Developing The Project Schedule:

Simplify!

Tips for Simplifying the Schedule

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Project Controls EXPO

Scheduling:

An Introduction

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Who Creates the Schedule?

- The General Contractor (GC) must create the detailed schedule, specifically for the construction phase:

    A. Usually used for bidding or negotiation

    B. An approved copy (by the owner) will be the "Baseline"; used as a reference to measure performance

    C. It is a roadmap for how the contractor intends to build the project.

    D. It must be updated periodically to reflect reality and implement changes.

    E. It is a legal document that may be used for or against you!

- Planning and Scheduling is a science. It is a lot more than just a software application!

Steps for Creating a CPM Schedule

1. *Breakdown the project into activities*
2. *Determine activities' durations*
3. *Define logical relationships (interdependencies)*
4. *Draw the network, and perform CPM calculations*
5. *Optional: Resource/cost-load the project*
6. *Review and analyze the schedule*

Before the start

7. *Implement the schedule*
8. *Monitor and update the schedule*

During execution

9. *Closing out: database and feedback*

After Completion

Simplify Your CPM Schedule

- Simplification stages:
    1. The contract
    2. The creation of the schedule
    3. The schedule updates (periodic and other)
        - Payment request and the percent complete maze
        - Submittal / shop drawings review cycle
        - Implementing change orders
        - Implementing time extensions
    4. Reporting and documentation
    5. Software issues
    6. Closing and archiving

Simplifying:

The Contract Stage

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Simplify: The Contract...

- Although in most cases, the owner makes the contract conditions, the general contractor (GC), may influence some of the terms.
    1. Technical specs must be up to date and simple to apply
        - Putting a cap on activity duration is a good idea.
        - The software specified, if any, must be suitable for work and "industry-friendly."
        - Ownership of the Total Float?
        - Penalty (LD's) and bonus clause?
    2. Project duration reasonable?
    3. The GC may introduce creative concepts and methods that the owner may not be aware of.

Simplifying:

The Schedule Creation Stage

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Simplify the Schedule, Tip #3: WBS

- The project breakdown structure:

- Every activity has to be:

  1. Well-defined,
  2. Easily measurable, using one unit only,
  3. Controllable, and
  4. Performed by one crew (unless…).

  Divide and conquer!

- Milestones are for important events only

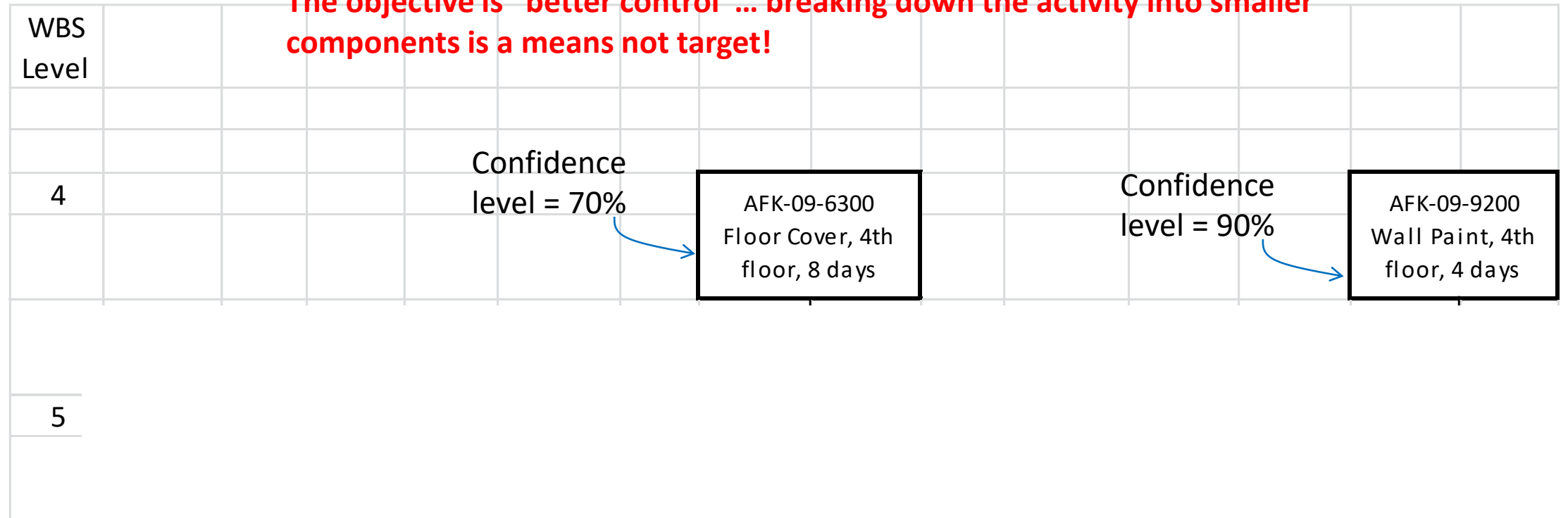- The project has 1000's of activities? So what?

Confidence Level Versus Level of Detail
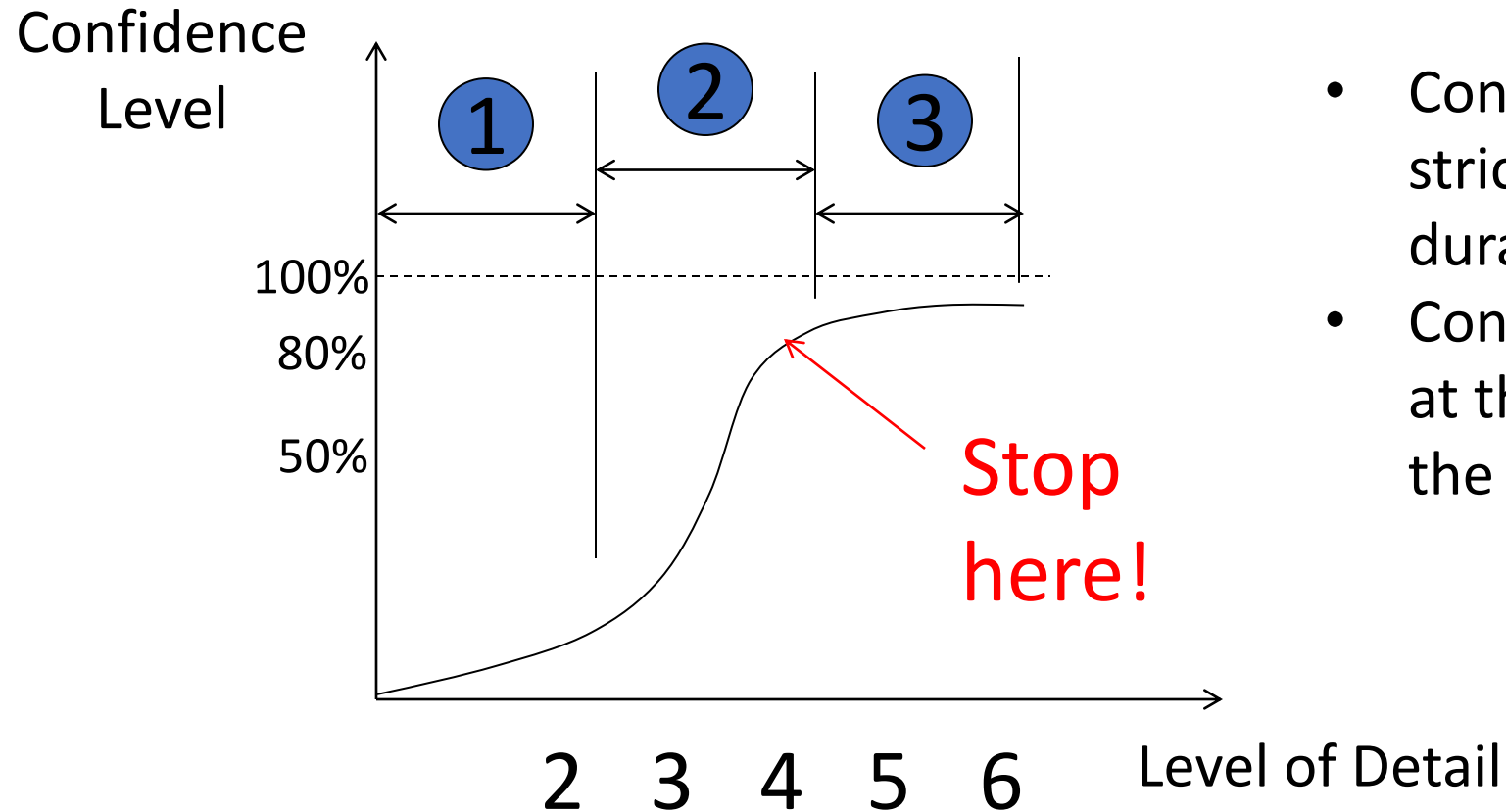
- Confidence here is strictly in the assigned duration
- Confidence is considered at the activity level, not the entire project level

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Confidence Level Versus Level of Detail

The objective is "better control"... breaking down the activity into smaller components is a means not target!

WBS Level					
4		Confidence level = 70%	AFK-09-6300 Floor Cover, 4th floor, 8 days	Confidence level = 90%	AFK-09-9200 Wall Paint, 4th floor, 4 days
5					

Simplify the Schedule: Activity Durations

- Activity durations:
    1. Where did you get your productivity numbers from?
    2. Have you applied proper adjustments?
    3. "Lean duration": Leave time contingency away from activities and under the control of the PM
    4. Do not include "non-work gaps".
        - An "Obtain Permit" activity should not be a 60-day activity. It can be a milestone with 60-day lag (or one-day activity with 59-day lag)

Simplify the Schedule: Activity Durations

- Activity durations:
    5. Remember that activities consume time, resources, and budget
        - Waiting for concrete or asphalt to cure (without effort) is NOT an activity
    6. Do not include two or more segments with different production rates within the same activity
    7. If you are using "Day" as the time unit, round up duration to whole numbers.
        - Do not use fractions of the day unless you schedule by the hour!
    8. If the duration is large (for example, 40 days), divide it based on geometric or other criteria.
        - For excavation, you can divide it by grid. For a CMU wall, you can divide it by segment.

Repercussions of Inaccurate Durations

- Always check production rates against project conditions

- Impact on succeeding activities
    - Delayed crews
    - Wasted money
    - Shortage of materials / crews (if actual date is earlier)
    - Possible problems with cash flow
    - Disrupted plans and chaos

- Warning: don't accept unrealistic expectations!
   - If you over-promise, you will under-deliver!

Simplify the Schedule: The Logic

- The logic (activities interdependencies):
  1. Use only / mostly F-S relationships.
     - Most situations with S-S, F-F, or combination relationships can be re-drawn using F-S relationships only.
  2. Lags are okay: They represent time period with no work.
     - Avoid using "Leads", i.e. negative lags
     - Lags are different in type!
  3. Remember "external activities"!
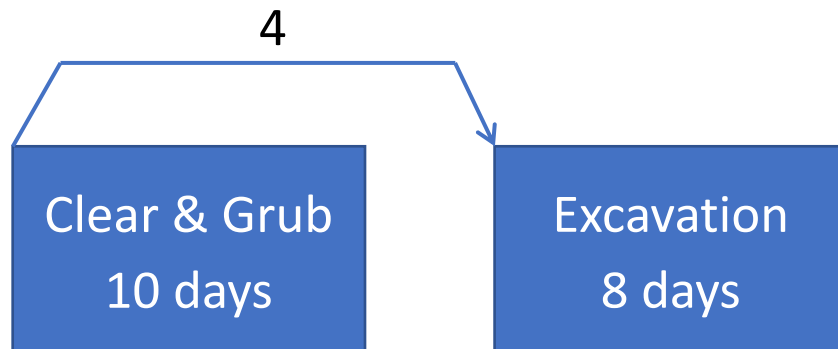
Simplify the Schedule: The Logic

- *Types of lags:*
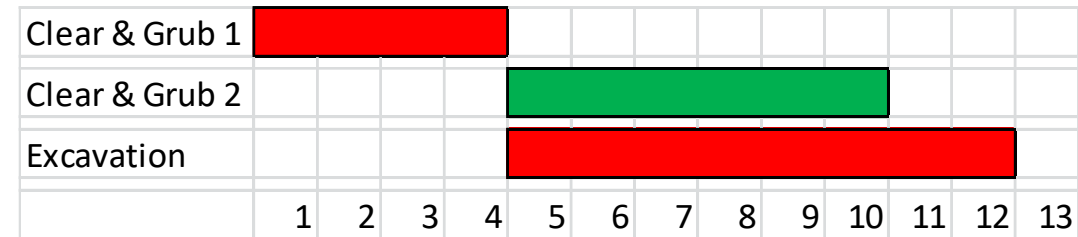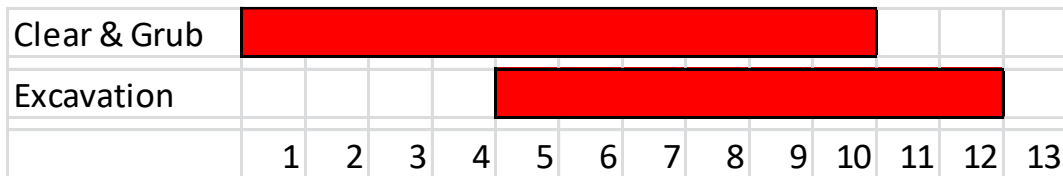 1. *The wait lag:* Make sure it is not part of the duration of the predecessor or the successor!
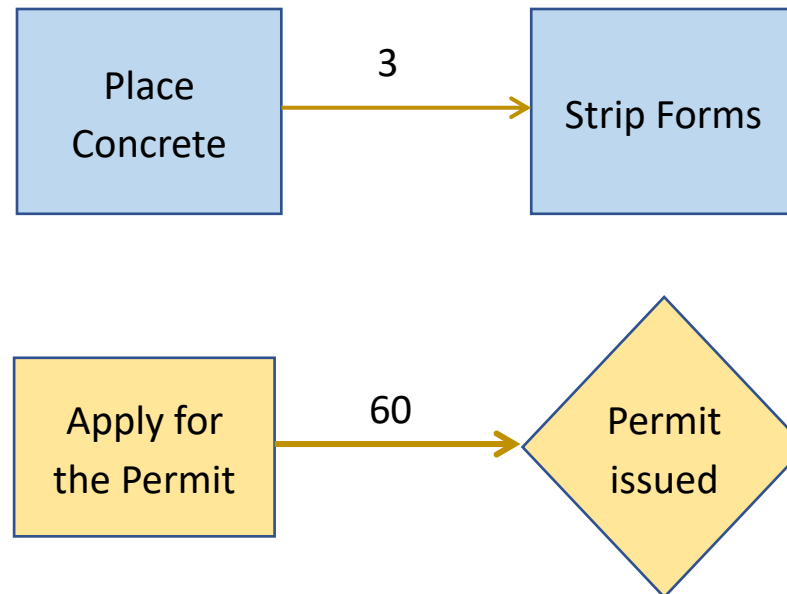
Splitting Activities to Simplify

2. The start lag

F-S relationship and no lag

Simplify the Schedule: The Logic

1

0, 8
Roof Sheathing
8 days

1, 13
Roof Shingles
12 days

1
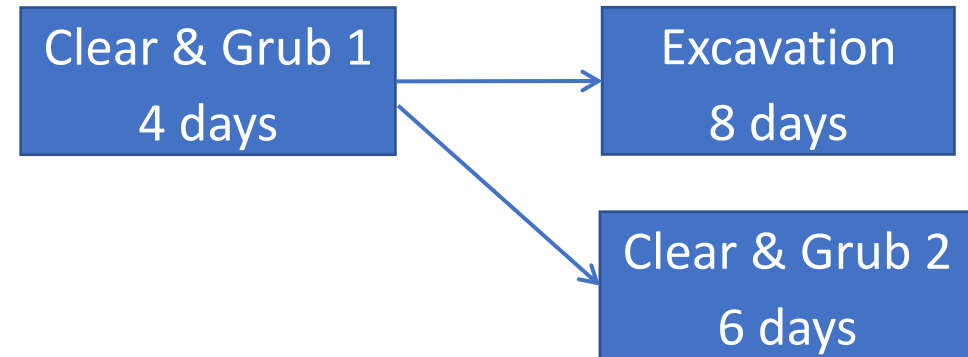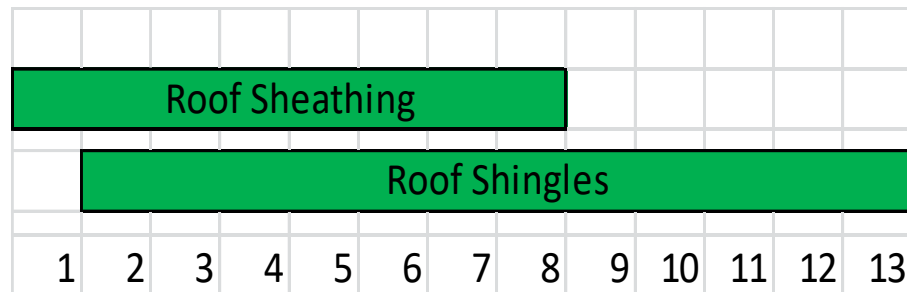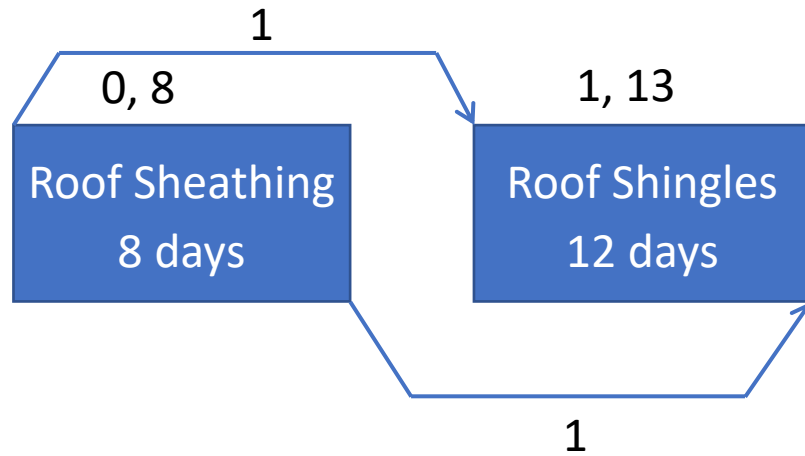
3. The continuous lag
It is okay to keep the lag and avoid splitting
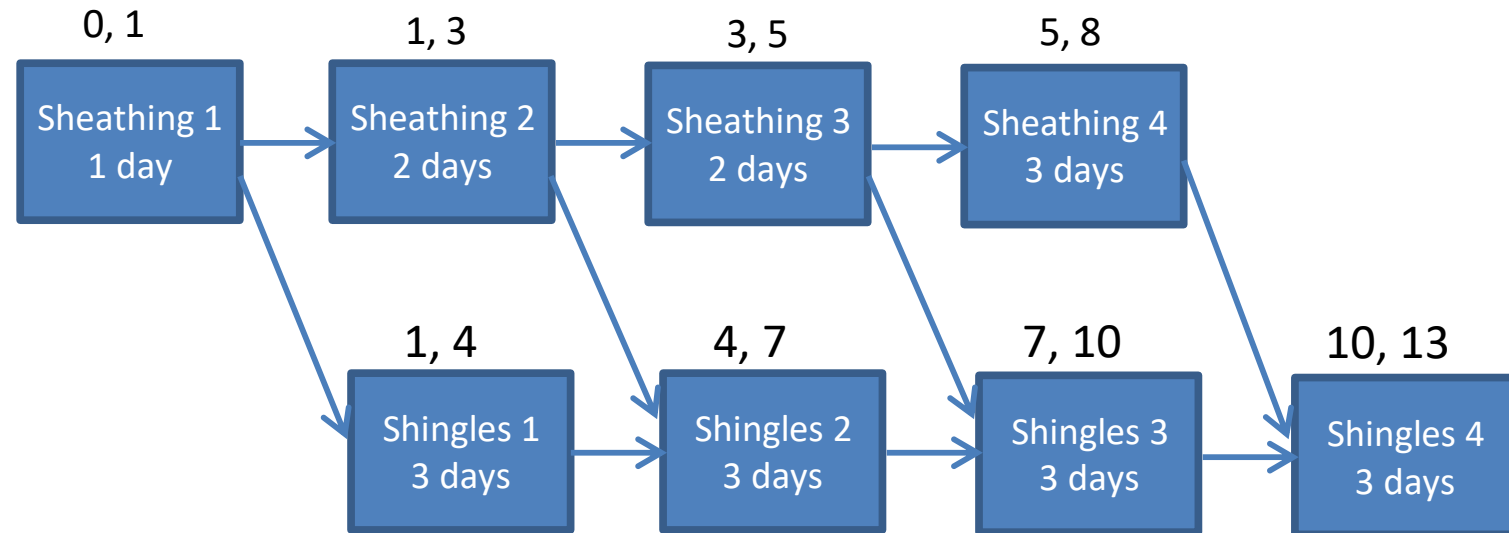
0, 1
Sheathing 1
1 day

1, 3
Sheathing 2
2 days

3, 5
Sheathing 3
2 days

5, 8
Sheathing 4
3 days

1, 4
Shingles 1
3 days

4, 7
Shingles 2
3 days

7, 10
Shingles 3
3 days

10, 13
Shingles 4
3 days

Roof Sheathing

Roof Shingles

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
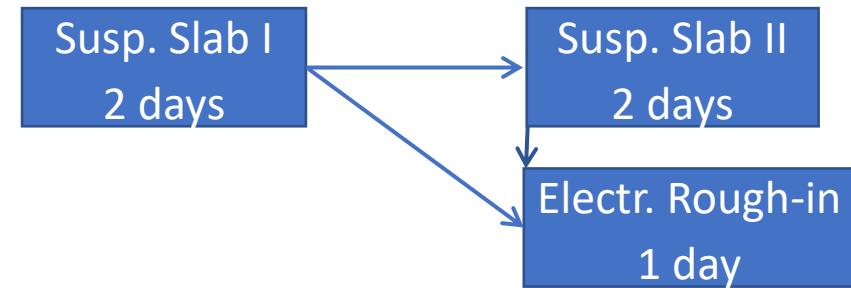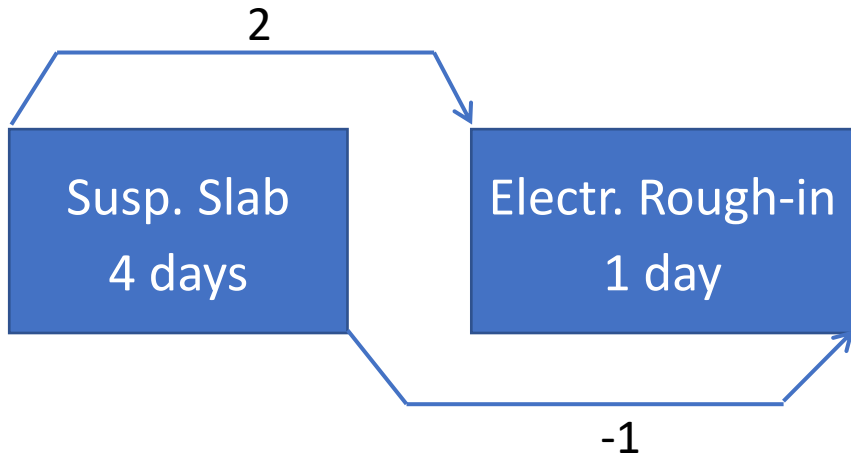
The encased (enclosed) lag

The encased (enclosed) lag

This example will be better simplified if the slab work is broken to:

a. Formwork,
b. Reinforcement, and
c. Concrete placement
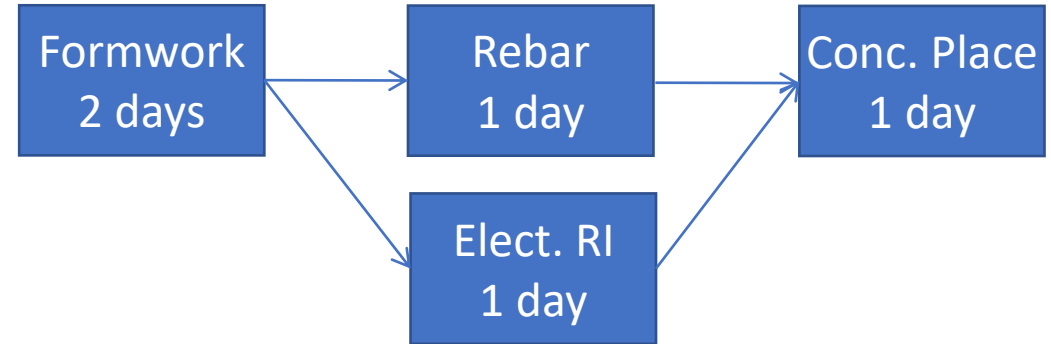
Suspended Concrete Slab				
Formwork				
Electr. Rough-in				
Rebar				
Concrete Placement				
	1	2	3	4

Simplify the Schedule: Imposed Constraints

- A constraint is an externally imposed restriction affecting when an activity can start and/or finish

- Constraints may, and usually do, impact the dates of subsequent activities.

- Most constraints are static, i.e. tied to a set date.

- Constraints may conflict with logical relationships

- Constraints should never be used in lieu of logic!

The only dynamic constraint

Start On
Start On or Before
Start On or After
Finish On
Finish On or Before
Finish On or After
As Late As Possible
Mandatory Start
Mandatory Finish

Completely avoid!

Simplify the Schedule Logic

- Minimize the number of:
  - Milestones
  - Constraints
  - SS, FF, and combination relationships
  - Lags
- Avoid using leads (negative lags)

Simplify the Schedule: Activities Attributes

- Activities attributes:
    1. The ID: The pattern, the default "jump"
        - ABC2200, ABC2210, ABC2220,
    2. The title / description: What and where
    3. The codes: Along with software tools such as "Group and Sort" and "Filter"
        - Using codes is a great way to group and select activities.
        - Do you have a code table (legend)?

Simplify the Schedule: Project and Activity Notes

- Notes are very important to explain things that cannot practically be put on the schedule (the bar chart or the network)
  - Especially when things don't go as planned!
- Project note versus activity note
- Who writes or who reads (sees)?

Simplify the Cost

- Cost loading or resource loading?

  - Is this activity to be performed by your own crew or a subcontractor?

- Direct versus total cost: How to carry overhead and profit in the cost?

  - You like to track direct cost but show total cost to client.

- Resource leveling? Great idea but…

  - We are talking about labor and equipment!
  - Again: Is this activity to be performed by your own crew or a subcontractor?
  - Among tens of different resources, level the few major ones.
  - If you don't level, at least manage. Resources are <u>not</u> unlimited!

Cost-Loading the Schedule - 1

	11-Apr	12-Apr	13-Apr	14-Apr	15-Apr	18-Apr	19-Apr	20-Apr	21-Apr	22-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	2-May	3-May	4-May	5-May	6-May	
Overhead	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	150	$3,000
A	500	500	500	500	500																$2,500
B			1000	500	200	200															$1,900
C						720	720	720													$2,160
D								600	200	200	200	200									$1,400
E								350	350	350	175	175	175	175							$1,750
F									600	600	600	600	600								$3,000
G													450	150	150	150	150				$1,050
H														320	160	250	90	50			$870
I														120	120	120	120	120	120	120	$840
Date	11-Apr	12-Apr	13-Apr	14-Apr	15-Apr	18-Apr	19-Apr	20-Apr	21-Apr	22-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	2-May	3-May	4-May	5-May	6-May	$15,470
																					$18,470
Total/day	$650	$650	$1,650	$1,150	$850	$1,070	$1,820	$1,420	$1,300	$1,125	$1,125	$1,375	$1,075	$740	$580	$670	$360	$320	$270	$270	

Model 1: Activities are loaded with direct cost only. Overhead and profit are carried by a separate hammock activity.

Cost-Loading the Schedule - 2

Activity	11-Apr	12-Apr	13-Apr	14-Apr	15-Apr	18-Apr	19-Apr	20-Apr	21-Apr	22-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	2-May	3-May	4-May	5-May	6-May	Total
A (direct)	500	500	500	500	500																$2,984.81
A (indirect)	$96.96	$96.96	$96.96	$96.96	$96.96																
B (direct)			1000	500	200	200															$2,268.46
B (indirect)			$193.92	$96.96	$38.78	$38.78															
C (direct)						720	720	720													$2,578.88
C (indirect)						$139.63	$139.63	$139.63													
D (direct)							600	200	200	200	200										$1,671.49
D (indirect)							$116.35	$38.78	$38.78	$38.78	$38.78										
E (direct)							350	350	350	175	175	175	175								$2,089.37
E (indirect)							$67.87	$67.87	$67.87	$33.94	$33.94	$33.94	$33.94								
F (direct)									600	600	600	600	600								$3,581.77
F (indirect)									$116.35	$116.35	$116.35	$116.35	$116.35								
G (direct)												450	150	150	150	150					$1,253.62
G (indirect)												$87.27	$29.09	$29.09	$29.09	$29.09					
H (direct)														320	160	250	90	50			$1,038.71
H (indirect)														$62.06	$31.03	$48.48	$17.45	$9.70			
I (direct)														120	120	120	120	120	120	120	$1,002.90
I (indirect)														$23.27	$23.27	$23.27	$23.27	$23.27	$23.27	$23.27	
																					$18,470.00
Total/day	$597	$597	$1,791	$1,194	$836	$1,098	$1,994	$1,516	$1,373	$1,164	$1,164	$1,463	$1,104	$704	$513	$621	$251	$203	$143	$143	$18,470.00

Model 2: Activities are loaded with direct and indirect cost, separately.

Cost-Loading the Schedule - 3

	11-Apr	12-Apr	13-Apr	14-Apr	15-Apr	18-Apr	19-Apr	20-Apr	21-Apr	22-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	2-May	3-May	4-May	5-May	6-May	
A	596.96	596.96	596.96	596.96	596.96																$2,985
B			1193.9	596.96	238.78	238.78															$2,268
C						859.63	859.63	859.63													$2,579
D							716.35	238.78	238.78	238.78	238.78										$1,671
E							417.87	417.87	417.87	208.94	208.94	208.94	208.94								$2,089
F									716.35	716.35	716.35	716.35	716.35								$3,582
G												537.27	179.09	179.09	179.09	179.09					$1,254
H														382.06	191.03	298.48	107.45	59.696			$1,039
I														143.27	143.27	143.27	143.27	143.27	143.27	143.27	$1,003
Date	11-Apr	12-Apr	13-Apr	14-Apr	15-Apr	18-Apr	19-Apr	20-Apr	21-Apr	22-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	2-May	3-May	4-May	5-May	6-May	$18,470
Total/day	$597	$597	$1,791	$1,194	$836	$1,098	$1,994	$1,516	$1,373	$1,164	$1,164	$1,463	$1,104	$704	$513	$621	$251	$203	$143	$143	$18,470

Model 3: Activities are loaded with direct and indirect cost, combined.

Simplify the Schedule: Who Owns the Float?

- This is the billion-dollar question ☺
  - Float ownership is one of the most controversial issues, technically and legally
- It is recommended to keep it under the GC's ownership, but the owner has the responsibility of reviewing, and the authority of approving the baseline schedule.
  - It is not only about delaying the project completion, but also about disrupting the GC and subcontractors' work plan.
  - If an unexpected delay happens or a change order issued, the GC and owner may decide if the delay can be absorbed by the float, or if an extension is justified.

Simplify the Schedule: Importance of Accuracy

- Be accurate and systematic in creating the schedule
  - Make it easy for you or anyone else to review any part
  - The schedule is a legal document that may be used in the court of law later
  - Make sure it is done by a professional!
  - Do not let greed, over-confidence, or the owner's pressure make you go against your educated logic and common-sense.
  - Avoid the "We'll correct it as we move on" syndrome!
- "Anything you say, may and will be used against you!"

Simplifying:

The Execution Stage

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Simplify the Schedule: Schedule Updating

- The "Look-ahead" reports.

- The Schedule update form:
  - Standardize!
  - Designate the person (the PM or superintendent) to provide input.
  - Use the software tools (Group and Sort, Filter) to put the spotlight on the activities to be focused on.
  - Data versus information!

- If the PM (or superintendent) is not proficient in the software, it is better to have a professional scheduler do the update.

Simplify the Schedule: Schedule Updating

- Make sure:
    1. There is a system and protocol for schedule updating.
    2. The interval is defined and respected.
    3. It is done on time and according to the policy, no exceptions!
    4. It is taken seriously: the process and the report.
   5. "Exceptional" updates are labeled as so and stored in a different way.

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Simplify the Schedule: Schedule Updating

- Choosing the type of % complete:
  - Know what each type means and know the math.
  - Pick the appropriate types and be consistent with them.
- Remember that updating includes two parts:
  - Past: What happened on the ground since previous update, and
  - Future: Impact of what happened, especially when things don't go as planned
- Change orders:
  - Approved or suggested?
  - Impact on schedule: Not only the project completion date but also successors, resources, cash-flow, etc.

Simplify the Schedule: Risk Management

- How do you account for risks in the project?
  - At the activity level:
    - Example: While performing an excavation activity you experienced unforeseen conditions, or the excavator blade broke down
  - At a group of activities level:
    - Example: A truck delivering items for several activities broke down
  - At the entire project level:
    - Example: hurricane or labor strike… or COVID-19
    - Does the risk impact all activities at the same level?
  - How much time contingency have you allocated? How do you manage it?
- Schedule update must be tied to risk register update.

Simplify the Schedule: Management Float

Use by discretion of PM

Construction schedule

Management Float

Finish date for crews

Finish date for client
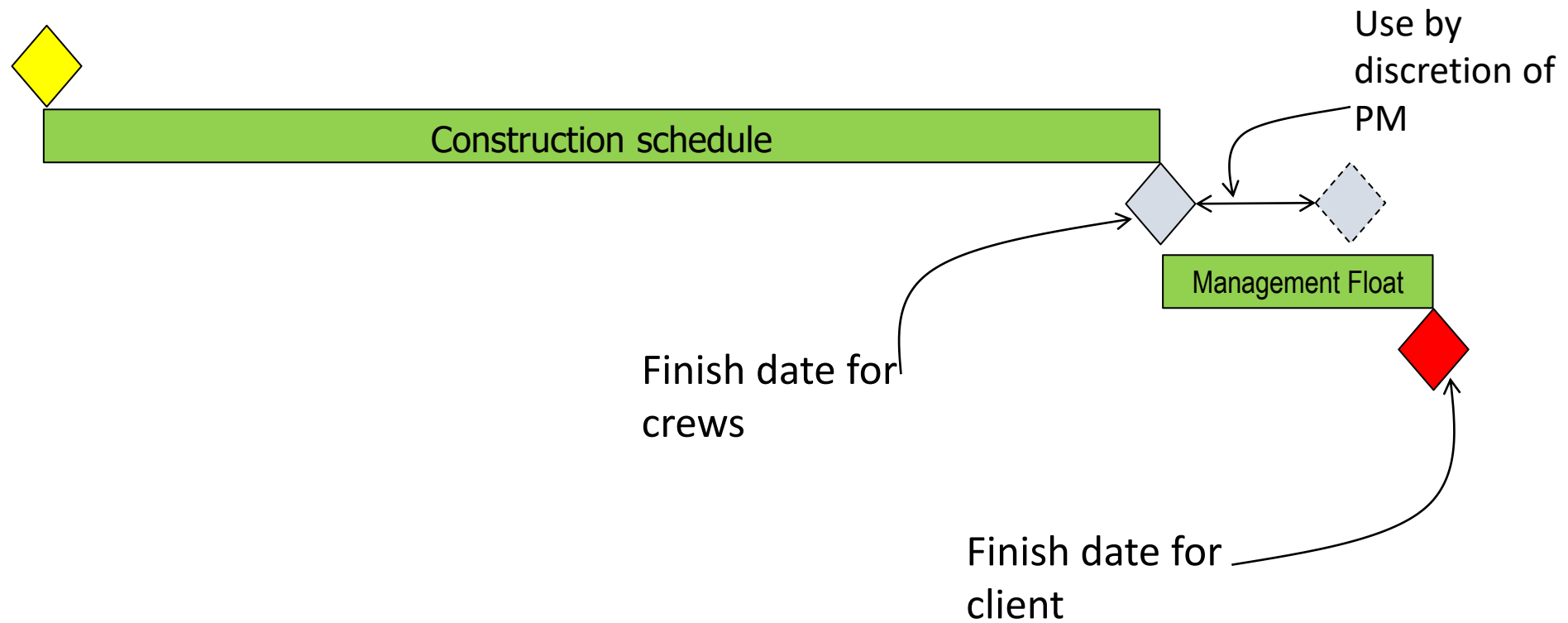
Simplifying:

Reporting and Documentation and more

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Simplify the Schedule: Reporting

- Reporting: There is no such thing as "one size fits all"!
  - Choose the type, amount, and organization of the information
  - Speak at the right technical level of the other side
  - Too much information is *not* good!
    - In e-reports, use the hyperlink function to allow user to go to the details
  - The spotlight concept: show only what you like to focus on.
    - Use software program tools: Summarization, Group'N Sort, Filter,…
  - External versus internal reporting
  - Speed and efficiency of conveying information

Simplify the Schedule: Documentation

- Create a system to store schedules (and other documentation):
  - Future (not started) projects,
  - Ongoing projects,
  - Completed and closed out projects,
  - Canceled / postponed projects,
- The project folder must also have sub-folders for topics such as change orders.
  - Paper and/or electronic? When electronic, what format?
  - Scanning documents
- Security, back-up, and accessibility.

Simplify the Schedule: Software Tips

- The human being running the computer program is more important than the computer or the program!
  - This is true only if this human being is qualified and competent!
- Every software has plenty of bells and whistles:
  - Learn the "ins and outs", defaults, rules, and options of the program,
  - Realize that the "language" of the program may differ in certain terms from the industry or textbook language.
  - Dig deep beneath the surface and challenge the calculations and rules.
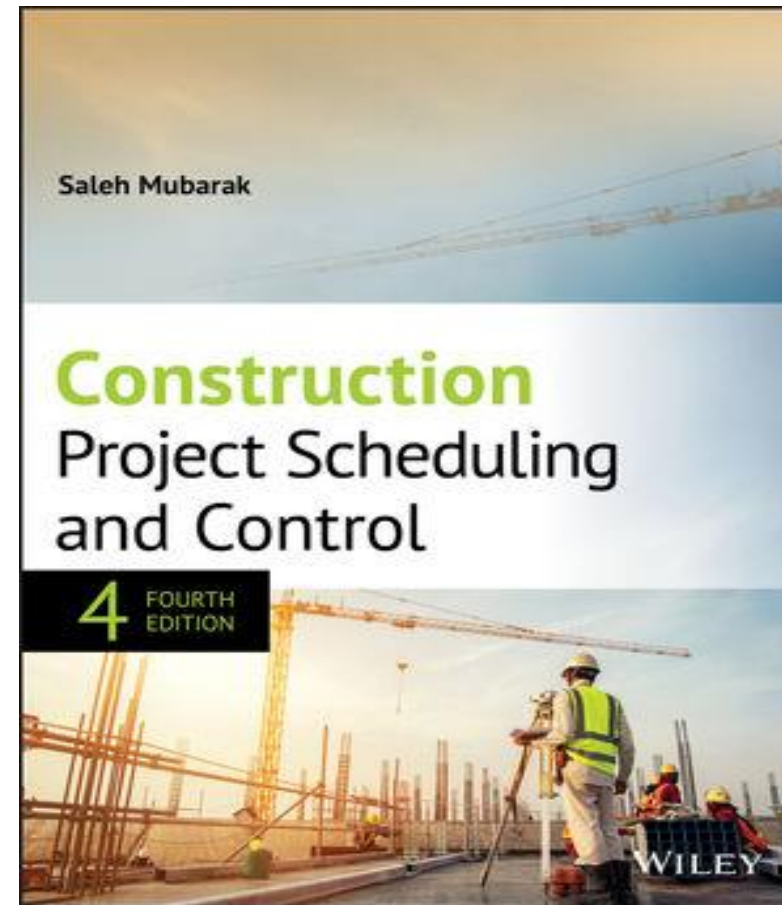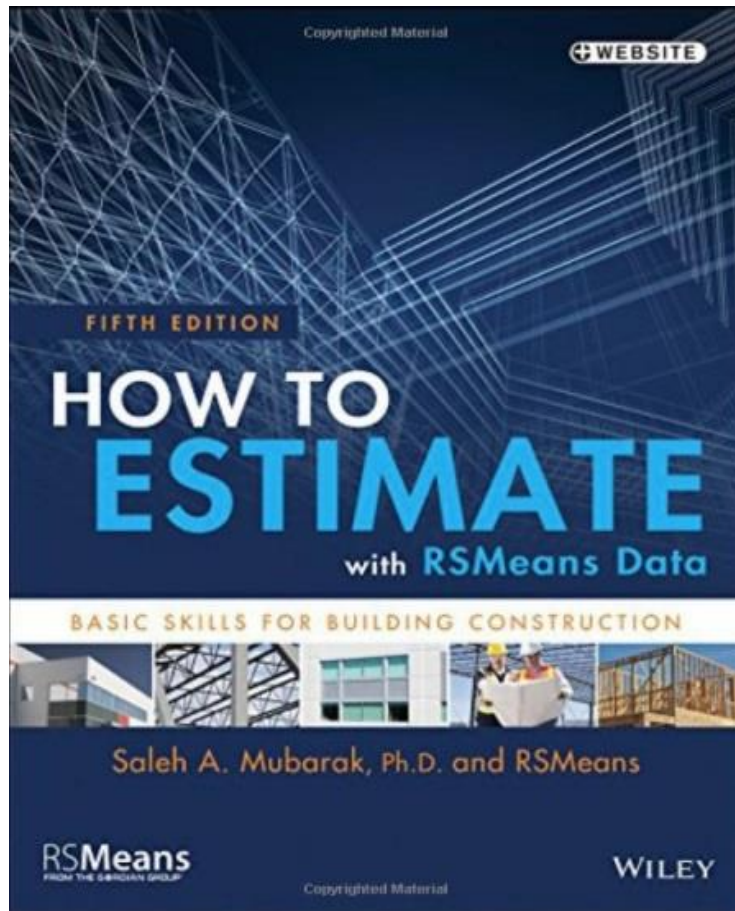
Simplify the Schedule: Final Comment

- The effective schedule has two legs:
  - Good preparation before start
  - Good follow-up (updating) while in progress
- You cannot walk with one leg!

Conclusion…

- Any comments? Questions?
- Keep in touch: (813) 455-9338   salehmubarak@hotmail.com

THANK YOU