Develop an MEP Based Scheduling Learning Module with Industry Support and Guidance to Understand the Impact on the General Contractor

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The Construction Management (CM) program at Cal Poly, San Luis Obispo is recognized as one of the best construction programs in country. The curriculum does an extraordinary job at teaching how to utilize software and technology to create a project schedule. The one thing that the curriculum lacks is learning sequencing of events when it comes to scheduling, and where to look to obtain this information. Although learning sequencing for scheduling is hard to teach because it comes with years of industry experience, it is important to have a basic understanding of how things come together to create a functioning project schedule. A way to understand sequencing is by learning a about the design of the systems that the general contractor is installing. By learning what the engineers do, it allows for the general contractor to understand how much time is going to be needed to install the required systems. As a general contractor it is important to bring on your MEP subcontractors early on because the MEP trades make up a great chunk of their overall budget. This learning module will not only help understand sequencing for general schedules, it will also make students more aware of the impact specialty contractors have on the general contractor.

Key Words: Construction, Schedule, MEP, Sequencing, Specialty

Introduction

The principal objective of this project is to further students' understanding of MEP scheduling, and their impact on the general contractor. By implementing these modules into the curriculum, it can help students understand sequencing of events which usually comes from field experience. Cal Poly's Construction Management curriculum does a good job at teaching how to utilize the software to create project schedules, but the hardest part is understanding the logic to link the activities to each other. Both of these modules will provide a strong foundation, allowing for a smoother transition between college and industry practice. By going through this experience, students will feel better prepared and more comfortable creating any schedule in their future career.

Methodology

As the scheduler for the Mechanical Reno Competition Team I have always struggled when it comes to creating an MEP schedule. I understand how the software works, but the problem is learning the order in which activities happen. To make sure that the rest of the Construction Management (CM) Department felt the same way, I surveyed thirty students, about seven to eight students per academic class. The survey asked two question, "*What is your academic standing (Freshman-Senior)?*" and "*In a scale from 1 to 10, 1 being the least comfortable and 10 being the most, how comfortable do you feel creating a good MEP schedule?*" The data that I received from this survey was exactly as I expected. Nobody felt 100 percent comfortable making an MEP schedule and 90 percent felt between 1-5 in the comfort ability range.

After looking at the results this survey, I decided to reach out to industry for help and guidance through the modules. I talked to both a general contractor and a mechanical contractor, and took into consideration their input when it came to scheduling. I also had to work with professors to ensure that the material in the modules lined up with the material that was being taught in the class. For this reason, I decided to have the modules be based on Bonderson Building located at Cal Poly. With access to the set of architectural plans, students will be guided though a little bit of design to understand the sequencing of events. After this they will be able to check how they did by looking at the mechanical plans that shows what is actually installed. The second module focuses on the steps of how to create a schedule. It explains the general information needed to begin a schedule, such as where to obtain the information like NTP and different activity durations. The plan is for these two modules to be implemented into the specialties lab so that students that are learning about MEP learn the basics on system design and project scheduling.

Deliverables

As I mentioned earlier both of these modules, should be implemented into the new curriculum. More specifically, these modules will become part of the already existing CM 411 Specialty Contracting Construction Management course at Cal Poly. I worked with both my SME (Andrew Kline), and the Specialties Professor (Paul Redden) who will be teaching next quarter to use my modules to better explain design and scheduling to current CM students.

The first module consists of HVAC system design of Bonderson Building located at Cal Poly. In this module, students are guided through how to design an HVAC system for a commercial building. The intention on this fist module is to learn the basics of system design to better understand the components that go into it. By doing this, students will begin to understand the sequencing of events on how this system is being put in place. After this exercise, students will understand one of the many logical ways to schedule and link the activities.

This leads to the second module that consists of the procedure taken in order to create a project schedule. In this module, students will learn to go through the project's contract documents to look for key information that is needed to create a schedule. After completing these two learning module, students should definitely feel more comfortable scheduling. The second module could be used as a checklist to ensure you have key information.

Lessons Learned

Throughout the process of working on this project, I came to many realizations such as creating learning modules is hard since students learn in different ways. I tried doing my best to make it as clear as possible so that students did not have to spend time trying to figure out what the intention of the module was. Learning modules that I have done in classes most of the time are hard to understand because of their lack of clarity. Although I think that students should not be guided through every single step, they need to have enough information to struggle with it. The more that a student struggles with an assignment, the more the student will learn and remember. I know this from experience.

Initially, my modules were longer and more in depth, but I learned that students will see this as an assignment, and it needed to be a maximum of two pages each so that they would not lose interest. When a module is short and sweet, it gives the students extra energy to finish it up.

From the results of my survey, I noticed that students are really not comfortable with scheduling, which means that professors should focus more on this problem. Scheduling is something that if done correctly can save the contractor a lot of time and money. The better prepared our CM students are before leaving and entering the industry, the more they will excel and take on leadership positions in their companies.

In conclusion some advice for the upcoming seniors, is to try and finish your senior project early. Do not leave it until last minute because along with graduation, many things come up. The earlier you complete the project, the more time you will have to have fun you last week at Cal Poly.

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HVAC System Design

ASSIGNMENT:

- Create an HVAC system design for Bonderson Building Architectural Drawings.

DELIVERABLES:

1. Area Takeoff
    a. Open Architectural drawing set on Bluebeam.
    b. Measure the Building Footprint in Square Feet (SF).
2. Load Calculations
    a. Load Calculation is a process used to determine what is the best size, application and style of the HVAC Equipment.
    b. Use Square Footage of Building Space, and distinguish between usable space and non-usable space.
    c. Count all windows, doors
        i. Check Specs for any Window Treatment.
    d. Count Number of Floors.
3. Equipment Selection
    a. Use information from Load Calculations to pick the Equipment that is best suitable for Bonderson building.
    b. Look up HVAC systems and compare their specifications to the load calculations you just created.
    c. Estimate Lead Time of the system.
4. Grille/Register/Diffuser Layout
    a. Calculate CFM per room serviced throughout the building
        i. To calculate CFM, you need to know the size of your HVAC unit in tons. Then multiply this number by the output of the HVAC system, which is usually an average of 400. Finally, divide by the total Area (SF) of Bonderson.

b. Make sure that the layout is aesthetically pleasing, as well as having as least bends as possible.
    i. All bends should be as smooth as possible to minimize energy costs.

5. Duct Routing/Sizing
    a. Use Load Calculations and CFM to estimate the size of the duct.
    b. Run duct in increments of fifty feet to fit onto a semi-trailer

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Module of Procedure for Creating a Construction Schedule

ASSIGNMENT:

- Gathering all the information needed from the construction documents to build a complete schedule.

DELIVERABLES:

1. Review Spec Book for Critical Dates and create a Table with ***Key*** Project Scheduling Information.
    a. List the Notice to Proceed (NTP)
    b. List the Project Duration
    c. Calculate Substantial Completion Date and Final Completion Date and List.
    d. If any additional milestone requirements are listed in the contract documents, then add them into the table.
    e. Check allowed days for Submittal Review?
    f. Check allowed days for RFI responses?

Notice to Proceed	5/3/2019
Project Duration	250 days
Final Completion	5/15/2020
List any Additional Milestone Requirements from the Contract Documents.	

2. Create a Procurement Schedule.
    a. Review Project Plans and Specs and Create a List of Deferred Submittals and Long Lead Time Items.
        i. Deferred Submittals
            1. Fire Sprinkler Design
            2. Fire Alarm Design
            3. Design, Structural Calculations for Curtain Walls.
            4. Security Design Shop Drawings

ii. Long Lead Items
    1. Electrical
        a. Lighting Package
        b. Electric Panels
    2. Plumbing
        a. Compressors
        b. Toilet Fixtures
    3. HVAC
        a. Air Handling Units (AHU)
        b. Chiller Units
        c. Reheat Coils
        d. VAV Valves/Boxes

b. The Procurement Schedule is a Matrix. List each item in the first column on the left. Create a column for each stage of procurement process: date submittal is required, actual date of submission, date submittal approval is required, actual submittal approval, date item is released for fabrication/production, expected lead time from factory, date fabrication completion expected, estimated ship time, earliest date that this item will be available, date that the item needs to be onsite before schedule is delayed.
c. Once a week do a status update by calling the subcontractors. Keep notes of what is promised. Follow up once each week and verify the dates match.
d. Keep the procurement phase as a separate section on the top of the schedule.

3. Put together Skeleton of Project Schedule.
    a. List all construction tasks
    b. Assign logic/dependency relationships
        i. For the first schedule, stick with finish/start (FS) relationships as much as possible.
        ii. Try to use a single linear progression.
    c. Input the duration for each task. See where the completion date ends up and adjust durations to meet required completion date.

4. Send Preliminary Schedule to ***all*** the Subs and request that they review.
    a. Adjust the schedule after getting input from the subcontractors.