14%
Vertical transportation	2%
Mechanical systems	18%
Electrical systems	10%
TOTAL DIRECT	**90%**

Lecture #15 – Topics and Workshops

Table 21. Tasks 11 to 15 Presentation Instructions

11	Roof plan	1. Calculate the roof rain water run-off and size of down spouts per plumbing code. (Assume roof sloping East-West) 2. Suggest the location for down spouts (see existing) – **Main and overflow.** 3. Locate any mechanical through the roof chase and suggest the location for equipment (if any). 4. Calculate the budget and time frame required for this part. 5. Include any assumptions/exceptions made while developing the plan
12	**Architectural finishes, Reflected Ceiling Plan, Door and hardware schedules and details (Stairs – include on your structural frame system plans and details)**	1. Provide the finishes for both interior (wall, floor, base, ceiling, etc.) and exterior (façade, windows, doors, etc.) of the addition. *Look up the existing finishes for reference and also include product description.* 2. Showcase the finishes with legends in floor plans and elevation. 3. Add details (if any). Indicate STC ratings & wall types for hall, classrooms, faculty rooms, etc. 4. Calculate the budget and time frame required for this part. 5. Include any assumptions/exceptions made while developing the plan
13	**Mechanical and plumbing plans**	1. Calculate the mechanical loads+ductwork and design the system. 2. Calculate fixture count for new population based on currently enforced plumbing code. 3. Calculate roof rain water run-off and size of downspout. 4. Calculate the budget and time frame required for this part. 5. Include any assumptions/exceptions made while developing the plan
14	**Electrical, power, emergency, audio visual, technologies, and lighting plans and details**	1. Calculate the electrical loads. 2. Show light fixtures with types, receptacles, exit signs, fire alarms, etc. in floor plans with legend. 3. Think about connection to transformer (existing or additional). 4. Calculate the budget and time frame required for this part. 5. Include any assumptions/exceptions made while developing the plan
15	SYSTEM: GENERAL CONDITIONS **Conceptual estimate by systems**	1. Collect historical data from recent TAMU constructions. Convert it to net present value (or future value). 2. Create a conceptual estimate based on tasks 2-14. IT should be a **Total cost (Direct, Indirect and Soft).** 3. Include FFE, contingencies, demolition, general conditions, profit, etc. along with the various building systems. 4. Collect budget information from all previous teams and compare it to the number you have. 5. Include any assumptions/exceptions made.

Table 22. Class Critique and Peer Assessment (Rubric B – Tasks 11 to 15)

Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1						91			95			88				
2				81			92					88				
3					89						93		90			
4			87					94								97
5					89					97				92		
6	Coordinator				89				95			88				
7			88				91								95	
8		85							95							97
9			87							97		88				
10					89		92						90			
11	BIM															
12					89		92							92		
13		85							95				90			
14			87						95						95	
15		85						94								97
16						91					93		90			
17	BIM															
18		85								97				92		
19				81							93				95	
20				81						97						97
21			87								93			92		
22				81				94							95	
23				81							93	88				

1. Cover
2. Site logistics
3. SWPPP
4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

11. Roof
12. Arch. Finishes
13. Mechanical (2)
14. Electrical
15. Estimate (2)

Table 23. Task Team Peer Assessment (Rubric C – Task 11 to 15)

Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1						.99			.93			.89				
2				.88			.91					.91				
3					.89						.94		.93			
4			.89					.91								.95
5					.93					1.0				.92		
6	Coordinator				.94				.97			.92				
7			.93				.99								.89	
8		.97							.92							.94
9			.88							.99		.94				
10					.99		.94						.94			
11	BIM															
12					.92		.92							.99		
13		.89							.89				.96			
14			.91						.93						.95	
15		.89						.98								.94
16						.95					.95		.98			
17	BIM															
18		.92								.95				.93		
19				.86							.97				.96	
20				.89						.97						.98
21			.98								.92			.91		
22				.87				.93							.99	
23				.93							.94	.92				

1. Cover
2. Site logistics
3. SWPPP
4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

11. Roof
12. Arch. Finishes
13. Mechanical (2)
14. Electrical
15. Estimate (2)

PMBOK List of Terms Applicable to Tasks 10 to 15

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Tasks 10 to 14

Risk Assessment – the process of identifying potential risks, quantifying their likelihood of occurrence and assessing their likely impact on the project

Risk Avoidance – planning activities to avoid risks that have been identified

Risk Evaluation – process used to determine risk management priorities

Task 15 Conceptual Estimate

Actual Cost of Work Performed (ACWP)(Spent Costs) – total costs incurred (direct and indirect) in accomplishing work during a given time period. See also earned value analysis

Actual Direct Costs – costs specifically identified with a contract or project. See also direct costs.

BCWP – Budgeted Cost of Work Performed

BCWS – Budgeted Cost of Work Scheduled

Bottom Up Cost Estimating – this is the method of making estimates for every activity in the work breakdown structure and summarizing them to provide a total project cost estimate

Budget – quantification of resources needed to achieve a task by a set time, within which the task owners are required to work. Note: a budget consists of a financial and/or quantitative statement, prepared and approved prior to a defined period, for the purpose of attaining a given objective for that period

Budget at Completion (BAC) – the sum total of the time-phased budgets - the estimated total cost of the project when done

Budgeted Cost of Work Performed (BCWP) – the sum of the budget for work completed plus apportioned work in progress to be completed during a relevant time period. BCWP can also be calculated by taking the percentage of work completed times the baseline cost of the activity (% Complete x Planned Cost for each activity)

Budgeted Cost of Work Scheduled (BCWS) – the sum of the budgets for work scheduled to be accomplished during a relevant time period - the planned cost of work that should have been achieved according to the project baseline dates - elapsed costs / baseline cost to date

Budget Element – budget elements are the same as resources – the people, materials, or other entities needed to do the work Budget Elements can be validated against a resource breakdown structure (RBS) - they are typically assigned to a work package, but can also be defined at the cost account level

Budget Estimate – an approximate estimate prepared in the early stages of a project to establish financial viability or secure resources

Budget Unit – base unit for the calculation - for example, the engineer budget element might have a budget unit of hours. Since budget units are user defined, they can be any appropriate unit of measure

Capital Cost – the carrying cost in a balance sheet of acquiring an asset and bringing it to the condition where it is capable of performing its intended function over a future series of periods

Capital Employed – amount of investment in an organization or project, normally the sum of fixed and current assets, less current liabilities at a particular date

Cash Flow – cash receipts and payments in a specified period

Cash Flow, Net – difference between cash received and payments made during a specific period

Change Control – process that ensures potential changes to the deliverables of a project or the sequence of work in a project, they are recorded, evaluated, authorized, and managed

Change Log – a record of all project changes, proposed, authorized, or rejected

Change Request – A request submitted to obtain formal approval for project changes - change requests may arise through changes in the business or because of issues in the project - change requests should be documented, logged, analyzed, and approved before a change to the project can be made

Contingency – planned allotment of time and cost or other resources for unforeseeable elements within a project.

Contingency Planning – the development of a management plan using alternative strategies to minimize or negate the adverse effects of a risk, should it occur

Contingency Reserve – a separately planned quantity used to allow for future situations which may be planned for only in part (sometimes called "known unknowns") - for example, rework is certain, the amount of rework is not - contingency reserves may involve cost, schedule, or both - they are intended to reduce the impact of missing cost or schedule objectives - contingency reserves are normally included in the project's cost and schedule baselines.

Contractor – a person, company, or firm who holds a contract for carrying out the works and/or the supply of goods or services in connection with the project

Contract Target Cost – the negotiated costs for the original defined contract and all contractual changes that have been agreed upon and approved, but excluding the estimated cost of any authorized, unpriced changes - the contract target cost equals the value of the budget at completion, plus, management or contingency reserve

Contract Target Price – the negotiated estimated costs, plus, profit or fee.

Cost Benefit Analysis – an analysis of the relationship between the costs of undertaking a task or project, initial and recurrent, and the benefits likely to arise from the changed situation, initially and recurrently

Cost Breakdown Structure – hierarchical breakdown of a project into cost elements

Cost Budgeting – allocating cost estimates to individual project components.

Cost Center – location, person, activity or project in respect of which costs may be ascertained and related to cost units

Cost Code – unique identifier for a specified element of work

Cost Control – Controlling changes to the project budget

Cost Control System – any system of keeping costs within the bounds of budgets or standards based upon work actually performed

Cost Curve – a graph plotted against a horizontal time scale and cumulative cost vertical scale

Cost Element – a unit of costs to perform a task or to acquire an item. The cost estimated may be a single value or a range of values.

Cost Estimating – estimating the cost of the resources needed to complete project activities

Cost Incurred – costs identified through the use of the accrued method of accounting or costs actually paid including direct labor, direct materials, and all allowable indirect costs

Cost of Quality – costs incurred to ensure quality, including quality planning, quality control, quality assurance, and rework

Cost Overrun – the amount by which a contractor exceeds or expects to exceed the estimated costs, and/or the final limitations (the ceiling) of a contract

Cost Performance Index (CPI) – the ratio of budgeted costs to actual costs (BCWP/ACWP) and is often used to predict the magnitude of a possible cost overrun using the following formula: original cost estimate/CPI = projected cost at completion

Cost Plus Fixed Fee (CPFF) Contract – a type of contract where the buyer reimburses the seller for the seller's allowable costs (allowable costs are defined by the contract) plus a fixed amount of profit (fee).

Cost Plus Incentive Fee (CPIF) Contract – a type of contract where the buyer reimburses the seller for the seller's allowable costs (allowable costs are defined by the contract), and the seller earns its profit if it meets defined performance criteria.

Cost Reimbursement Type Contracts – a category of contracts based on payments to a contractor for allowable estimated costs, normally requiring only a 'best efforts' performance standard from the contractor

Cost Variance (CV) – any difference between the estimated cost of an activity and the actual cost of that activity in earned value, BCWP less ACWP

Delphi Technique – a process where a consensus view is reached by consultation with experts – it is often used as an estimating technique

Deterministic Network – contains paths, all of which have to be followed and whose durations are fixed, and distinguishes traditional networking from probabilistic networking

Direct Costs – costs specifically attributable to an activity or group of activities without apportionment, and best contrasted with indirect costs that cannot be identified to a specific project

Estimate – An assessment of the likely quantitative result. It is usually applied to project costs and durations and should always include some indication of accuracy (e.g., ± x percent), also, it is used with a modifier (e.g., preliminary, conceptual, feasibility, schematics, design development, 50% construction)

Estimate at Completion (EAC) – a value expressed in either money and/or hours, to represent the projected final costs of work when completed, and it is calculated as ETC + ACWP

Estimate to Complete (ETC) – the value expressed in either money or hours developed to represent the cost of the work required to complete a task

Estimating – the act of combining the results of post project reviews, metrics, consultation and informed assessment to arrive at time and resource requirements for an activity

Expenditure – a charge against available funds, evidenced by a voucher, claim, or other documents, it represent the actual payment of funds

Feasibility Phase – the project phase that demonstrates that the client's requirement can be achieved, this phase identifies and evaluates the options to determine the one preferred solution.

Feasibility Study – analysis to determine if a course of action is possible within the terms of reference of the project

Feasible Schedule – any schedule capable of implementation within the externally determined constraints of time and/or resource limits

Firm Fixed Price (FFP) Contract – A type of contract where the buyer pays the seller a set amount (as defined by the contract) regardless of the seller's costs

Incurred Costs – sum of actual and committed costs, whether invoiced/paid or not, at a specified time

Indirect Cost – costs associated with a project that cannot be directly attributed to an activity or group of activities, such as resources expended which are not directly identified to any specific contract, project, product or service, such as overheads and general administration

Net Present Value – aggregate of future net cash flows discounted back to a common base date, usually the present

Non-recurring Costs – expenditures against specific tasks that are expected to occur only once on a given project

Order of Magnitude Estimate – an estimate carried out to give very approximate indication of likely out-turn costs

Original Budget – the initial budget established at or near the time a contract was signed or a project authorized, based on the negotiated contract cost or management's authorization

Other Direct Costs (ODC) – a group of accounting elements which can be isolated to specific tasks, other than labor and material - included in ODC are such items as travel, computer time, and services

Overhead – costs incurred in the operation of a business that cannot be directly related to the individual products or services being produced

Overrun – costs incurred in excess of the contract target costs on an incentive type contract or the estimated costs on a fixed-price contract - an overrun is that value of costs which are needed to complete a project, over that value originally authorized by management

Parametric Estimating – an estimating technique that uses a statistical relationship between historical data and other variables (e.g., square footage in construction, lines of code in software development) to calculate an estimate

Post Project Appraisal – an evaluation that provides feedback in order to learn for the future

Project Calendar – a calendar that defines global project working and non-working periods

Project Change Control – process ensuring potential changes to a project including scope, cost, resources, time (schedule), deliverables, design, methods, costs, or any other planned aspects of a project are recorded, evaluated, authorized, and managed

Project Champion – person within the parent organization who promotes and defends a project

Project Closure – formal termination of a project at any point during its life

Project Cost Management – a subset of project management including resource planning, cost estimating, cost control and cost budgeting in an effort to complete the project within its approved budget

Recurring Costs – expenditures against specific tasks that would occur on a repetitive basis - examples are hire of computer equipment, tool maintenance, etc.

Reserve – a provision in the project plan to mitigate cost and/or schedule risk – it is often used with a modifier (e.g., management reserve, contingency reserve) to provide further detail on what types of risk are meant to be mitigated

Retainage – a portion of a contract payment that is held until contract completion in order to ensure full performance of the contract terms

Retention – a part of payment withheld until the project is completed in order to ensure satisfactory performance or completion of contract terms

Revenue Cost – expenditure charged to the profit and loss account as incurred or accrued due

System – the complete technical output of the project including technical products

Systems and Procedures – Systems and procedure detail the standard methods, practices, and procedures of handling frequently occurring events within the project

Systems Management – management that includes the prime activities of systems analysis, systems design and engineering and systems development

Top Down Cost Estimating – an estimate based on historical costs and other project variables and then subdivided down to individual activities

Variance – a discrepancy between the actual and planned performance on a project, either in terms of schedule or cost.

Variance at Completion – the difference between budget at completion and estimate at completion

Variation – a change in scope or timing of work which a supplier is obliged to do under a contract

Comments:

The student's peer team grading has a constant pattern where the leader of the group most likely has a higher peer assessment. This is to be expected. However, instances in the past a student as a team member has shown greater leadership and initiative. The team member was recognized with a higher score by the peers in the assessment.

The students are encouraged to apply the PMBOK terminology in their PPT and oral presentations. Their presentations have a higher level of sophistication and professionalism when the terms are not only properly applied, but also, when the students know the definition and have mastered the implications of their meaning in context.

Chapter 5 – Deeper Project Base Learning

Overview

This chapter's lecture topics and workshops build on new knowledge and the information gathered in previous Tasks. Student continue visualizing the final product and are motivated to win the project in competition with other classes.

The current set of Tasks are part of the General Contractor's services known in the contract document as General Conditions. Lean Construction and BIM are typically not required on a POR. However, they are tools for better managing a project flow and hence, beneficial first to the GC, then to the subcontractors, and thus, the project by creating value for all the stakeholders. A project well run, one that flows with minimal waste of time and meets or exceeds owner expectations is the best marketing and sales tool for repeat business and new business. Creating a Decision Support System (DSS) matrix is a new concept for the students. The students worked on a DSS for qualifying the owner. The students, in this Task, create two DSS: one for selecting a subcontractor among others that vie for their part of the project based on a multi-criteria best value system; the second is similar but has more strict constraints for selecting HUB subcontractors and directing the subs to apply the criterial on their own selection of HUB's to meet public work criteria. Students have heard of Quality Assurance and Quality Control (QA/QC) but appear to have light knowledge on how it is used in the field. Commissioning is another type of QA/QC plan and activity that the students treat as new knowledge.

Learning Objectives

Tasks 16 to 20 along with Task 15 are part of the services included under General Conditions. Conceptual estimating a project budget and eight systems' budgets against the estimated system cost are new knowledge for the students. Likewise estimating project construction time budget and eight systems' time budgets and comparing them to the calculated systems construction time are new knowledge for the students. Lean Construction theories and practices are new knowledge also.

Lecture #16 – Tasks 16 to 20 Topics and Workshops

Table 24. Tasks 16 to 20 Team Members Formation

Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1																					
2																					
3																					
4																					
5																					
6	Coord.																				
7																					
8																					
9																					
10																					
11	BIM																				
12																					
13																					
14																					
15																					
16																					
17	BIM																				
18																					
19																					
20																					
21																					
22																					
23																					

1. Cover
2. Site logistics
3. SWPP
4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

11. Roof
12. Arch. Finishes
13. Mechanical
14. Electrical
15. Estimate (2)

16. Schedule
17. Sub & HUB
18. QA/QC
19. Lean
20. BIM (2)

Task #16 Conceptual Cost Loaded Schedule by Systems

Two items are needed to do this Task: 1. What is the overall estimated or POR determined length of time available for design and for construction. Remember, the owner has selected CMAR as the project acquisition system. The GC is brought in early to work up a preliminary project budget for the design to fit within. From this overall project budget, owner costs and contingencies are subtracted, leaving a net construction cost budget. The net construction cost budget is parceled along the eight systems per Mr. Latona ratios. Now, it is up to the Architect's designers and consultant team to stay within the allocated system budget, see Task 15, to fit within.

The ninth system is the General Conditions which is estimated at 10%, it includes a 3% project profit. The cost of a GC Pre-construction Services is negotiated separately and list the time allowed for design. Typically, total project design and construction time at 100% will have design time at 40% and construction time at 60%. In CMAR and Design Build, the project can have early release packages at the end of Schematic Design such as mobilization, civil and utilities, foundation and structure, Tables 25 and 26.

When analyzing typical projects in the area, the total construction cost and time give an indication of how many millions of dollars are put-in-place (spent) in a month's time. This is a rule of thumb that can be used at the conceptual schedule to estimate the total project construction duration, and from that the expected design duration. This has to work within the time frame that the owner has established in the POR. The POR typically has an idea when the team of designers and General Contractors are going to be selected and when the project must be delivered for use and occupancy. The two calculations must be reconciled, and if necessary, negotiated. Putting in place (material and labor, plus, overhead) more millions of dollars per month than typical for the area will incur extra costs and higher risks that need to be calculated on the fees and negotiate.

Table 25. Sam Latona Conceptual Time Ratios by Systems – Design Bid Build

CONCEPTUAL SCHEDULING CSP DELIVERY METHOD
TYPICALLY 8-10 MONTHS TOTAL DURATION

DESIGN ACTIVITIES

SCHEMATIC	15%
DD'S	40%
CD'S	45%

CONSTRUCTION STARTS AFTER CD'S ARE 100% COMPLETE

		CONSTRUCTION TIME FRAME STARTS AT END OF DD'S																		
BUILDING SYSTEMS	PERCENTAGE	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
FOUNDATIONS	10%																			
STRUCTURAL FRAME	25%																			
EXTERIOR WALL	35%																			
INTERIOR FINISHES	40%																			
VERTICAL TRANSPORTATION	15%																			
MECHANICAL	40%																			
ELECTRICAL	40%																			

Table 26. Sam Latona Conceptual Time Ratios by Systems – Design Build (also applicable to Construction Management at Risk)

TEXAS A&M UNIVERSITY

CONCEPTUAL SCHEDULING DESIGN BUILD DELIVERY METHOD

TYPICALLY 8-10 MONTHS TOTAL DURATION

DESIGN ACTIVITIES		
SCHEMATIC	15%	
DD'S	40%	CONSTRUCTION STARTS AFTER DD'S ARE COMPLETE
CD'S	45%	TOTAL SCHEDULE SAVINGS IS 4 TO 4.5 MONTHS

		CONSTRUCTION TIME FRAME STARTS AT END OF DD'S																		
BUILDING SYSTEMS	PERCENTAGE	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%	65%	70%	75%	80%	85%	90%	95%	100%
FOUNDATIONS	10%																			
STRUCTURAL FRAME	25%																			
EXTERIOR WALL	35%																			
INTERIOR FINISHES	40%																			
VERTICAL TRANSPORTATION	15%																			
MECHANICAL	40%																			
ELECTRICAL	40%																			

Turner

Task #17 Subcontractor and HUB Selection Strategy

The Subcontractor Selection Plan requires that the General Contractor understands the critical needs and wants of the owner for the project in order to select the best set of subcontractors to address the issues. Once what is critical to the owner and the project is clear, then a DSS can be created that has a set of criteria with a weight factor to determine the subcontractor that provides the best value. Students are asked to create a list of project critical items and a list of criteria for discussion.

What is a HUB? What are the qualifications that a HUB must meet? When does a HUB cease qualifying for this designation and privilege? What are the different types of HUBs?

Task #18 Quality Assurance /Quality Control (QA/QC) and Commissioning Plans

Students are asked to research what is QA is and QC.

Where can they find project QA and QC items?

Students also need to create a list of items to be included in QA and QC.

Students need to research what a commissioning agent is and how a commissioning plan is created.

Students also create a sample list of commissioning items that includes an example of what a future comprehensive commissioning plan could look like.

Task #19 Lean Construction Plan and Details

Students in this Task are asked to research why the industry saw the need to create Lean Construction.

What is Lean Construction? What is the purpose or objective of Lean initiatives in construction?

Students are also asked to create a list of five or more Lean techniques or practices and explain them.

Task #20 Building Information Model, BIM360, AutoDesk (PlanGrid), ProCore, or Builder'sBox Models

Two students volunteer or are elected to work on creating a BIM model from the beginning of the semester. They were encouraged to use BIM or BIM360 or AutoDesk or any other modeling software including Navisworks, Blue Beam, Builder'sBox, ProCore and others. Each time a Task group presents, they also report on their progress, what they were working on and what information they need from the other Tasks to take the model to the next level.

Lecture #17 - Tasks 16 to 20 Topics and Workshops

The workshop approach is: *"This lecture is in the form of a company executive progress report meeting.*

Show me your progress. This is the last lecture before you present your work. You should be 95% complete with the information on your two boards or PPT's"

Task #16 Conceptual Cost Loaded Schedule by Systems

Once a conceptual milestone schedule is visualized for the project overall and the systems are noted on the schedule, the students gather information from Task 15's conceptual estimate and from each of the other Tasks to create a per month expected disbursement of funds. This is typically a S curve.

Task #17 Subcontractor and HUB Selection Strategy

What is a HUB? What are the qualifications that a HUB must meet? When does a HUB cease qualifying for this designation and privilege? What are the different types of HUBs?

HUB selection is associated with the dollar percent required in public project acquisition by University, State and Federal authorities. What is the University's required HUB percentage of the total project construction cost?

Discuss how this percentage can be achieved.

Task #18 QA/QC and Commissioning Plan

Discuss the criteria of a QA plan and then determine how it is verified in a QC assessment.

Discuss the criteria of a commissioning plan and how it is assessed and verified.

Task #19 Lean Construction Plan and Details

Discuss what was learned about Lean and how the five techniques or practices can be useful or add value to the project management plan.

Students are encouraged to contact a Lean Black Belt and discuss the project and the techniques.

Contact information is provided for students to choose from, or they can contact Lean experts, also called Lean Black Belts, that they met in their internships.

Task #20 BIM

Two students volunteered to be leaders and doers of a BIM model for the project. They have worked on this since the first lecture. Every time a Task group is graded, their work is graded also.

Lecture #18 - Tasks 16 to 20 Topics and Workshops

The workshop approach is: '*This lecture is in the form of a company executive progress report meeting."*

Tasks 16 to 20 Students Report on the Progress

"Show me your progress. This is the last lecture before you present your work. You should be 65% complete with the information on your two boards".

Lecture #19 - Tasks 16 to 20 Topics and Workshops

The workshop approach is: *"This lecture is in the form of a company executive progress report meeting."*

Tasks 16 to 20 students report on the progress. This is the final discussion of the topics.

"Show me your progress. This is the last lecture before you present your work. You should be 95% complete with the information on your two boards."

Lecture #20 – Student Presentations

Students present their work by Task. Everyone must participate and present their own work, see Table 27.

Table 27. Task 16 to 20 Presentation Instructions

16	**Conceptual cost-loaded schedule by systems**	1. Create a conceptual schedule based on systems based on task 15 estimates. 2. Show cash flow chart (if possible). 3. Collect time frame information from all previous teams and compare it to the number you have. 4. Include your assumptions and exceptions.
17	**Sub-contractor and HUB selection strategy by systems and sub-systems components**	1. Research about subs and HUB selection for TAMU. 2. Determine what the critical items are. 3. Create a matrix for sub-contractor selection and HUB selection. 4. As an example, show details for sub-contractor and HUB selection for any one of the elements in construction.
18	**QA/QC and commissioning plan**	1. Research about QA/QC and commissioning plan. 2. Indicate what might be the most critical items for QA/QC and commissioning. 3. Explain how QA/QC and commissioning will be used. 4. Show a typical detail for one/two of the critical items. 5. Include your assumptions and exceptions.
19	**Lean construction plan and details**	1. Research about various lean construction strategies. 2. Suggest what methods can be utilized in this project. 3. Include any examples (if any) of using lean – *Benefit of using lean construction.*
20	**Building Information Model, BIM 360 or AutoCAD model**	1. Collaborate with all other teams to create a model with all the components of the building (if possible). 2. Come up with the actual area spaces and total – *Fill in memo and give it to other teams if required.*

Table 28. Class Critique and Peer Assessment (Rubric B – Tasks 16 to 20 only)

Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	18	20
1						91			95			88							91		
2				81			92					88								94	
3					89						93		90				97				
4			87					94								97	97				
5					89					97				92					91		
6	Coord.				89				95			88								94	
7			88				92								95		97				
8		85							95							97				94	
9			87							97		88						96			
10					89		92						90						91		
11	BIM																				98
12					89		92							92				96			
13		85							95				90						91		
14			87						95						95					94	
15		85						94								97	97				
16						91					93		90					96			
17	BIM																				99
18		85								97				92			97				
19				81							93				95		97				
20				81						97						97				94	
21			87								93			92				96			
22				81				94							95				91		
23				81							93	88								94	

1. Cover
2. Site logistics
3. SWPP
4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

11. Roof
12. Arch. Finishes
13. Mechanical
14. Electrical
15. Estimate (2)

16. Schedule
17. Sub & HUB
18. QA/QC
19. Lean
20. BIM (2)

Table 29. Task Team Peer Assessment (Rubric C – Tasks 16 to 20)

Tasks Team & Leader		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1						.99			.93			.89							.91		
2				.88			.91					.91								.95	
3					.89						.94		.93				.97				
4			.89					.91								.95	.95				
5					.93					1.0				.92					.93		
6	Coord.				.94				.97			.92								.96	
7			.93				.99								.89		.98				
8		.97							.92							.94				.96	
9			.88							.99		.94						.91			
10					.99		.94						.94						.97		
11	BIM																				.98
12					.92		.92							.99				.95			
13		.89							.89				.96						.68		
14			.91						.93						.95					.94	
15		.89						.98								.94	.93				
16						.95					.95		.98					.92			
17	BIM																				.99
18		.92								.95				.93			.97				
19				.86							.97				.96		.94				
20				.89						.97						.98				.93	
21			.98								.92			.91				.96			
22				.87				.93							.99				.93		
23				.93							.94	.92								.94	

1. Cover
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4. Safety
5. Demolition

6. Civil
7. Landscape
8. Foundation
9. Structure (2)
10. Exterior

11. Roof
12. Arch. Finishes
13. Mechanical
14. Electrical
15. Estimate (2)

16. Schedule
17. Sub & HUB
18. QA/QC
19. Lean
20. BIM (2)

PMBOK List of Terms Applicable to Tasks 16 to 20

Permission to share from Project-Management.com

Task 16 Conceptual Cost Loaded Schedule by Systems

Activity – task, job, operation or process consuming time and possibly other resources (the smallest self-contained unit of work used to define the logic of a project - in general, activities share the following characteristics: a definite duration, logic relationships to other activities in a project, use resources such as people, materials or facilities, and have an associated cost - they should be defined in terms of start and end dates and the person or organization responsible for their completion)

Activity Definition – identifying the specific activities to be performed in order to produce the various project deliverables

Activity Description (AD) – a short phrase or label used in a project network diagram. The activity description normally describes the scope of work of the activity

Activity Duration – specifies the length of time (hours, days, weeks, months) that it takes to complete an activity

Activity Duration Estimating – the number of work periods which will be needed to complete individual activities

Activity Status – the state of completion of an activity: a planned activity has not yet started; a started activity is in progress; a finished activity is complete

AND Relationship – logical relationship between two or more activities that converge on or diverge from an event indicating that every one of the activities has to be undertaken

Bar Chart – A graphic display of schedule-related information. In the typical bar chart, activities or other project elements are listed down the left side of the chart, dates are shown across the top, and activity durations are shown as date-placed horizontal bars – it is also called a Gantt chart

Baseline – The original plan (for a project, a work package, or an activity), plus or minus approved changes – it is usually used with a modifier (e.g., cost baseline, schedule baseline, performance measurement baseline)

Baseline Cost – the amount of money an activity was intended to cost when the schedule was baselined

Baseline Dates – original planned start and finish dates for an activity and used to compare with current planned dates to determine any delays - they are also used to calculate budgeted cost of work scheduled for earned-valued analysis

Baseline Review – a customer review conducted to determine that a contractor is continuing to use the previously accepted performance system and is properly implementing a baseline on the contract or option under review

Baseline Schedule – a fixed project schedule. It is the standard by which project performance is measured - the current schedule is copied into the baseline schedule which remains frozen until it is reset - resetting the baseline is done when the scope of the project has been changed significantly, for example, after a negotiated change, at that point, the original or current baseline becomes invalid and should not be compared with the current schedule

Breakdown Structure – a hierarchical structure by which project elements are broken down, or decomposed. See also product breakdown structure (PBS), organizational breakdown structure (OBS) and work breakdown structure (WBS)

Burden – overhead expenses distributed over appropriate direct labor and/or material base

Calendar Unit – the smallest unit of time used in scheduling the project. Calendar units are generally in hours, days, or weeks, but can also be in shifts or even in minutes. Used primarily in relation to project management software

Calendars – lists time intervals in which activities or resources can or cannot be scheduled. A project usually has one default calendar for the normal workweek (for example Monday to Friday), but may have other calendars as well - each calendar can be customized with its own holidays and extra work days - resources and activities can be attached to any of the calendars that are defined

Crashing – a specific type of project schedule compression technique performed by taking action to decrease the total project schedule duration after analyzing a number of alternatives to determine how to get the maximum schedule duration compression for the least cost - typical approaches for crashing a schedule include reducing schedule activity durations and increasing the assignment of resources on schedule activities

Critical Activity – any activity on a critical path with zero or negative float. Most commonly determined by using the critical path method

Criticality Index – used in risk analysis, the criticality index represents the percentage of simulation trails that resulted in the activity being placed on the critical path

Critical Path Method (CPM) – a network analysis technique used to predict project duration by analyzing which sequence of activities (which path) has the least amount of scheduling flexibility (the least amount of float) - early dates are calculated by means of a forward pass using a specified start date - late dates are calculated by means of a backward pass starting from a specified completion date (usually the forward pass's calculated project early finish date)

Critical Performance Indicator – a critical factor against which aspects of project performance may be assessed

Critical Success Fctor – a factor considered to be most conducive to the achievement of a successful project

Current Finish Date – The current estimate of the point in time when an activity will be completed

Current Start Date – The current estimate of the point in time when an activity will begin

Discrete Milestone – a milestone that has a definite scheduled occurrence in time. Logical link that may require time but no other resource

Duration (DU) – work periods (not including holidays or other non-working periods) required to complete an activity or other project element that are usually expressed as workdays or workweeks

Duration Compression – shortening the project schedule without reducing the project scope. Duration compression is not always possible and often requires an increase in project cost

Earliest Feasible Date – the earliest date on which the activity could be scheduled to start based on the scheduled dates of all its predecessors, but in the absence of any resource constraints on the activity itself

Early Dates – calculated in the forward pass of time analysis, early dates are the earliest dates on which an activity can start and finish

Early Finish Date (EF) – in the critical path method, the earliest possible point in time on which the uncompleted portions of an activity (or the project) can finish based on the network logic and any schedule constraints - early finish dates can change as the project progresses and changes are made to the project plan

Early Start Date (ES) – In the critical path method, the earliest possible point in time on which the uncompleted portions of an activity (or the project) can start, based on the network logic and any schedule constraints

Earned Hours – the time in standard hours credited as a result of the completion of a given task or a group of tasks

Earned Value (EV) – a measure of the value of completed work using original estimates and progress-to-date to show whether the actual costs incurred are on budget and whether the tasks are ahead or behind the baseline schedule

Earned Value Analysis – analysis of project progress where the actual money, hours (or other measure) budgeted and spent is compared to the value of the work achieved

Earned Value Cost Control – the quantification of the overall progress of a project in financial terms so as to provide a realistic yardstick against which to compare the actual cost to date

Effort – the number of labor units necessary to complete the work and is expressed in staff-hours, staff-days or staff-weeks and should not be confused with duration

Effort-driven Activity – an activity whose duration is governed by resource usage and availability - the resource requiring the greatest time to complete the specified amount of work on the activity will determine its duration

Effort Remaining – the estimate of effort remaining to complete an activity

Elapsed Time – the total number of calendar days (excluding non-work days such as weekends or holidays) that is needed to complete an activity - it gives a realistic view of how long an activity is scheduled to take for completion

End Activity – an activity with no logical successors

End Event (of a project) – event with proceeding, but no succeeding activities

Environmental Factoring – use of data relating to an external factor (such as the weather) to modify or bias the value of parameters concerned

Equivalent Activity – activity that is equivalent, in the probabilistic sense, to any combination of series and parallel activities

Event – state in the progress of a project after the completion of all preceding activities, but before the start of any succeeding activity

Event-on-Node – a network diagramming technique in which events are represented by boxes (or nodes) connected by arrows to show the sequence in which the events are to occur

Execution Phase – the phase of a project in which work towards direct achievement of the project's objectives and the production of the project's deliverables occurs. Sometimes called the implementation phase

Feasibility Phase – the project phase that demonstrates that the client's requirement can be achieved - this phase identifies and evaluates the options to determine the one preferred solution

Feasibility Study – analysis to determine if a course of action is possible within the terms of reference of the project

Feasible Schedule – any schedule capable of implementation within the externally determined constraints of time and/or resource limits

Finish Date – the actual or estimated time associated with an activity's completion

Finishing Activity – the last activity that must be completed before a project can be considered finished - this activity is not a predecessor to any other activity-it has no successors

Finish-to-Finish Lag – minimum amount of time that must pass between the finish of one activity and the finish of its successor(s)

Finish-to-start lag – minimum amount of time that must pass between the finish of one activity and the start of its successor(s), the default finish-to-start lag is zero

Fixed Date – a calendar date (associated with a plan) that cannot be moved or changed during the schedule

Fixed-duration Scheduling – a scheduling method in which, regardless of the number of resources assigned to the task, the duration remains the same

Float – the amount of time an activity may be delayed from its early start without delaying the project finish date - float is a mathematical calculation and can change as the project progresses and changes are made to the project plan

Forecast at Completion – scheduled cost for a task

Free Float (FF) – The amount of time an activity can be delayed without delaying the early start of any immediately following activities

Funding Profile – an estimate of funding requirements over time

Gantt Chart – particular type of bar chart showing planned activity against time - 'Gantt Chart', although named for a particular type of bar chart, is a name for bar charts in general

Histogram – a graphic display of planned and or actual resource usage over a period of time - it is in the form of a vertical bar chart, the height of each bar representing the quantity of resource usage in a given time unit - bars may be single, multiple, or show stacked resources

Hypercritical Activities – activities on the critical path with negative float

Impact – the assessment of the adverse effects of an occurring risk

Impact Analysis – assessing the merits of pursuing a particular course of action

Implementation Phase – the project phase that develops the chosen solution into a completed deliverable

In Progress – an activity that has been started, but not yet completed

Key Performance Indicators – measurable indicators used to report progress chosen to reflect the critical success factors of the project - key events major events, the achievement of which that are deemed to be critical to the execution of the project

Labor Rate Variances – difference between planned labor rates and actual labor rates

Ladder – device for representing a set of overlapping activities in a network diagram - the start and finish of each succeeding activity are linked only to the start and finish of the preceding activity by lead and lag activities, which consume only time

Lag – a) In a network diagram, the minimum necessary lapse of time between the finish of one activity and the finish of an overlapping activity or b) delay incurred between two specified activities - for example, in a finish-to-start dependency with a 10-day lag, the successor activity cannot start until 10 days after the predecessor has finished

Late Dates – calculated in the backward pass of time analysis, late dates are the latest dates by which an activity can be allowed to start or finish

Latest Event Time – Latest time by which an event can occur within the logical and imposed constraints of the network, without affecting the total project duration

Late Event Date – calculated from backward pass, the latest date an event can occur

Late Finish Date (LF) – in the critical path method, the latest possible point in time that an activity may be completed without delaying a specified milestone (usually the project finish date)

Latest Finish Time – the latest possible time by which an activity has to finish within the logical activity and imposed constraints of the network, without affecting the total project duration

Late Start Date (LS) – In the critical path method, the latest possible point in time that an activity may begin without delaying a specified milestone (usually the project finish date)

Latest Start Time – latest possible time by which an activity has to start within the logical and imposed constraints of the network, without affecting the total project duration

Lead – in a network diagram, the minimum necessary lapse of time between the start of one activity and the start of an overlapping activity - for example, in a finish-to-start dependency with a 10-day lead, the successor activity can start 10 days before the predecessor has finished. See also lag

Level of Effort (LOE) – support-type activity (e.g., vendor or customer liaison) that does not readily lend itself to measurement of discrete accomplishment. It is generally characterized by a uniform rate of activity over a specific period of time

Life Cycle – a sequence of defined stages over the full duration of a project

Life-cycle Costing – the concept of including acquisition, operating, and disposal costs when evaluating various alternatives

Logic Diagram – a diagram that displays the logical relationships between project activities

Logical Relationship – a dependency between two project activities, or between a project activity and a milestone - the four possible types of logical relationships are:

- **Finish-to-start**—The "from" activity must finish before the "to" activity can start
- **Finish-to-finish**—The "from" activity must finish before the "to" activity can finish
- **Start-to-start**—The "from" activity must start before the "to" activity can start
- **Start-to-finish**—The "from" activity must start before the "to" activity can finish

Linked Bar Chart – a bar chart that shows the dependency links between activities

Master Schedule – A summary-level schedule which identifies the major activities and key milestones. See also milestone schedule

Milestone – a key event - an event selected for its importance in the project - milestones are commonly used in relation to progress and chosen to represent the start of a new phase or the completion of a major deliverable - they are used to monitor progress at summary level. Milestones are activities of zero duration

Milestone Plan – a plan containing only milestones which highlight key points of the project

Milestone Schedule – a schedule that identifies the major milestones

Mobilization – the bringing together of project personnel and securing equipment and facilities – it is carried out during project start-up phases

Monitoring – the capture, analysis, and reporting of project performance, usually as compared to plan

Monte Carol Simulation – a schedule risk assessment technique used to estimate the likely range of outcomes from a complex process by simulating the process under randomly selected conditions a large number of times

Network – a pictorial presentation of project data in which the project logic is the main determinant of the placements of the activities in the drawing – it is frequently called a flowchart, PERT chart, logic drawing, or logic diagram

Node – one of the defining points of a network; a junction point joined to some or all of the other dependency lines

Nodes – points in a network at which arrows start and finish

Non-Splittable Activity – an activity that, once started, has to be completed to plan without interruption

No Earlier Than – a restriction on an activity that indicates that it may not start or end earlier than a specified date

No Later Than – a restriction on an activity that indicates that it may not start or end later than a specified date

Operation phase – period when the completed deliverable is used and maintained in service for its intended purpose

Opportunity – the opposite of a risk. The chance to enhance the project benefits

Original Duration – the duration of activities or groups of activities as recorded in the baseline schedule

Out-of-sequence progress – progress that has been reported even though activities that have been deemed predecessors in project logic have not been completed

Parallel activities – two or more activities than can be done at the same time. This allows a project to be completed faster than if the activities were arranged serially

Parent Activity – task within the work breakdown structure that embodies several subordinate 'child' tasks

Pareto Diagram – a histogram, ordered by frequency of occurrence, that shows how many results were generated by each identified cause

Path – a set of sequentially connected activities in a project network diagram

Path Convergence – in mathematical analysis, the tendency of parallel paths of approximately equal duration to delay the completion of the milestone where they meet

Pending – Status describing project work submitted for review but not yet discussed

Phase (of a project) – that part of a project during which a set of related and interlinked activities are performed - a project consists of a series of phases that together constitute the whole project life cycle

Plan – an intended future course of action. It is owned by the project manager, it is the basis of the project controls and includes the **'what', 'how', 'when', "where", and 'who'**

Planned Activity – an activity not yet started

Planned Cost – estimated cost of achieving a specified objective

Planned Value (PV) – the sum of the budgets for all planned work scheduled to be accomplished within a given time period – it is also known as the Budgeted Costs of Work Scheduled (BCWS)

Planner – a member of a project team or project support office with the responsibility for planning, scheduling and tracking of projects - they are often primarily concerned with schedule, progress and manpower resources.

Planning – the process of identifying the means, resources and actions necessary to accomplish an objective.

Planning Stage – the stage prior to the implementation stage when product activity, resource and quality plans are produced.

Positive Float – positive float is defined as the amount of time that an activity's start can be delayed without affecting the project completion date

Precedence Diagramming Method (PDM) – A network diagramming technique in which activities are represented by boxes (or nodes) and the relationship between them by arrows - activities are linked by precedence relationships to show the sequence in which the activities are to be performed.

Precedence network – a multiple dependency network - an activity-on-node network in which a sequence arrow represents one of four forms of precedence relationship, depending on the positioning of the head and the tail of the sequence arrow - the relationships are:

- Start of activity depends on finish of preceding activity, either immediately or after a lapse of time,

- Finish of activity depends on finish of preceding activity, either immediately or after a lapse of time,
- Start of activity depends on start of preceding activity, either immediately or after a lapse of time,
- Finish of activity depends on start of preceding activity, either immediately or after a lapse of time.

Precedence Relationship – in current usage, however, precedence relationship, logical relationship, and dependency are widely used interchangeably regardless of the diagramming method in use

Preceding Event – in an activity-on-arrow network, an event at the beginning of an activity

Predecessor – an activity that must be completed (or be partially completed) before a specified activity can begin

Predecessor Activity In the arrow diagramming method, the activity which logically precedes the current activity and enters a node. In the precedence diagramming method, the "from" activity.

Probabilistic Network – network containing alternative paths with which probabilities are associated

Probability – likelihood of a risk occurring

Product Breakdown Structure – a hierarchy of deliverable products which are required to be produced on the project - it forms the base document from which the execution strategy and product-based work breakdown structure may be derived - it provides a guide for configuration control documentation

Product Description – the description of the purpose form and components of a product - it should always be used as a basis for acceptance of the product by the customer

Product Flow Diagram – represents how the products are produced by identifying their derivation and the dependencies between them

Progress – the partial completion of a project, or a measure of the same

Progress Payments – payments made to a contractor during the life of a fixed-price type contract, on the basis of some agreed-to formula, for example, budget cost of work performed or simply costs incurred

Progress Report – a regular report to senior personnel, sponsors or stakeholders summarizing the progress of a project including key events, milestones, costs and other issues

Project Monitoring – comparison of current project status with what was planned to be done to identify and report any deviations

Project Network Diagram – any schematic display of the logical relationships of project activities it is always drawn from left to right to reflect project chronology

Project Network Techniques – group of techniques that, for the description, analysis, planning, and control of projects, considers the logical inter-relationships of all project activities - the group includes techniques concerned with time, resources, costs, and other influencing factors, e.g. uncertainty

Project Phase – a collection of logically related project activities, usually culminating in the completion of a major deliverable

Project Plan – a formal, approved document used to guide both project execution and project control - the primary uses of the project plan are to document planning assumptions and decisions, to facilitate communication among stakeholders, and to document approved scope, cost, and schedule baselines

Project Plan Development – taking the results of other planning processes and putting them into a consistent, coherent document

Project Plan Execution – carrying out the project plan by performing the activities included therein

Project Progress Report – formal statement that compares the project progress, achievements and expectations with the project plan

Project Review Calendar – calendar of project review dates, meetings and issues of reports set against project week numbers or dates

Project Risk Management – the processes concerned with identifying, analyzing, and responding to project risk - it consists of risk identification, risk quantification, risk response development, and risk response control

Project Schedule – The planned dates for performing activities and meeting milestones

Project Scope Management – A subset of project management including the processes required to ensure that the project includes all of the work required, and only the work required, to complete the project successfully - it consists of initiation, scope planning, scope definition, scope verification, and scope change control

Project Status Indicators

- Green = On Track
- Yellow = Caution, at risk, behind schedule, over budget, action needed by project manager or by the steering committee
- Red = Alert, project in serious trouble and almost certain to miss the target date or other project objectives. Immediate action needs to be taken and senior management needs to be involved to save the project

Project Status Report – a report on the status of accomplishments and any variances to spending and schedule plans

Project Success/Failure Criteria – the criteria by which the success or failure of a project may be judged

Project Time Management – a subset of project management including the processes required to ensure timely completion of the project. It consists of activity definition, activity sequencing, activity duration estimating, schedule development, and schedule control

Remaining Duration (RDU) – time needed to complete an activity or project

Re-planning – actions performed for any remaining effort within project scope – it is often the cost and/or schedule variances are zeroed out at this time for history items

Schedule – the timetable for a project. It shows how project tasks and milestones are planned out over a period of time

Schedule Control – controlling schedule changes

Schedule Dates – start and finish dates calculated with regard to resource or external constraints as well as project logic

Schedule Performance Index (SPI) – ratio of work accomplished versus work planned, for a specified time period - the SPI is an efficiency rating for work accomplishment, comparing work accomplished to what should have been accomplished

Schedule Variance (cost) – the difference between the budgeted cost of work performed and the budgeted cost of work scheduled at any point in time

Scheduled Finish – the earliest date on which an activity can finish, having regard to resource or external constraints as well as project logic

Scheduled Start – the earliest date on which an activity can start, having regard to resource or external constraints as well as project logic

Scheduling – scheduling is the process of determining when project activities will take place depending on defined durations and precedent activities

Schedule Constraints – specify when an activity should start or end based on duration, predecessors, external predecessor relationships, resource availability, or target dates

Scope – the scope is the sum of work content of a project

Scope Change – any change in a project scope that requires a change in the project's cost or schedule

Scope Verification – ensuring all identified project deliverables have been completed satisfactorily

Scope of Work – a description of the work to be accomplished or resources to be supplied

Secondary Risk – the risk that may occur as a result of invoking a risk response or fallback plan

S-Curve – graphic display of cumulative costs, labor hours, or other quantities, plotted against time - the name derives from the S-like shape of the curve (flatter at the beginning and end, steeper in the middle) produced on a project that starts slowly, accelerates, and then tails off

Scope – The sum of the products and services to be provided as a project

Scope Change – any change to the project scope that almost always requires an adjustment to the project cost or schedule

Scope Definition – decomposing the major deliverables into smaller, more manageable components to provide better control

Scope Planning – developing a written scope statement that includes the project justification, the major deliverables, and the project objectives

Scope Verification – ensuring that all identified project deliverables have been completed satisfactorily

Sequence – sequence is the order in which activities will occur with respect to one another

Should-Cost Estimates – an estimate of the cost of a product or service used to provide an assessment of the reasonableness of a prospective contractor's proposed cost

Slack – calculated time span during which an event has to occur within the logical and imposed constraints of the network, without affecting the total project duration - Note 1: It may be made negative by an imposed date; Note 2. The term slack is used as referring only to an event

Slip Chart – a pictorial representation of the predicted completion dates of milestones (also referred to as trend chart)

Slippage – the amount of slack or float time used up by the current activity due to a delayed start or increased duration

Stakeholder – individuals and organizations involved in or affected by project activities - project managers, sponsors, and clients/customers are all stakeholders

Start Date – the date project work is officially scheduled to begin

Start Event of a Project – event with succeeding, but no preceding activities.
Note: there may be more than one start event

Start-to-Start Lag – minimum amount of time that must pass between the start of one activity and the start of its successor(s) - this may be expressed in terms of duration or percentage.

Starting Activity – a starting activity has no predecessors. It does not have to wait for any other activity to start

Statement of Work (SOW) – a narrative description of products or services to be supplied under contract

Status – the comparison of actual against planned progress to determine variance and corrective action - possible statuses are: Active, Approved, Cancelled, Completed, On-hold, and Pending

Status Report– A report completed and distributed to all stakeholders describing the project status. Status reports should be used to control the project and to keep management informed of project status.

Successor – a successor is an activity whose start or finish depends on the start or finish of a predecessor activity

Sunk Costs – unavoidable costs (even if the project were to be terminated)

Super-critical Activity – an activity that is behind schedule is considered to be super-critical. If it has been delayed to a point where it floats. it is calculated to be a negative value

System – the complete technical output of the project including technical products

Systems Management – management that includes the prime activities of systems analysis, systems design and engineering and systems development

Target Completion Date (TC) – an imposed date which constrains or otherwise modifies the network analysis

Target Finish Date (TF) – when planned (targeted) to finish on an activity

Target Start Date (TS) – when planned (targeted) to start on an activity

Task – the smallest indivisible part of an activity when it is broken down to a level best understood and performed by a specific person or organization

Variance – a discrepancy between the actual and planned performance on a project, either in terms of schedule or cost

Variance at Completion – the difference between budget at completion and estimate at completion

Variation – a change in scope or timing of work which a supplier is obliged to do under a contract

Task 17 Subcontractor and HUB Selection

Decision – the removal of uncertainty with respect to a course of action

Invitation for Bid (IFB) – generally, this term is equivalent to request for proposal

Outsourcing – contracting-out, buying in facilities or work (as opposed to using in-house resources)

Project Human Resource Management – a subset of project management that includes the processes required to make the most effective use of the people involved with the project - it consists of organizational planning, staff acquisition, and team development

Project Procurement Management – a subset of project management that includes the processes required to acquire goods and services from outside the performing organization - it consists of procurement planning, solicitation planning, solicitation, source selection, contract administration, and contract closeout

Resource – any personnel, material or equipment required for the performance of an activity

Resource Aggregation – summation of the requirements for each resource, and for each time period

Resource Allocation – scheduling of activities and the resources required by those activities, so that predetermined constraints of resource availability and/or project time are not exceeded

Resource Analysis – the process of analyzing and optimizing the use of resources on a project - It often uses resource leveling and resource smoothing techniques

Resource Assignment – the work on an activity related to a specific resource

Resource Availability – the level of availability of a resource, which may vary over time

Resource Breakdown Structure – a hierarchical structure of resources that enables scheduling at the detailed requirements level, and roll up of both requirements and availabilities to a higher level

Resource Calendar – a calendar that defines the working and non-working patterns for specific resources

Resource Constraint – limitation due to the availability of a resource

Resource Accumulation – process of accumulating the requirements for each resource to give the total required to date at all times throughout the project

Resource Driven Task Durations – task durations that are driven by the need for scarce resources

Resource Histogram – a view of project data in which resource requirements, usage, and availability are shown using vertical bars against a horizontal time scale

Resource Leveling – any form of network analysis in which scheduling decisions (start and finish dates) are driven by resource management concerns (e.g., limited resource availability or difficult-to-manage changes in resource levels)

Resource Optimization – a term for resource leveling and resource smoothing

Resource Plan – part of the definition statement stating how the program will be resource loaded and what supporting services, infrastructure and third-party services are required

Resource Planning – determining what resources (people, equipment, materials) are needed in what quantities to perform project activities

Resource Requirement – the requirement for a particular resource by a particular activity

Resource Scheduling – the process of determining dates on which activities should be performed in order to smooth the demand for resources, or to avoid exceeding stated constraints on these restraints

Resource Smoothing – scheduling of activities, within the limits of their float, so that fluctuations in individual resource requirements are minimized, in smoothing, as opposed to resource leveling, the project completion date may not be delayed)

Responsibility Assignment Matrix (RAM) – A structure which relates the project organization structure to the work breakdown structure to help ensure that each element of the project's scope of work is assigned to a responsible individual

Soft Skills – soft skills include team building, conflict management and negotiation

Solicitation – obtaining quotations, bids, offers, or proposals as appropriate

Solicitation Planning – documenting product requirements and identifying potential sources

Source Selection – choosing from among potential contractors

Subcontract – a contractual document which legally transfers the responsibility and effort of providing goods, services, data, or other hardware, from one firm to another

Subcontractor – an organization that supplies goods or services to a supplier, another name is specialty contractor (CA)

Supplier – includes contractors, consultants and any organization that supplies services or goods to the customer

Work – the total number of hours, people or effort required to complete a task

Workaround – a response to a negative risk event it is distinguished from contingency plan in that a workaround is not planned in advance of the occurrence of the risk event

Work Breakdown Structure (WBS) – a deliverable oriented grouping of project elements that organizes and defines the total work scope of the project - each descending level represents an increasingly detailed definition of the project work

Workload – workload is the amount of work units assigned to a resource over a period of time

Work Package – group of related tasks that are defined at the same level within a work breakdown structure and in traditional cost/schedule systems, the criteria for defining work packages is as follows:

- Each work package is clearly distinguishable from all other work packages,
- Each work package has a scheduled start and finish date,
- Each work package has an assigned budget that is time-phased over the duration of the work package,
- Each work package either has a relatively short duration, or can be divided into a series of milestones whose status can be objectively measured, or
- Each work package has a schedule that is integrated with higher-level schedules)

Work Units – work units provide the measurement units for resources - for example, people as a resource can be measured by the number of hours they work

Task 18 QA/QC, Commissioning

Commissioning – advancement of an installation from the stage of static completion to full working order and achievement of the specified operational requirements

Cost of Quality – the costs incurred to ensure quality. The cost of quality includes quality planning, quality control, quality assurance, and rework

Post Implementation Review – a review between 6-12 months after a system in a project has met its objectives to verify that it continues to meet user requirements

Pre-commissioning – that work which is carried out prior to commissioning in order to demonstrate that commissioning may be safely undertaken

Project Quality Management – A subset of project management including the processes required to ensure that the project will satisfy the needs for which it was undertaken - it consists of quality planning, quality assurance, and quality control

Quality – a trait or characteristic used to measure the degree of excellence of a product or service – that is, it meets customer's needs

Quality Assurance (QA) – (1) the process of evaluating overall project performance on a regular basis to provide confidence that the project will satisfy the relevant quality standards (2) the organizational unit that is assigned responsibility for quality assurance

Quality Assurance Plan – a plan that guarantees a quality approach and conformance to all customer requirements for all activities in a project

Quality Audit – an official examination to determine whether practices conform to specified standards or a critical analysis of whether a deliverable meets quality criteria

Quality Control (QC) – (1) the process of monitoring specific project results to determine if they comply with relevant quality standards and identifying ways to eliminate causes of unsatisfactory performance (2) the organizational unit that is assigned responsibility for quality control

Quality Criteria – the characteristics of a product that determines whether it meets certain requirements

Quality Guide – the quality guide describes quality and configuration management procedures and is aimed at people directly involved with quality reviews, configuration management and technical exceptions

Quality Plan (for a project) – the part of the project plan that concerns quality management and quality assurance strategies

Quality Planning – identifying which quality standards are relevant to the project and determining how to apply them

Quality Review – a review of a product against an established set of quality criteria

Total Quality Management (TQM) – A common approach to implementing a quality improvement program within an organization

Task 19 Lean Construction

Backward Pas – the calculation of late finish dates and late start dates for the uncompleted portions of all network activities and it is determined by working backwards through the network logic from the project's end date - the end date may be calculated in a forward pass or set by the customer or sponsor

Benefits – the enhanced efficiency, economy and effectiveness of future business or other operations to be delivered by a project or program

Benefits Framework – an outline of the expected benefits of the project or program, the business operations affected and current and target performance measures

Benefits Management – it is the process for planning, managing, delivering and measuring the project or program benefits

Benefits Management Plan – specifies who is responsible for achieving the benefits set out in the benefit profiles and how achievement of the benefits is to be measured, managed and monitored

Brainstorming – the unstructured generation of ideas by a group of people

Champion – an end user representative often seconded into a project team. Someone who acts as an advocate for a proposal or project

Constraint – applicable restriction affecting the performance of the project - any factor affecting when an activity can be scheduled

Decision – the removal of uncertainty with respect to a course of action

External constraint – a constraint from outside the project network

Fast–tracking – Reducing the duration of a project usually by overlapping phases or activities originally planned to be to done sequentially

Fallback Plan – a plan for an alternative course of action that can be adopted to overcome the consequences of a risk, should it occur (including carrying out any advance activities that may be required to render the plan practical)

Forward Pass – The calculation of the early start and early finish dates for the uncompleted portions of all network activities

Key Performance Indicators – measurable indicators used to report progress chosen to reflect the critical success factors of the project - they are events major events, the achievement of which that are deemed to be critical to the execution of the project

Modern Project Management (MPM) – a term used to distinguish the current broad range of project management (scope, cost, time, quality, risk, etc.) from narrower, traditional use that focused on cost and time

Parallel Activities –two or more activities than can be done at the same time - this allows a project to be completed faster than if the activities were arranged serially

Percent Complete (PC) – an estimate, expressed as a percent, of the amount of work which has been completed on an activity or group of activities - may be aggregated to sections of a project or the whole project

Performance Measurement Techniques – performance measurement techniques are the methods used to estimate earned value - different methods are appropriate to different work packages, either due to the nature of the work or to the planned duration of the work package

Performance Reporting – Collecting and disseminating information about project performance to help ensure project progress

Performance Specification – statement of the totality of needs expressed by the benefits, features, characteristics, process conditions, boundaries and constraints that together define the expected performance of a deliverable

Performing – a team building stage where the emphasis is on the work currently being performed

Performing Organization – the enterprise whose employees are most directly involved in doing the work of the project

PERT – Program Evaluation and Review Technique

PERT Chart – a specific type of project network diagram

Physical percent complete – the percentage of the work content of an activity that has been achieved

Pilot – a form of testing a new development and its implementation prior to committing to its full release

Responsibility Assignment Matrix (RAM) – a structure which relates the project organization structure to the work breakdown structure to help ensure that each element of the project's scope of work is assigned to a responsible individual

Task 20 BIM, BIM 360, AutoDesk, Builder'sBox, ProCore

Graphical Evaluation and Review Technique (GERT) – a network analysis technique that allows for conditional and probabilistic treatment of logical relationships (i.e., some activities may not be performed)

Project Management Software – a class of computer applications specifically designed to aid with planning and controlling project costs and schedules

Project Technical Plan – a plan produced at the beginning of a project that addresses technical issues and strategic issues related to quality control and configuration management

Comments:

The students are beginning to see the parts of the Tasks fit into the whole of a project presentation and are getting excited to present the project. By this point, they are gauging who are the weak presenters and who are the strong ones. They begin to develop the strategies to balance their presentations. A quality check is done to the boards or PPT so that it looks like it is done by a company and not individuals. All must have the same template of colors, fonts, types, bolding, page numbering, and presentation uniformity that is expected of a professional company. Most students have to work hard to finish, coordinate information among themselves and cooperate with the students of Task #20 BIM. Task #1 Cover, Task #8 Foundation, Task #13 Mechanical, Task #15 Estimate, Task #16 Schedule, and Task #20 BIM are critical to earn favorable points from the panel of jurors. The rest have to be well presented and linked one to another so that the company teamwork and collaboration is obvious.

Chapter 6 – Oral Presentations

Overview

It is show-time, and the students are impressed with the amount of work, data, information and knowledge that is going into each task, and moreover, amazed at the work produced by their virtual company. As expected, some presenters are stronger than others, some content is more developed than others. The delta between the presenters and the presentations is captured by the class peer review and evaluations at the leadership presentation level, as well as, in the final presentation. The panel of external jurors typically are more critical since their baseline is that of their own company experience at a professional level with many presentations under their belts.

Learning Objectives

The presentations made by a Task team are now summarized by the Task leader. The following presentations are a final rehearsal of the content, as well as, the form and delivery with peer critique, suggestions and evaluation. There is no teamwork evaluation

Lecture #21 Tasks 1 to 7 Leader Presentation

The first set of presentations are for Tasks 1 to 7 and is done by the Task leader. This allows within one class period for an oral presentation, critique and evaluation by all the other class members using the rubric shown in Table 28.

Table 30. Class Leader Peer Assessment (Rubric B – Tasks 1 to 7 only)

Student Name:______________________________________Number:______ Date:_________

A20 COSC 442 – SECTION - _________

WRITTEN AND ORAL PRESENTATION – ACCE SLO #2 & USLO COMMUNICATE EFFECTIVELY - Leader Presentation – Peer and Faculty Evaluation

	COSC 442 - Session	931
TASK	Each Task must have a visual that includes: the names of the students working on that particular Task, data, findings, information and a proposed solution or design, quantitative components (such as area, volume, weight, types and number of items, etc.); and qualitative components (such as assumptions and exceptions). The grading is from 0 lacking on all the above through 10 excelling on all the above and more. Grades must be realistic, or they will be considered out-layers and disqualified. **Grade scale: 10 is perfect; 9 very good; 8 good; 7 passable needs improvement; 6 must be redone.**	
1	**Cover page and narrative: Needs for Francis Hall Addition** **Class teaming process** **– Project based teaching** **– Active learning**	
2	**Site logistics layout plans and details**	
3	**Erosion control plans (SWPPP) and details**	
4	**Site safety & evacuation plans and details**	
5	**Demolition drawings (ground and vertical) and details**	
6	**Civil, drainage, temporary and permanent utilities (locate both in plan)**	
7	**Landscape, and irrigation plans and details**	

Please add comments below or on the back of your assessment.

Lecture #22 Tasks 8 to 14 Leader Presentation

The second set of presentations are for Tasks 8 to 14 and is done by the Task leader. This allows within one class period for an oral presentation, critique and evaluation by all the other class members using the rubric shown in Table 29.

Table 31. Class Peer Assessment (Rubric B – Tasks 8 to 14 only)

Student Name: ________________________________ **Number:** ______ **Date:**_________

A20 COSC 442 – SECTION - _________

WRITTEN AND ORAL PRESENTATION – ACCE SLO #2 & USLO COMMUNICATE EFFECTIVELY - Leader Presentation – Peer and Faculty Evaluation

	COSC 442 - Session	931
TASK	Each Task must have a visual that includes: the names of the students working on that particular Task, data, findings, information and a proposed solution or design, quantitative components (such as area, volume, weight, types and number of items, etc.); and qualitative components (such as assumptions and exceptions). The grading is from 0 lacking on all the above through 10 excelling on all the above and more. Grades must be realistic, or they will be considered out-layers and disqualified. **Grade scale: 10 is perfect; 9 very good; 8 good; 7 passable needs improvement; 6 must be redone.**	
8	**Foundation design, basement plans and details**	
9	**Structure and stair design, plans and details, live and dead load for all levels, calculate total column loads and girder loads, propose a floor slab design**	
10	**Elevations, window schedule**	
11	**Roof plan**	
12	**Architectural finishes, reflected ceiling plans, door and hardware schedules and details**	
13	**Mechanical and plumbing plans, calculate fixture count for new population based on currently enforced plumbing code, calculate roof rain water run-off and size of downspout**	
14	**Electrical, power, emergency, audio visual, technologies, and lighting plans and details**	

Please add comments below or on the back of your assessment.

Lecture #23 Tasks 15 to 20 Leader Presentation

The third set of presentations are for Tasks 15 to 20 and is done by the Task leader. This allows within one class period for an oral presentation, critique and evaluation by all the other class members using the rubric shown in Table 20. There are fewer presentations so that the BIM Task team is allowed more time to showcase their work.

Table #32. Class Peer assessment (Rubric B – Tasks 15 to 20 only)

Student Name:________________________________ Number:______ Date:_________

A20 COSC 442 – SECTION - _________

WRITTEN AND ORAL PRESENTATION – ACCE SLO #2 & USLO COMMUNICATE

	COSC 442 - Session	**931**
TASK	Each Task must have a visual that includes: the names of the students working on that particular Task, data, findings, information and a proposed solution or design, quantitative components (such as area, volume, weight, types and number of items, etc.); and qualitative components (such as assumptions and exceptions). The grading is from 0 lacking on all the above through 10 excelling on all the above and more. Grades must be realistic, or they will be considered out-layers and disqualified. **Grade scale: 10 is perfect; 9 very good; 8 good; 7 passable needs improvement; 6 must be redone.**	
15	**Conceptual estimate by systems (based on Tasks 2 - 14 estimates, plus, general conditions and overage factors)**	
16	**Conceptual cost loaded schedule by systems (base on Task 15 estimates)**	
17	**Sub-contractor and HUB selection strategy by systems and sub-systems components**	
18	**QA/QC and commissioning plans**	
19	**Lean Construction plans and details**	
20	**Building Information Model, BIM360, AutoDesk (PlanGrid), ProCore, or Builder'sBox model**	

EFFECTIVELY - Leader Presentation – Peer and Faculty Evaluation

Please add comments below or on the back of your assessment.

Lecture #24 Float Day for Additional Presentation Rehearsals

In the past, approximately twenty-five percent of the Task leader ask for additional presentation time with the faculty alone. I am delighted to oblige and typically they can take their presentation to a new level.

Lecture #25 Oral Leader Presentation to a Panel of Jurors (industry, faulty and freshmen students)

In past capstone settings, the students formed four virtual companies with five to six students on each. Each company presented their RFP to a panel of jurors formed from industry, professionals and the other class students.

This capstone class is modeled after the Worcester Polytechnic Institute – IPBL set up where a class is one company with 20 Tasks. The leader of each task presents his or her Task to a roaming set of jurors. A juror set is composed of a mix of professionals, classmates and when possible freshmen from COSC 175. The set comes up with an evaluation for each Task. This requires the juror set to discuss among themselves the presentation that they saw in relation to other presentations and agree on a value for the Task using the prescribed rubric matrix. Juror more often than not, make comments on the evaluation rubrics. All the juror sets are collected and the grading values captured in a matrix. The average for each Task is then analyzed by the faculty that has the ultimate say on the final grade.

Lately, I have evaluated each Task presentation separately and compared my grade with the juror set average. If the two are close, I will take the average and that becomes the final grade.

Industry jurors assess the student's presentations rigorously and award lower scores than faculty and peers. These jurors' critique with reason in that the student's written and oral presentations lack the depth and rigor of the professional ones they are accustomed to at their companies. However, they also agree that the expected rigor and depth only comes with maturity gained through years of experience in the practice. For those that are eager to succeed, internal and external company networking provides the opportunities for continuous learning. In construction, learning never stops for the willing at heart.

Table #33. Student and Jurors' Rubric for Evaluating Task Leaders Presentations

COSC 442 - COMMERCIAL CAPSTONE - PROJECT: FRANCIS HALL ADDITION - Dr. Solis								REMARKS AND COMMENTS
1 Recording Referee Name:		**Oral Presentation** - Spring 2020			☐	931: 11:10 to 12:25 pm		
2 Referee Name:		**Date:** 28 April, 2019			☐	932: 2:20 to 3:35 pm		
3 Referee Name:		**Place:** ZOOM			☐	933: 3:55 to 5:10 pm		
A senior capstone course for students preparing to enter the commercial construction sector; project management of commercial construction projects, including: aspects of design, bidding/estimating. Presentation, value engineering, contracts/negotiation, subcontractor relations, cost controls, management during construction, close out, and postconstruction requirements.								
Grade scale: 20 is perfect, 15 is very good, 10 is good and 5 is passable but needs improvement.								
Task #	**Task description**	**Professional presentation (20)**	**Team (20)**	**Assumptions/ Except. (20)**	**Content F.H.A. Ref. other Tasks (20)**	**Answer to questions (20)**	**Total (100)**	
1	Cover page							
2	Site logistics layout plan							
3	Erosion control plan (SWPPP)							
4	Site safety & evacuation plan							
5	Demolition information & drawings							
6	Site civil, drainage & utilities plan							
7	Landscape and irrigation plan							
8	Foundation & basement plans							
9	Structural & stairs plans							
10	Elevations & window schedule							
11	Roof Plan							
12	Architectural finishes, Reflected Ceiling Plan							
13	Mechanical & plumbing plans							
14	Electrical, power, emergency & lighting plans							
15	Conceptual estimate by system							
16	Conceptual cost-loaded schedule							
17	Subcontractor & HUB selection strategy							
18	QA/QC & commissioning plan							
19	Lean construction plan							
20	BIM, BIM 360 or AutoCAD model							

Table #34. Typical Juror of Tasks 1 to 20 Presentations (values are not real, Monte Carlo Simulation)

	JUROR SET														
TASK	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**AVERAGE**	**FACULTY**	**GRADE**
1	74	69	93	84	87	76	90	83	79	86	92	84	83	84	**84**
2	77	62	84	62	75	81	87	80	77	78	91	80	78	80	**79**
3	86	89	80	76	81	78	91	66	86	79	95	66	81	82	**82**
4	75	86	66	67	78	79	89	87	75	76	93	87	80	85	**82**
5	82	77	87	86	79	67	79	78	82	81	96	86	82	86	**84**
6	77	60	78	69	70	62	80	87	77	78	88	69	75	73	**74**
7	90	88	87	88	82	76	93	91	66	79	93	88	85	80	**83**
8	89	90	91	87	85	67	84	89	79	67	89	87	84	82	**83**
9	78	80	89	83	81	84	80	79	70	62	91	83	80	81	**81**
10	84	81	79	84	84	80	66	80	82	76	93	84	81	82	**82**
11	79	83	80	82	83	66	84	91	85	67	92	82	81	80	**81**
12	83	80	85	87	86	81	79	89	81	86	90	87	85	86	**85**
13	82	84	86	81	81	83	83	79	84	81	89	81	83	84	**83**
14	90	87	89	88	86	80	82	80	83	86	88	88	86	88	**87**
15	95	93	95	90	95	91	95	95	93	95	98	95	94	96	**95**
16	97	95	94	93	96	93	97	96	95	96	97	97	96	97	**96**
17	91	89	91	88	90	82	91	90	89	95	93	91	90	91	**91**
18	89	91	90	89	89	90	89	89	91	91	91	89	90	92	**91**
19	87	88	90	87	94	91	85	87	94	88	95	87	89	93	**91**
20	98	96	97	92	95	93	86	93	95	97	93	98	94	95	**95**
AVER	85	83	87	83	85	80	86	85	83	82	92	85	85	86	

Table 34 showcases what a set of juror's evaluations could be, based on historical precedence but with random values derived using a Monte Carlo Simulation program. In this instance, for example, juror set 6 graded stricter that the average while juror set 11 was more generous. In this example, Task 6 appears to be a weaker presentation and contains weaker information content while Task 20 BIM modeling typically is a favorite along with Tasks 15 and 16.

Table 35. Example of Student Grading Matrix (Monte Carlo generated values)

Peer Graded Tasks 1 - 5					Peer Graded Tasks 6 - 10					Peer Graded Tasks 11 - 15					Peer Graded Tasks 16 - 20					Leader												
Task 1	Task 2	Task 3	Task 4	Task 5	Task 6	Task 7	Task 8	Task 9	Task 10	Task 11	Task 12	Task 13	Task 14	Task 15	Task 16	Task 17	Task 18	Task 19	Task 20	Internal	SUM	Grade	Task Peer Evaluations 1 to 5	6 to 10	11 to 15	16 to 20	Peer Avera.	Attend.	Grade	Bonus Pts.	Grade	Letter
		10					10					10					10			10	40.0	100	100	100	100	100						
				7.06				9.48					9.37			9.35				9.2	44.5	89	95	95.3	99.0	98.3	97	1.0	86	5	91	A
		8.72						9.48		9.37						9.35				9.2	46.1	92	96.8	94.3	98.6	97.3	97	1.0	89	5	94	A
			8.70		9.20					9.37						9.35				9.3	45.9	92	97.8	98.5	95.3	98.7	98	1.0	90	5	95	A
	8.44					9.02								9.27		9.35				9.4	45.5	91	95.3	98.8	96.7	98.3	97	1.0	88	0	88	B
			8.70					9.48				9.43					9.43			9.2	46.2	92	98.5	98.8	96.7	99.3	98	1.0	91	0	91	A
			8.70		9.20					9.37							9.43			9.2	45.9	92	98.5	97.5	97.7	99.8	98	1.0	90	5	95	A
	8.44				9.20							9.43						9.21		9.2	45.5	91	95.5	95.7	96.0	97.8	96	1.0	88	5	93	A
8.12									9.23				9.37					9.21		8.4	44.3	89	98.0	95.7	97.0	96.5	97	1.0	86	5	91	B
	8.44							9.48					9.37		9.26					9.4	45.9	92	95.0	97.5	96.5	97.6	97	1.0	89	0	89	A
			8.70			9.02				9.37								9.21		9.0	45.3	91	98.5	98	94.3	90	95	1.0	86	0	86	B
																			9.6	9.6	48.0	96	98.0	98.3	99.0	99	99	1.0	95	5	100	A
			8.70			9.02						9.43				9.35				9.4	45.9	92	98.5	98.5	92.7	97.8	97	1.0	89	0	89	B
8.12								9.48			9.36							9.21		9.2	45.4	91	98.0	98.3	97.5	98.8	98	1.0	89	5	94	A
	8.44						9.04							9.27	9.26					8.8	44.8	90	94.3	98.8	97.3	95.8	97	1.0	87	5	92	A
8.12						9.02					9.36				9.26					9.2	45.0	90	98.3	97	96.7	96.2	97	1.0	87	5	92	A
				7.06					9.23		9.36							9.21		9.2	44.1	88	95	98	97.0	94.5	96	1.0	85	5	90	A
																			9.6	9.6	48.0	96	98.3	98	96.0	92	96	1.0	92	0	92	A
8.12									9.23			9.43			9.26					9.3	45.3	91	97.5	98	95.0	97.2	97	1.0	88	5	93	A
		8.72							9.23		9.36				9.26					9.0	45.6	91	97.3	98.5	98.0	96	97	1.0	89	5	94	A
		8.72				9.02								9.27			9.43			9.4	45.8	92	96.3	98.3	96.7	95	97	1.0	89	0	89	B
	8.44						9.04							9.27	9.26					8.8	44.8	90	97.2	98	97.7	97.2	98	1.0	87	0	87	B
		8.72					9.04						9.37				9.43			9.4	46.0	92	97.3	94	98.0	96.25	96	1.0	89	5	94	A
		8.72					9.04			9.37							9.43			8.8	45.4	91	97.3	94	96.3	95.5	96	1.0	87	5	92	A
8.12	8.44	8.72	8.70	7.06	9.20	9.02	9.04	9.48	9.23	9.37	9.36	9.43	9.37	9.27	9.26	9.35	9.43	9.21	9.60	9.18								Ave	88		92	

TASK	Topic and Reference to Author's Publications
1	**Cover page** – Project Delivery System, POR, Pro-Forma • **Fernandez-Solis, J. L.**, & Chugh, K. (2018). "Structured Literature Review of Design-Build/Bridging, Design-Bid-Build & Design-Build." oaktrust.library.tamu.edu
2	**Site logistics** layout plans and details
3	**Erosion control plans** (SWPPP) and details
4	**Site safety**, and evacuation plan and details • **Fernandez-Solis, J. L.**, Prakash, R., & McGowan, A. (2018). "Framework for Understanding the Relationship between Lean and Safety in Construction." oaktrust.library.tamu.edu • **Fernandez-Solis, J. L**., & Tupe, H. (2018). "Mortality rate in the USA construction industry (2004–2014)." oaktrust.library.tamu.edu
5	**Demolition** drawings (ground and vertical) and details
6	**Civil, drainage**, (relocate as needed and show in plan), temporary and permanent utilities
7	**Landscape**, and irrigation plans and details
8	**Foundation design**, basement plans and details
9	**Structure** and stair design, plans and details, live and dead load for all levels, calculate total column loads and girder loads, propose a floor slab design
10	**Elevations**, window schedule
11	**Roof plans** and details
12	**Architectural finishes**, reflected ceiling plans, door and hardware schedules and details
13	**Mechanical and plumbing** plans, calculate fixture count for new population based on currently enforced plumbing code, calculate roof rain water run-off and size of downspout
14	**Electrical**, power, emergency, audio visual, technologies, and lighting plans and details
15	**Conceptual estimate** by systems (based on Tasks 2 - 14 estimates plus general conditions and overage factors)
16	**Conceptual cost loaded schedule** by systems (base on Task 15 estimates) • **Fernández-Solís, J. L**., Rybkowski, Z. K., Xiao, C., Lü, X., Chae, L. S. (2015) "General contractor project of projects – a meta-project: understanding the new paradigm and its implications through the lens of entropy. *Architectural Engineering and Design management* 1-30. • **Fernández-Solís, J. L**., Lü, X., and Ryoo, B. Y., (2013), "Building Construction: A deterministic non-periodic flow – A case study of chaos theories in tracking production flow", *Architectural Engineering and Design Management*, 9 (**1**) 21-48.

	• **Fernández-Solís, J. L**., Lü, X., Ryoo, B. Y., (2011) "Building Construction: a Deterministic nonperiodic flow – A case study of chaos theories in tracking production flow", *Architectural Engineering and Design Management*, 9(1) 21-48. • Porwal, V., **Fernández-Solís, J. L.,** Lavy, S., Rybkowski, Z.K., (2010). "Last Planner System: Implementation Challenges", 18th Annual conference of International Group of Lean Construction, Haifa, Israel, Proceedings. • Xiao. C., **Fernandez-Solis, J.L.**, Rybkowski, Z.K., (2014). "Is building construction, as a social project organization and production system, complicated or complex?" ASC Proceedings Paper ID: CPRT332002015, Texas A&M University 51st Annual International Conference, College Station, Texas; April 22-26, 2015 • **Fernandez-Solis, J. L.**, Du, J., & Rincón Fonseca, J. L. (2018). "Do Management Practices Impact Cost and Schedule Indicators? Comparative of Case Studies." oaktrust.library.tamu.edu
17	**Sub-contractor and HUB selection** strategy by systems and sub-systems components
18	**QA/QC and commissioning** plans • **Fernández-Solís, J. L.,** 2005, "*Design-Build Project Manager Role Definition for a Quality Assurance Process of Total Building Commissioning (TBCxP)*," Submitted to the Construction Information Quarterly, The Chartered Institute of Building, UK
19	**Lean Construction** plans and details • **Fernández-Solis, J.L.**, Rybkowski, Z. K., (2012) "A Theory of Waste and Value", International Journal of Construction Project Management, 4(2), 1-6. • **Fernández-Solis, J.L.**, Lagoo, N. (2012). "A Seminal Case Study on Application of Last Planner® System with Cash Flow Data for Improvement in Construction Management Practices", Journal of Engineering Management Reviews, 1(**1**) Dec. 2012, 1-12. • **Fernández-Solís, J. L**., Porwal, V., Lavy, S., Shafaat, A., Rybkowski, Z. K., Son, K., Lagoo, N., (2011) "Survey of Motivations, Benefits and Implementation Challenges of Last Planner System Users", *Journal of Construction Engineering and Management,* 139(**2**) 354-360.
20	**Building Information Model**, BIM360, AutoDesk (PlanGrid), ProCore, or Builder'sBox model • **Fernández-Solís, J. L.,** Mutis, I., (2009), "The Ideation of an integrated BIM, Lean and Green model (BLG)," *Handbook of Research on Building Information Modeling and Construction Informatics: Concepts and Technologies*, edt. Jason Underwood and Umit Isikdag, IGI Global, University of Salford, Manchester, UK, pp 302-334. ISBN 1605669288

<u>Comments:</u>

Commercial Capstone classes are a laboratory for teaching IPBL, AL, and Transformative Learning. Every time the class has been taught, thus far, students have come up to the plate and in some form amazed me with their insights and abilities to grasp new and more sophisticated knowledge. I tell students that they need to continue learning because the class behind them will be even sharper and will catch up faster.

It is a privilege and an honor to experience how capstone students learn. The future is here because they have learned how to learn.

End of the Semester