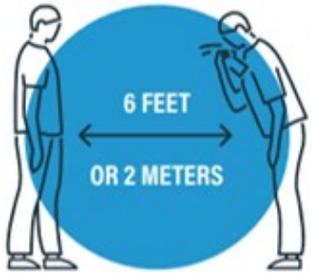


NO MORE THAN TWO PEOPLE IN THE ELEVATOR AT A TIME


AVOID HANDSHAKING


AVOID CROWDS AND MASS MEETINGS

Pandemic Caused Schedule Impacts

Greg Hall, Kiewit Corporation

Pandemic-Caused Schedule Impacts

- “Unique and Historic” Events: What’s different, and what’s the same
- Navigating the Effects
- Follow-Up Analysis

Unique and Historic Events

- No prior pandemic in our lifetime has caused this much disruption
- None of us have ever seen shutdowns of this magnitude before
- Has there been anything this impactful since the Second World War?

Summary: we can't just handle this the way we did last time

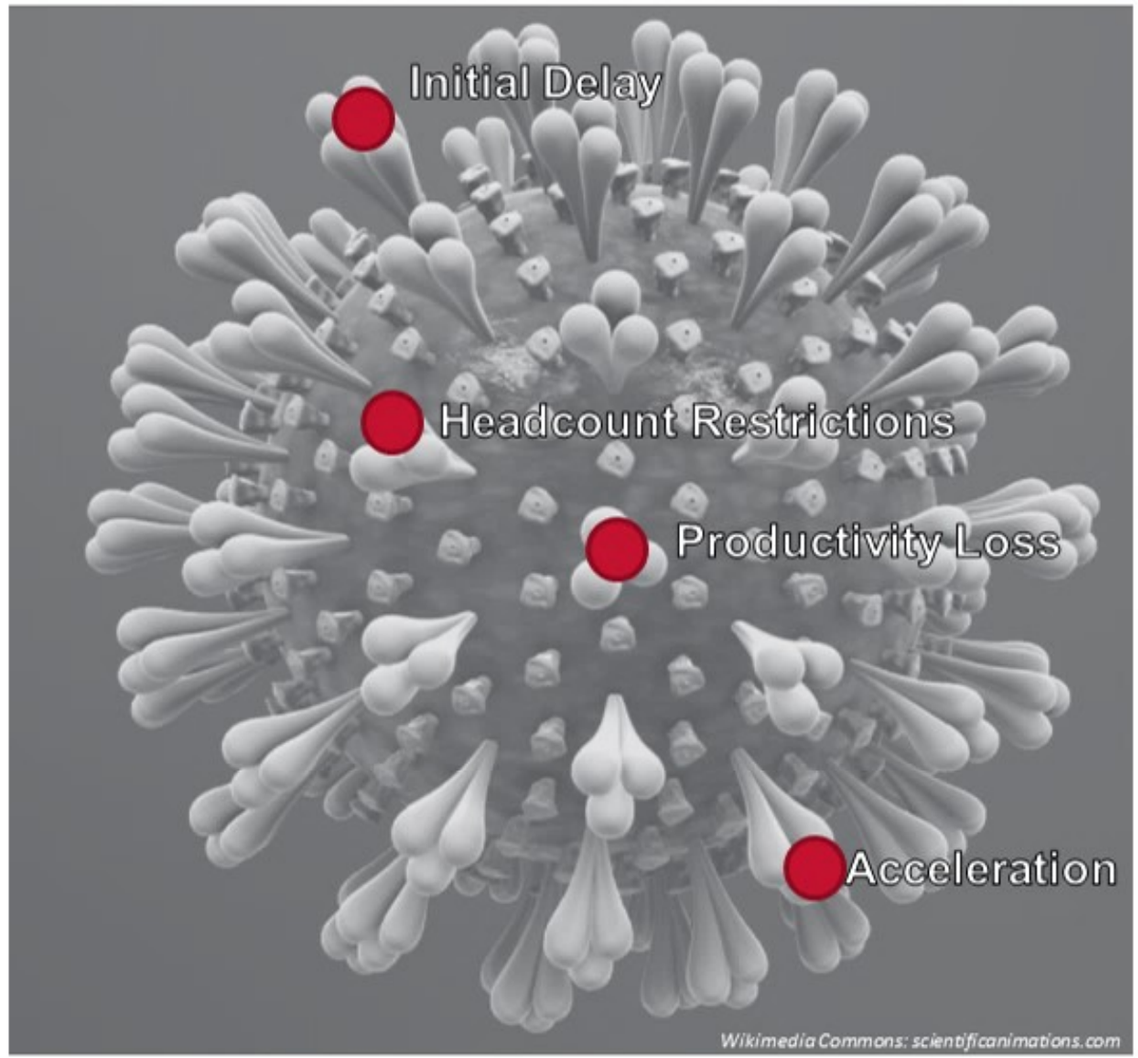
Unique and Historic Events Are Still Events

- We're all familiar with delays and disruptions
- While the pandemic created more external factors than normal, projects have always dealt with external issues
- Define the objectives, establish the road-map
  - Time: Is the goal to quantify delay for time extension? For recovery/acceleration? For a combination?
  - Cost: Is a change order to include cost? Will you need multiple scenarios for a cost/benefit analysis?
  - Entitlement: Is this a force majeure event? What will that mean? Is it a fixed / unit price contract or cost-plus?
- Follow through on your plan, evaluate and adjust

Navigating the Effects

Initial Delay

- Shutdown of one, several, or all operations
- Fabricator Shutdowns
- Delivery/Logistic Delays



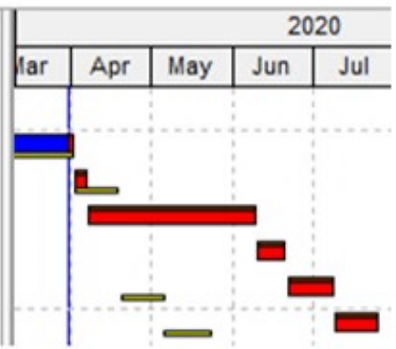
Initial Delay

- Obvious / Intuitive cause & effect
- If you can't work, you can't complete work
- Prospective: additive analysis or calendar modification
- Retrospective: any of the recognized analysis methods

Initial Delay – Prospective - Additive

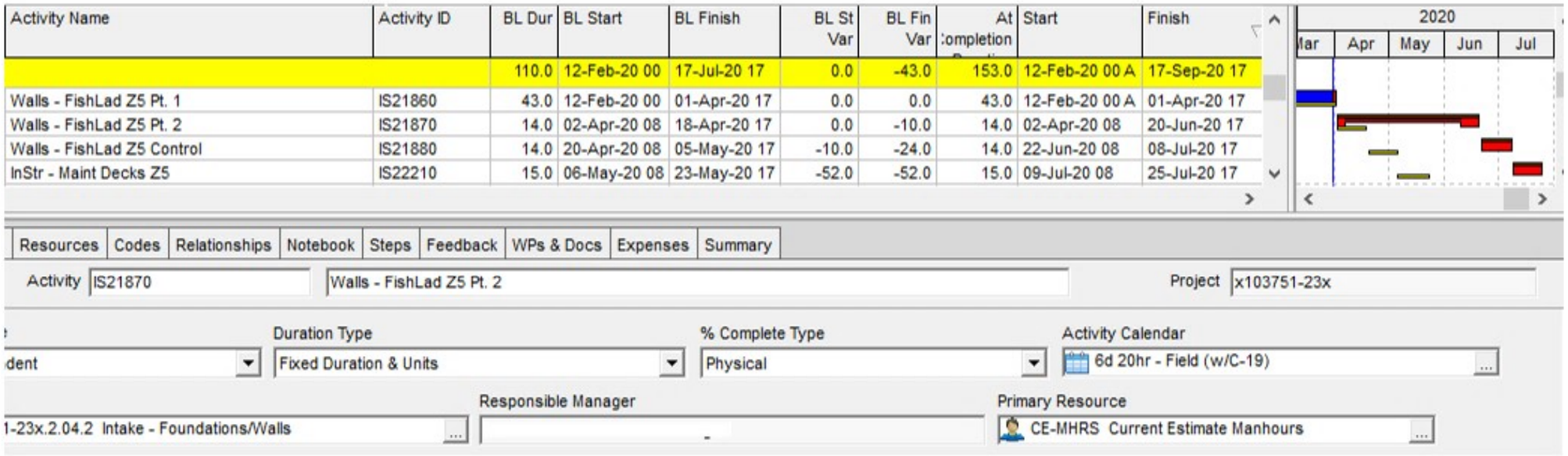
- Clearly defined/understood critical and near critical paths
- Most basic: impact the critical path only to show completion date impacts
- Requires an insertion to every ongoing activity if EV curves / Labor usage graph impacts must be shown (This is a lot of work!)
  - Follow-up Mitigation/Recovery/Acceleration study also requires this step

Activity Name	Activity ID	BL Dur	BL Start	BL Finish	BL St Var	BL Fin Var	At Completion	Start	Finish
		178.0	12-Feb-20 00	16-Oct-20 17	0.0	-45.0	223.0	12-Feb-20 00 A	18-Dec-20 17
Walls - FishLad Z5 Pt. 1	IS21860	43.0	12-Feb-20 00	01-Apr-20 17	0.0	0.0	43.0	12-Feb-20 00 A	01-Apr-20 17
Walls - FishLad Z5 Pt. 2 (PRIOR TO SHUTDOWN)	IS21870	14.0	02-Apr-20 08	18-Apr-20 17	0.0	10.0	4.0	02-Apr-20 08	06-Apr-20 17
Walls - FishLad Z5 Pt. 2 (SHUTDOWN-NO WORK	IS21870_C19	0.0					45.0	07-Apr-20 08	09-Jun-20 17
Walls - FishLad Z5 Pt. 2 (AFTER SHUTDOWN)	IS21870B	0.0					10.0	10-Jun-20 08	20-Jun-20 17
Walls - FishLad Z5 Control	IS21880	14.0	20-Apr-20 08	05-May-20 17	-53.0	-53.0	14.0	22-Jun-20 08	08-Jul-20 17
InStr - Maint Decks Z5	IS22210	15.0	06-May-20 08	23-May-20 17	-52.0	-52.0	15.0	09-Jul-20 08	25-Jul-20 17



Initial Delay – Prospective - Calendar

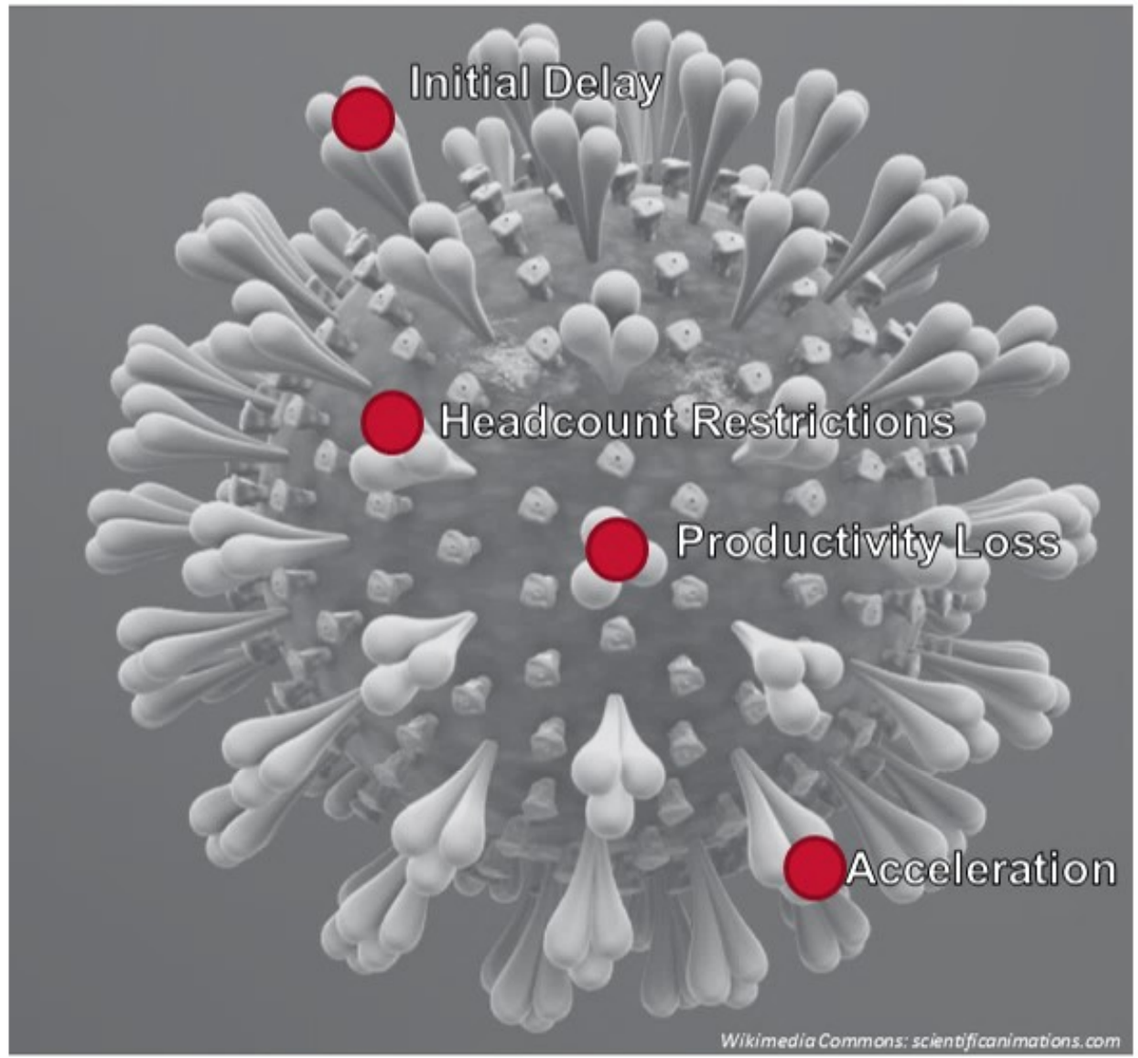
- Easiest to implement
- Shows impact to EV curves / Labor usage
- Critical Path and other logic paths can have an “air gap” if the shutdown doesn’t hit the middle of an activity



Activity Name	Activity ID	BL Dur	BL Start	BL Finish	BL St Var	BL Fin Var	At completion	Start	Finish
		110.0	12-Feb-20 00	17-Jul-20 17	0.0	-43.0	153.0	12-Feb-20 00 A	17-Sep-20 17
Walls - FishLad Z5 Pt. 1	IS21860	43.0	12-Feb-20 00	01-Apr-20 17	0.0	0.0	43.0	12-Feb-20 00 A	01-Apr-20 17
Walls - FishLad Z5 Pt. 2	IS21870	14.0	02-Apr-20 08	18-Apr-20 17	0.0	-10.0	14.0	02-Apr-20 08	20-Jun-20 17
Walls - FishLad Z5 Control	IS21880	14.0	20-Apr-20 08	05-May-20 17	-10.0	-24.0	14.0	22-Jun-20 08	08-Jul-20 17
InStr - Maint Decks Z5	IS22210	15.0	06-May-20 08	23-May-20 17	-52.0	-52.0	15.0	09-Jul-20 08	25-Jul-20 17

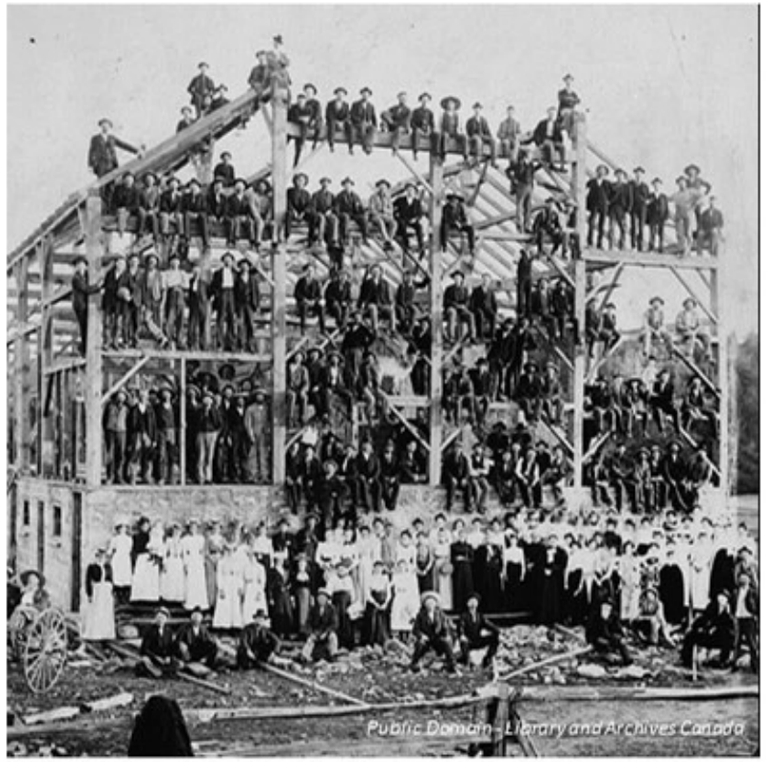
Navigating the Effects

- Headcount Restrictions

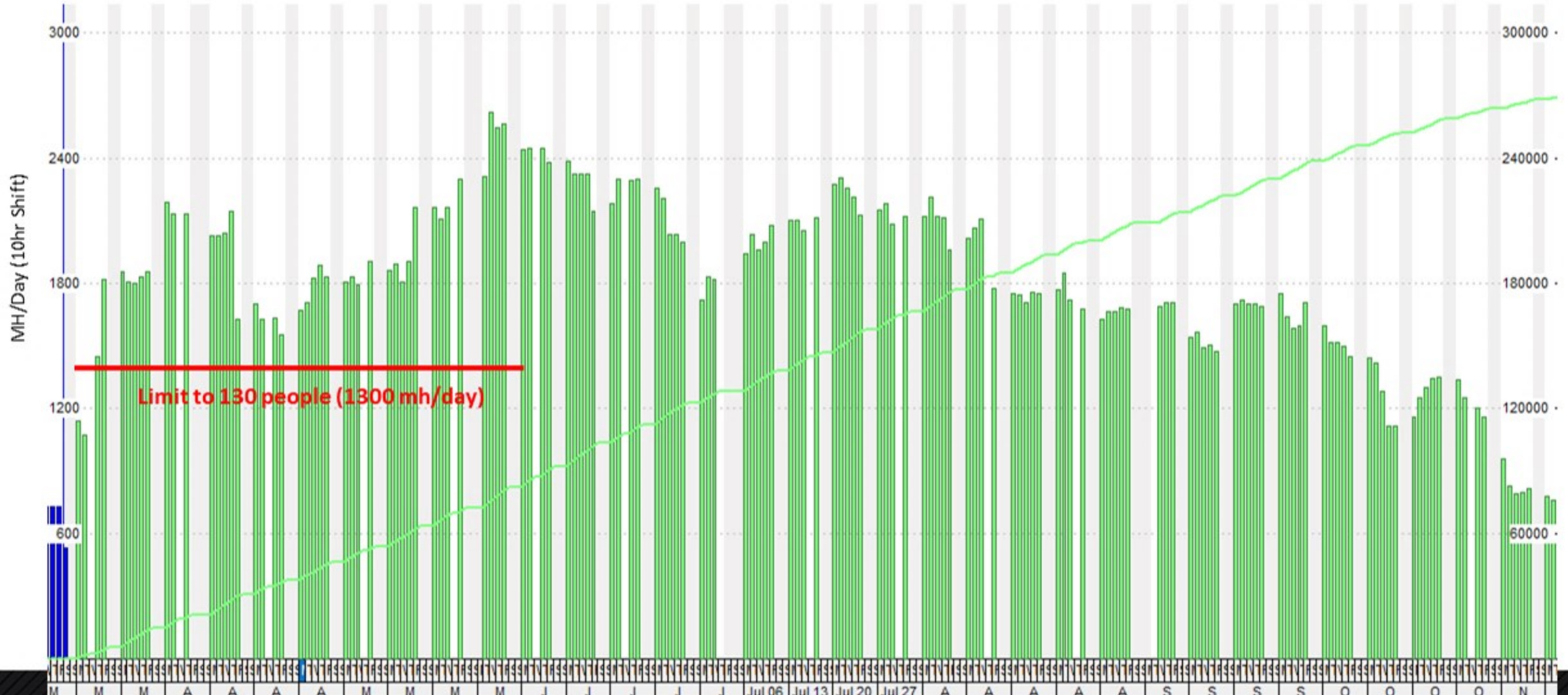


Headcount Restrictions

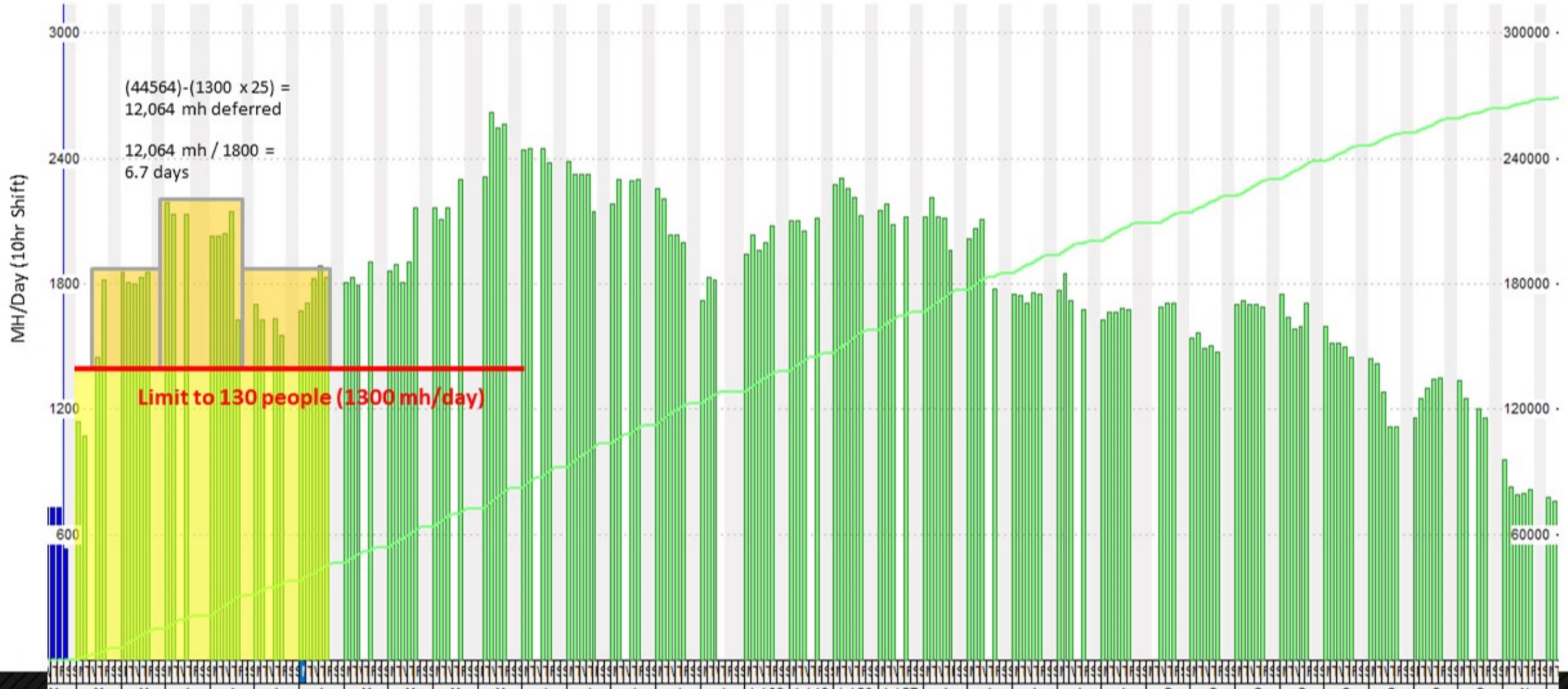
- Obvious / intuitive cause & effect
- “Many hands make the work light”…in reverse
- Less obvious / intuitive to demonstrate in a schedule
  - Prospective: activities aren’t delayed, just slowed
  - Retrospective:
    - How much was due to lower headcount?
    - How much added duration was due to compensable productivity loss?
    - How much added duration was due to the contractor failing to make estimate?



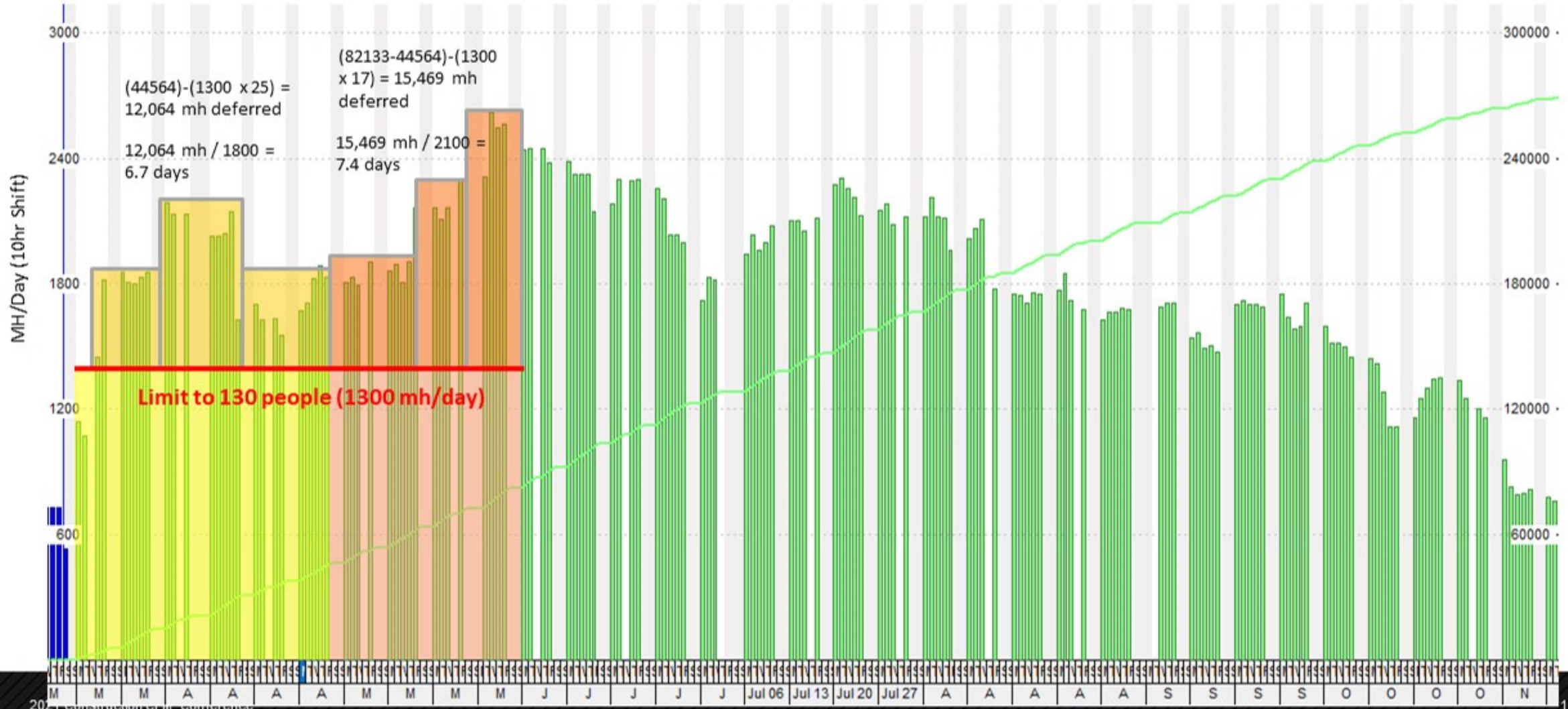
Headcount Restrictions – Preliminary Calculation



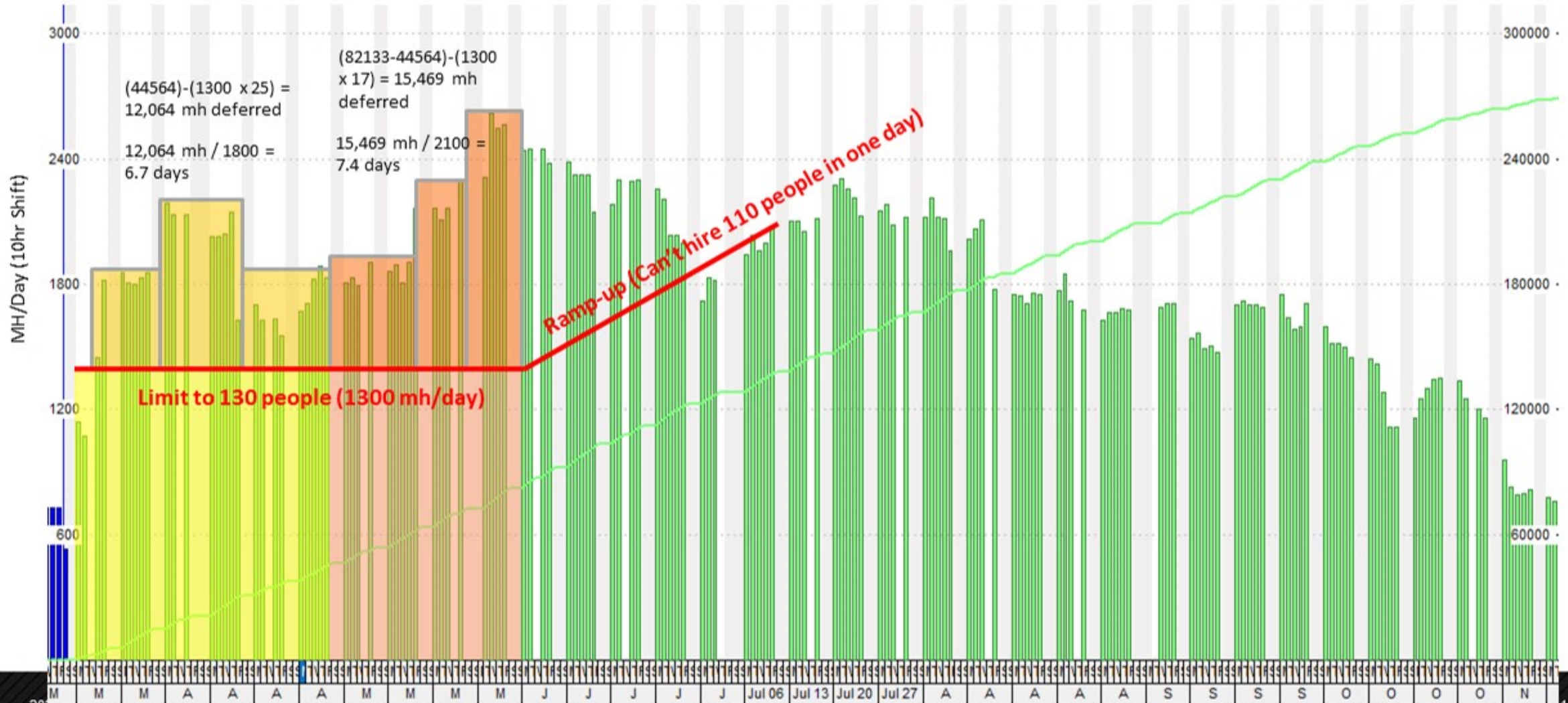
Headcount Restrictions – Preliminary Calculation



Headcount Restrictions – Preliminary Calculation

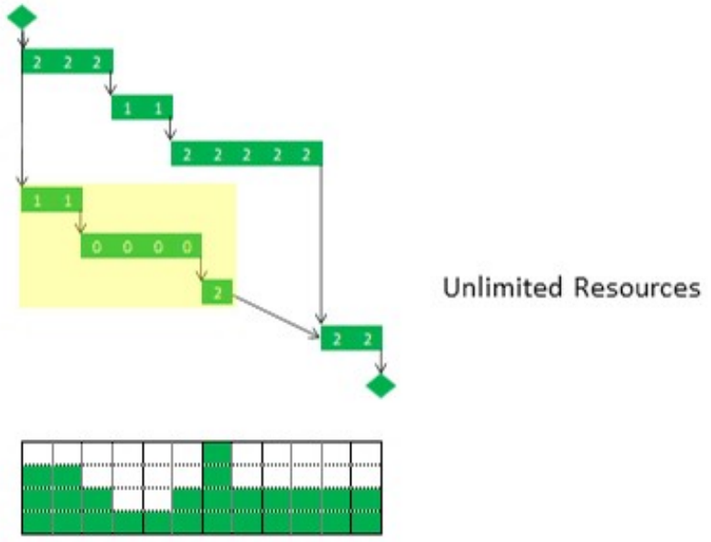


Headcount Restrictions – Preliminary Calculation

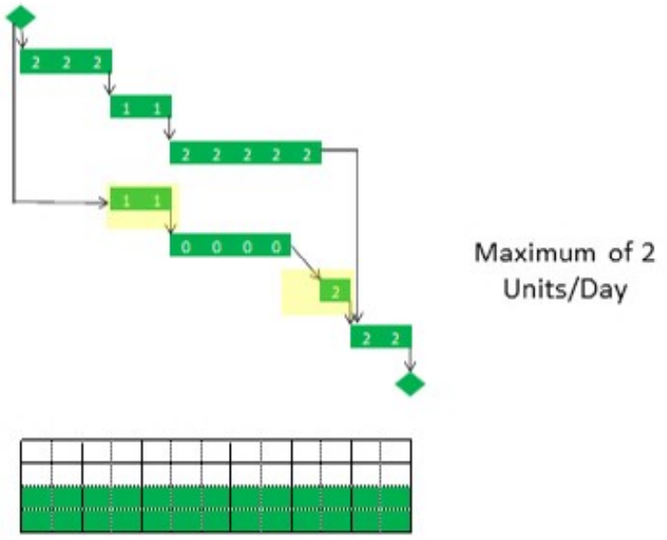


Auto-Leveling to the Rescue

- Only allows activities using the same resource to schedule if that resource is available
- Defers activities needing that resource if none are available
- No consideration of if the deferred activity is “the right one”
- Once auto-leveling establishes proof of concept, project team must make the revised schedule with the most effective sequence



Unlimited Resources



Maximum of 2 Units/Day

Headcount Restrictions – Establishing the Parameters

Scenario A

Covid Restrictions based on Feb 29 Schedule & April MH Reforecast; limit to 75 through 01Jun20

0.8 PF during restriction & ramp up

0.9 PF after-double hiring Mid July to Mid Aug (341k MH remaining)

no restriction after 15Aug20

Full Double Shift

Scenario B

MHs are direct MH only, based on Apr 2020 reforecast plus May Electrical Qtys

Limit 75 through 01Jun20

0.8 PF during restriction & Ramp up

0.9 PF after ramp-up

Hire 17/wk mid June to mid July

Double hiring (34/wk) mid July to Mud August

No headcount restriction after 15Aug20

Selective Double Shifting

Scenario C

MHs are direct MH only, based on Apr 2020 reforecast (292k MH remaining)

Limit 75 through 01Jun20

1.0 PF on all operations

Hire 17/wk Until work force peak (approx 230 craft)

No headcount restriction after 28Aug20

Level at data date
750 mh/day

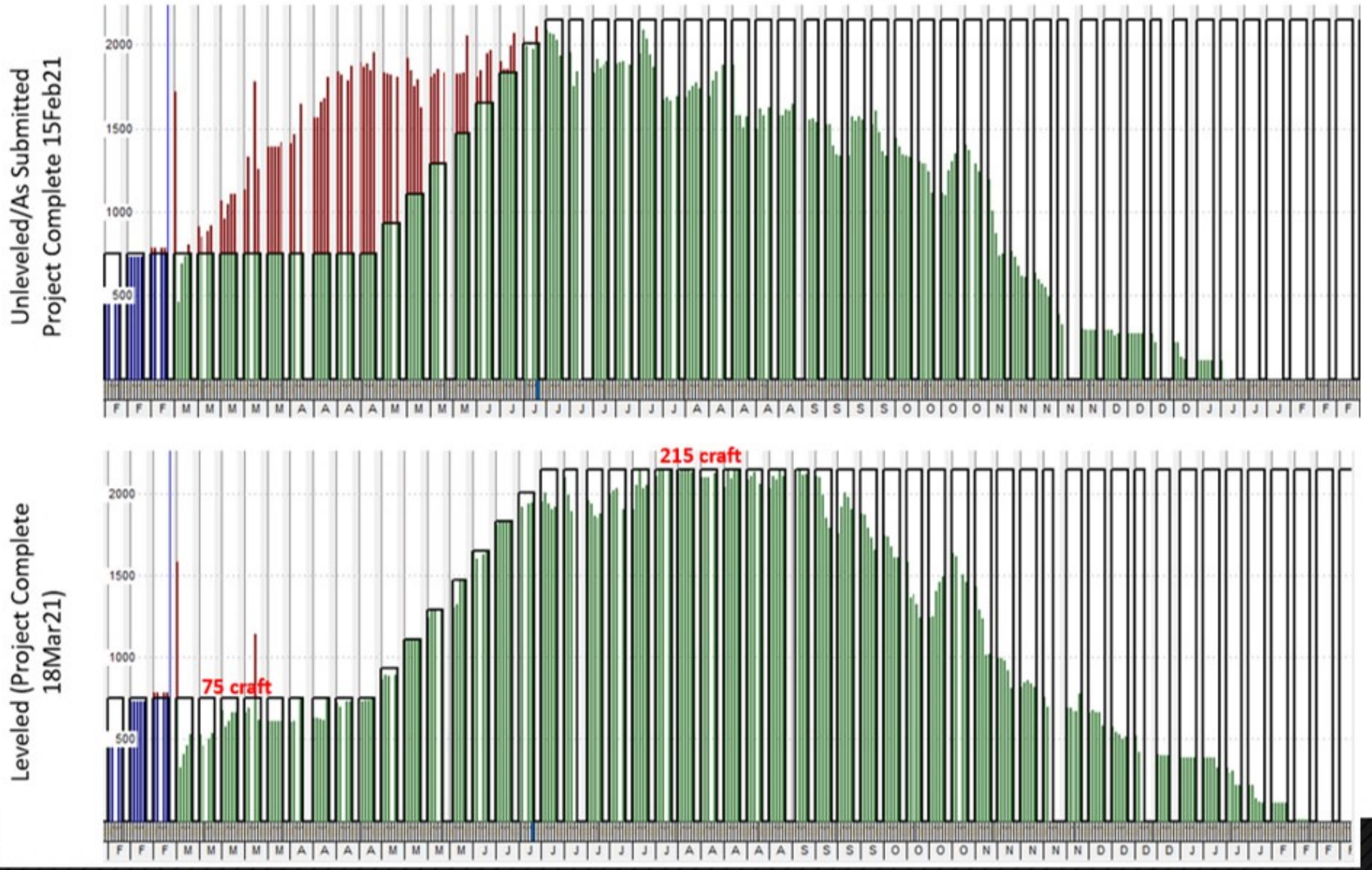
Level at peak
2110 mh/day

delta, 2150 mh/day vs 750 mh/day
1400

8 week ramp up 175 mh/wk round to 180 (1 person = 10mh)

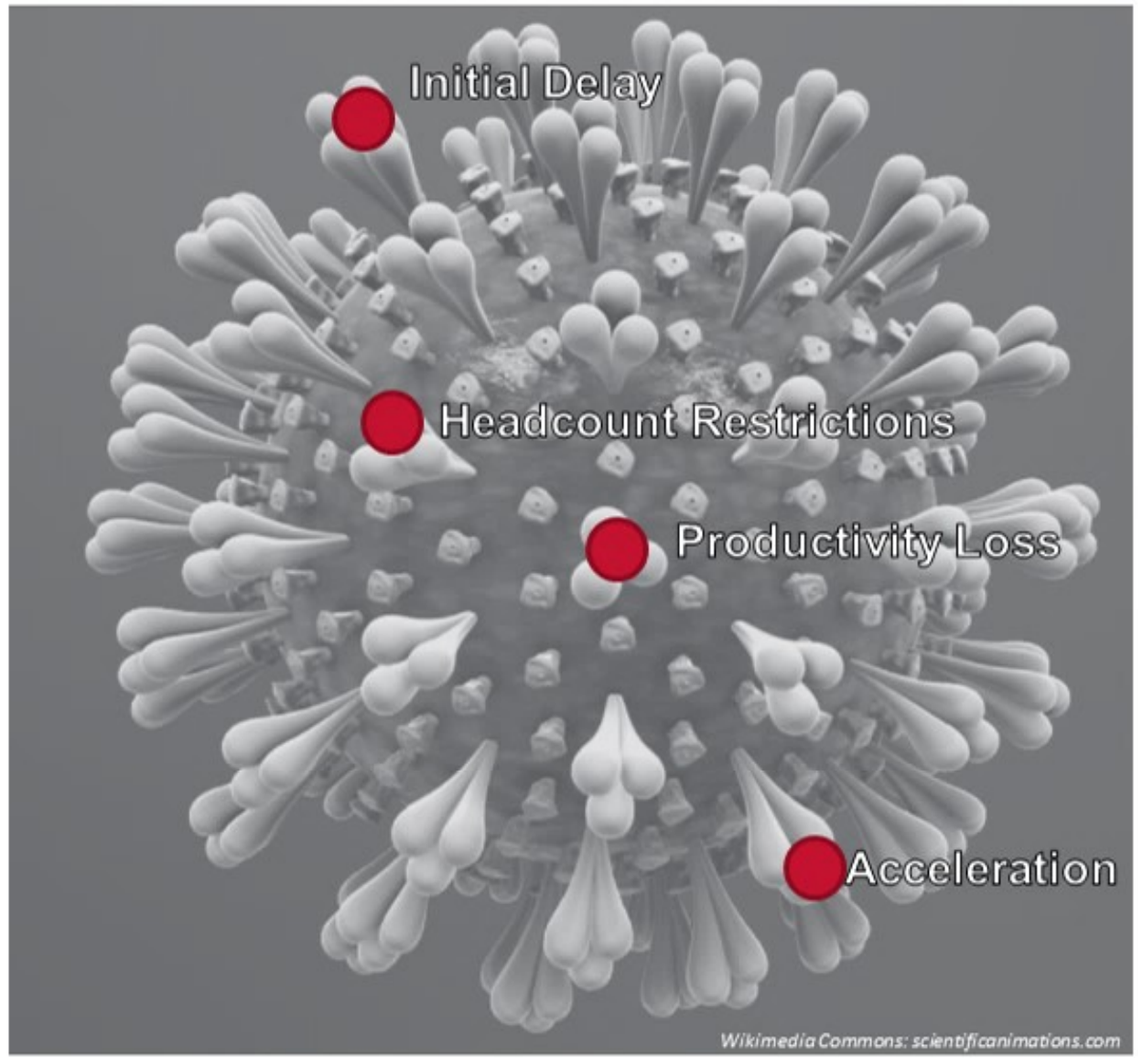
Week Start	Week End	Prior	Add	Headcount
	7-Mar-20	750		750
8-Mar-20	14-Mar-20			750
15-Mar-20	21-Mar-20			750
22-Mar-20	28-Mar-20			750
29-Mar-20	4-Apr-20			750
5-Apr-20	11-Apr-20			750
12-Apr-20	18-Apr-20			750
19-Apr-20	25-Apr-20			750
26-Apr-20	2-May-20			750
3-May-20	9-May-20	750	180	930
10-May-20	16-May-20	930	180	1110
17-May-20	23-May-20	1110	180	1290
24-May-20	30-May-20	1290	180	1470
31-May-20	6-Jun-20	1470	180	1650
7-Jun-20	13-Jun-20	1650	180	1830
14-Jun-20	20-Jun-20	1830	180	2010
21-Jun-20	27-Jun-20	2010	140	2150

Headcount Restrictions – Auto-Leveling Effect



Navigating the Effects

- Productivity Loss



Productivity Loss

- Intuitive, but hard to quantify
- Contractor was never going to match estimate exactly
- Up-front/prospective versus retrospective
- Ideally, establish measured mile productions & costs from before pandemic
- Shutdowns started in March…in cold-weather areas there may not be a measured mile

Productivity Loss

Global Approach

	Factor	% of Loss if Condition				Selected Severity	% Loss	Hrs Lost	Running Total	
		Minor (M)	Average (A)	Severe (S)					100	= Base productivity percentage
1	Stacking of Trades	10%	20%	30%			0	-	100	
2	Morale and Attitude	5%	10%	15%	m	Minor (M)	5	5	105	Pandemic-induced uncertainty and disruption of normal life
3	Reassignment of Manpower	5%	10%	15%			0	-	105	
4	Crew Size Inefficiency	10%	20%	30%			0	-	105	
5	Concurrent Operations	5%	15%	25%			0	-	105	
6	Dilution of Supervision	10%	15%	25%	A	Average (A)	15	15	120	196 M-Day of Supervisory personnel quarantined / work-from-home
7	Learning Curve	5%	15%	30%	A	Average (A)	15	15	135	893 M-Day of craft on quarantine/missing shift
8	Errors and Omissions	1%	3%	6%			0	-	135	
9	Beneficial Occupancy	15%	25%	40%			0	-	135	
10	Joint Occupancy	5%	12%	20%			0	-	135	
11	Site Access	5%	12%	30%	M	Minor (M)	5	5	140	New screening procedures applied to all employees
12	Logistics	10%	25%	50%	M	Minor (M)	10	10	150	Means and methods of employee movement changed
13	Fatigue	8%	10%	12%			0	-	150	
14	Ripple	10%	15%	20%			0	-	150	
15	Overtime	10%	15%	20%			0	-	150	
16	Season & Weather Changes	10%	20%	30%			0	-	150	= Impacted productivity percentage

* Based on MCAA - Bulletin PD 2 (2014 version)

50 = Net Impact Difference

Factor-by-Factor Approach

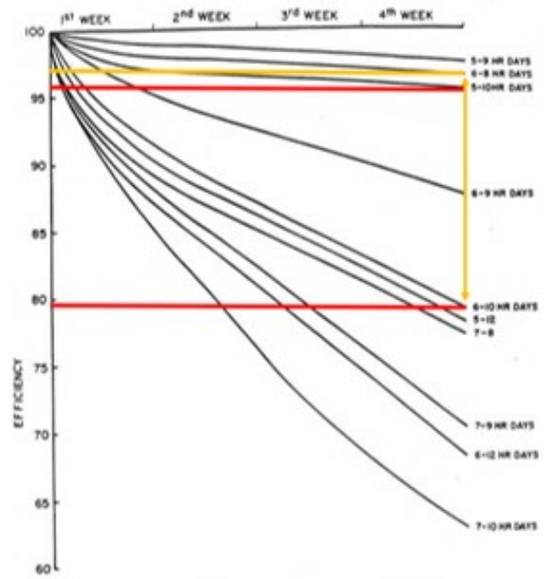


Figure 4-4. Effect of work schedule on efficiency.

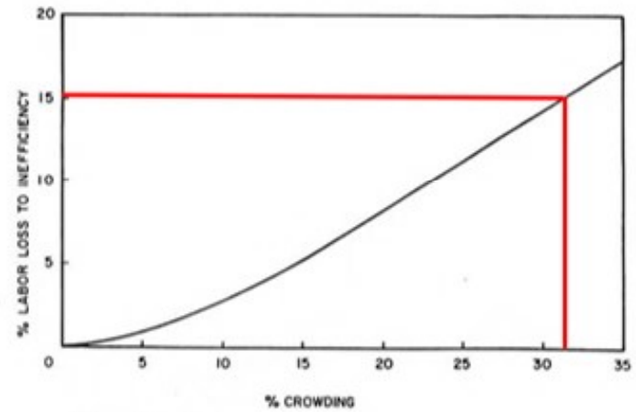


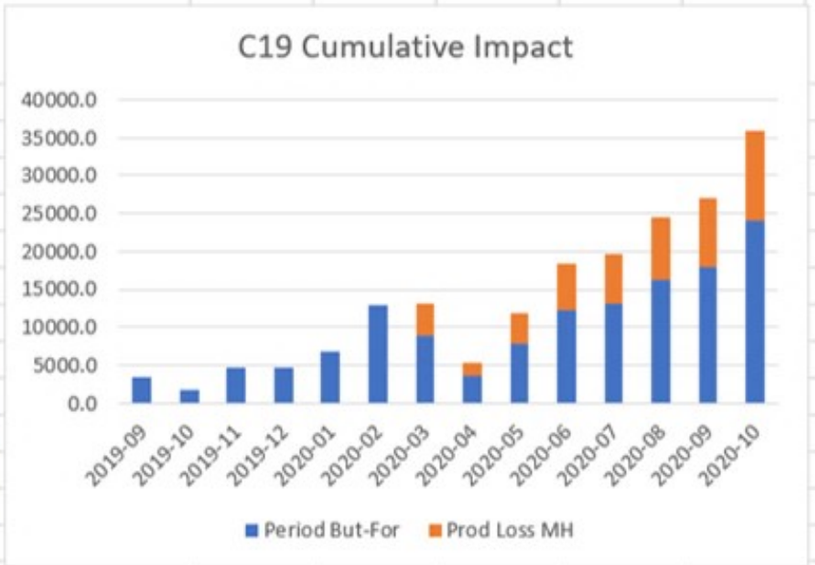
Figure 4-2. Effect of crowding on labor efficiency.

(From Figure 4-2, US Army Corps of Engineers EP-415-1-3, Modification Impact Evaluation Guide)

Productivity Loss

Sanity Check

Month	Period FTE (@10hr/d)	Period Spent (TD-TD)	Period Earned (TD-TD)	Period PF (TD-TD)	JTD PF	JTD G/L		Prod Loss (C19)	Period But-For	But-For PF	Prod Loss MH	
2019-09	338.8	3388	2697	0.796	0.804	-1081			3388.0	0.80	0.0	
2019-10	170.8	1708	2096	1.227	0.904	-693			1708.0	1.23	0.0	
2019-11	465.4	4654	4516	0.970	0.930	-831			4654.0	0.97	0.0	
2019-12	476	4760	3131	0.658	0.852	-2460			4760.0	0.66	0.0	
2020-01	677.5	6775	2502	0.369	0.713	-6733			6775.0	0.37	0.0	
2020-02	1298.5	12985	6200	0.477	0.629	-13518			12985.0	0.48	0.0	
2020-03	1320.3	13203	7786	0.590	0.618	-18935		50%	8802.0	0.88	4401.0	
2020-04	538.7	5387	9210	1.710	0.725	-15112		50%	3591.3	2.56	1795.7	
2020-05	1180.6	11806	8881	0.752	0.730	-18037		50%	7870.7	1.13	3935.3	
2020-06	1832	18320	13425	0.733	0.731	-22932		50%	12213.3	1.10	6106.7	
2020-07	1958	19580	10971	0.560	0.699	-31541		50%	13053.3	0.84	6526.7	
2020-08	2443.3	24433	17904	0.733	0.705	-38070		50%	16288.7	1.10	8144.3	
2020-09	2700.3	27003	21839	0.809	0.723	-43234		50%	18002.0	1.21	9001.0	
2020-10	3597.5	35975	25622	0.712	0.721	-53587		50%	23983.3	1.07	11991.7	
											39910.7	$ 1,596,426.67



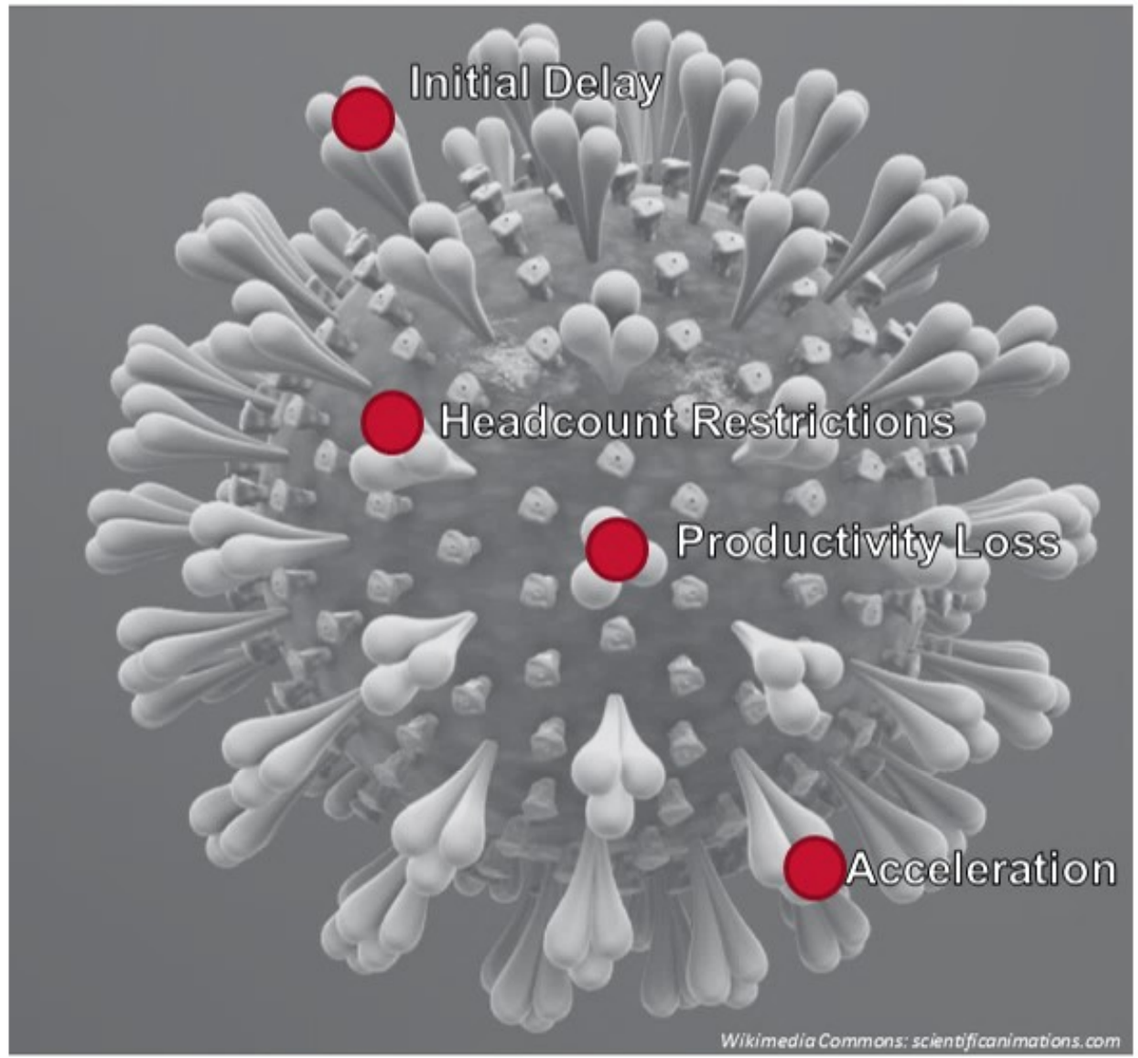
Actual MH Worked

Global Factor Approach

But-For Approach Leaves Estimate Out of Conversation

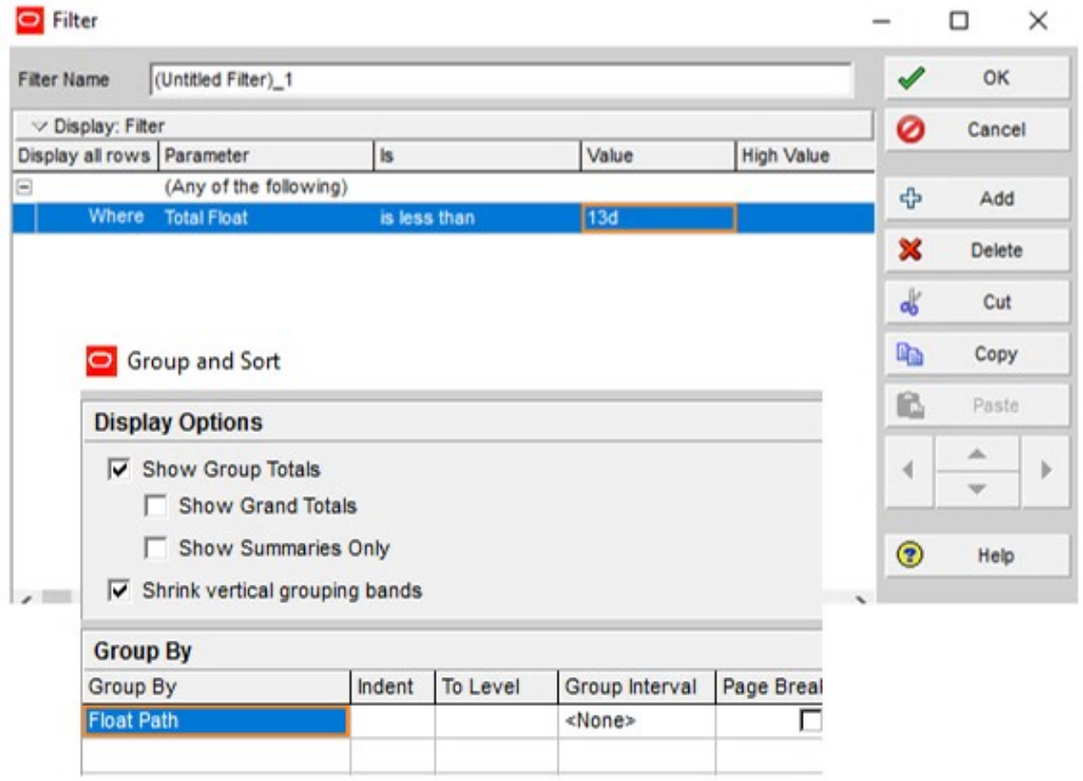
Navigating the Effects

- Acceleration

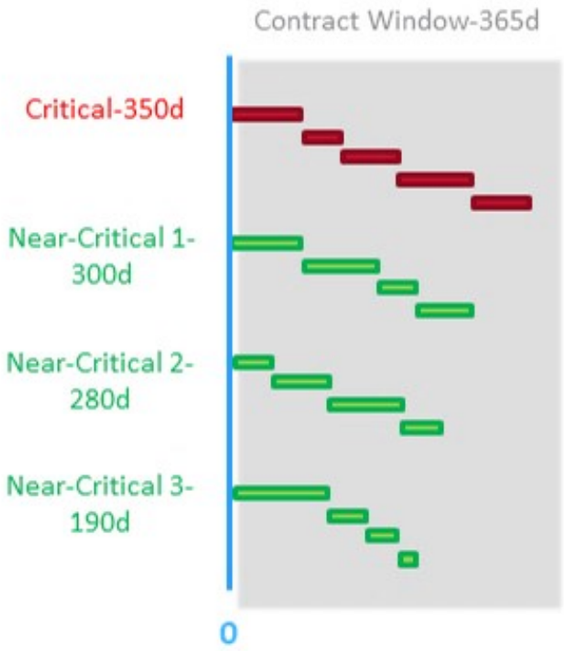


Acceleration - Basic

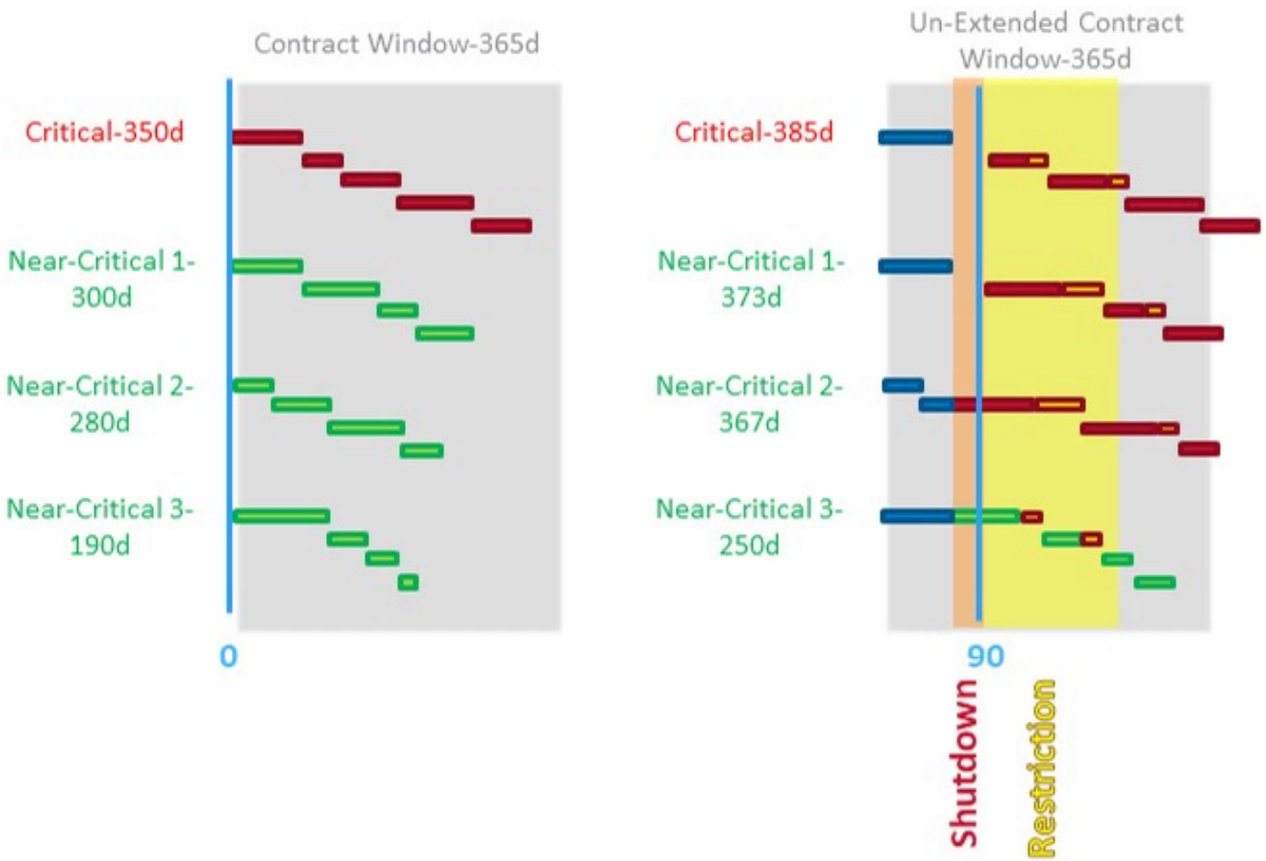
- The *real* accelerated schedule must be an overhaul led by the superintendents / experienced planners
- The ‘can it be done’ study is a matter of isolating logic paths.
- Filter on float value needed to hit the targeted completion date
- Group by float path <turn the feature on if you have it!>
- Isolate the float paths that are ‘too long’
- Shorten the float paths



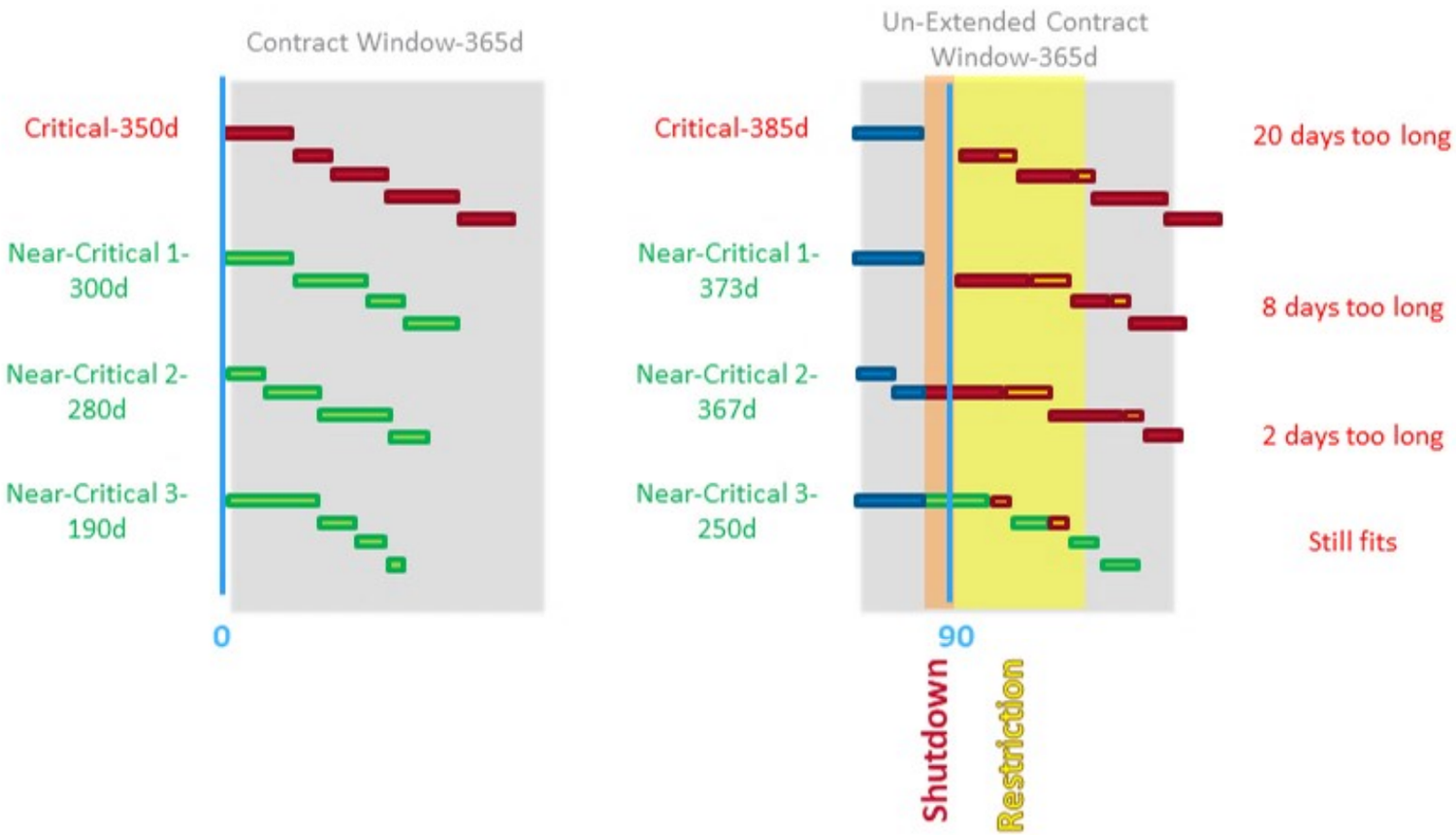
Acceleration - Basic



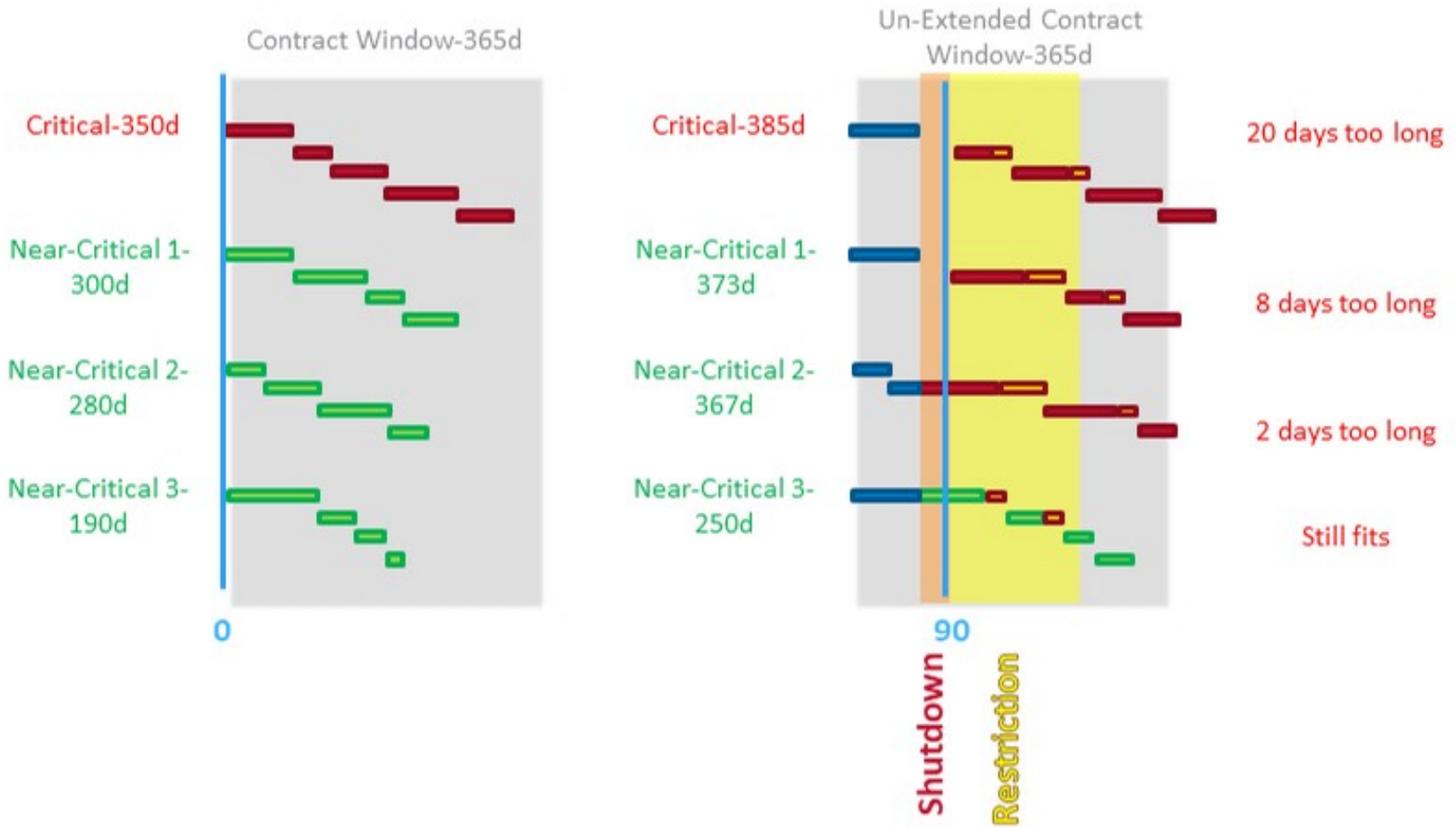
Acceleration - Basic



Acceleration - Basic

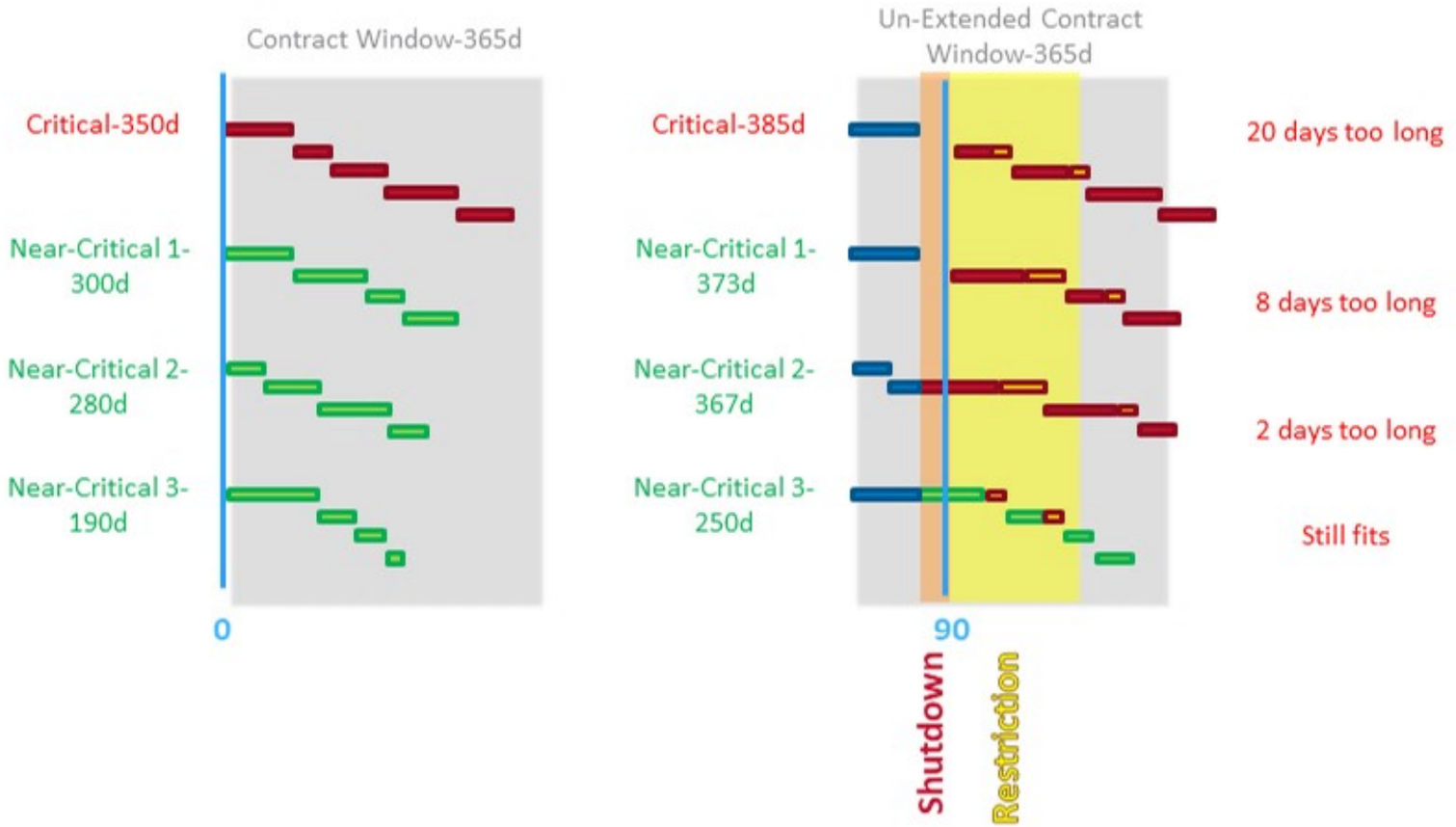


Acceleration - Basic



You have 275 days to compress the extra 20 days.

Acceleration - Basic



You have 275 days to compress the extra 20 days.

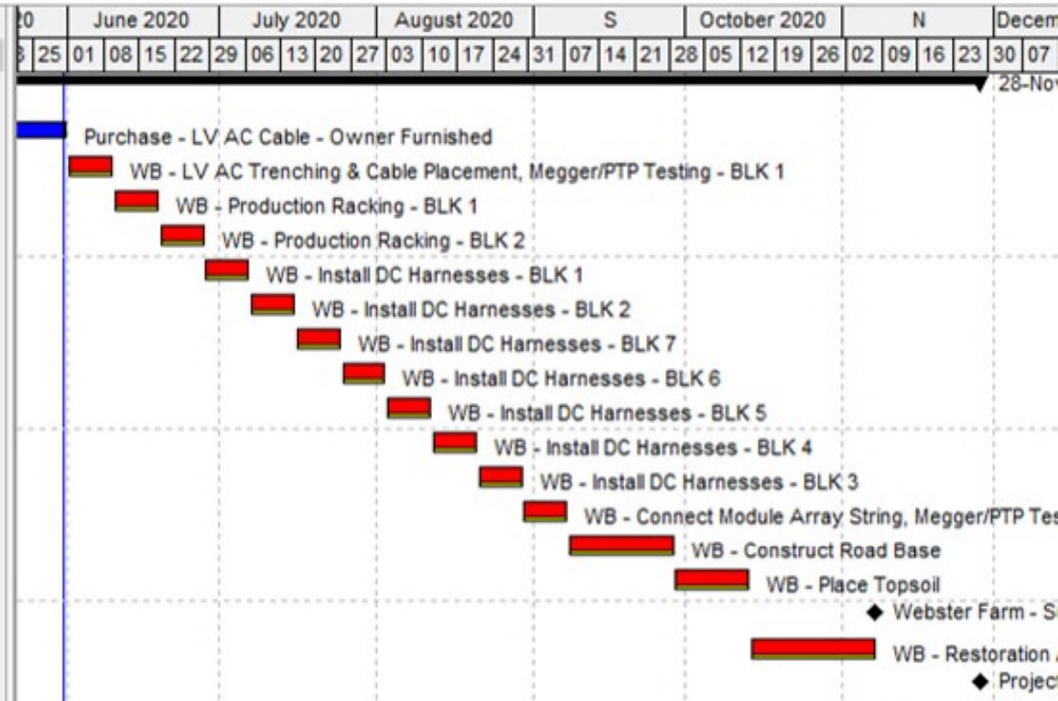
275/255 = 1.08

- 10h day vs 8hr day = 1.25
- 6 craft vs 5 craft = 1.2
- 6d/wk vs 5d/wk = 1.2

Acceleration - Basic

- Path 1: Need to gain 28 days
- 182d remain – 160 are production activities (not punch list or client)
- Could reduce all production activities to 160-28 = 132 days, or 82.5% of current durations

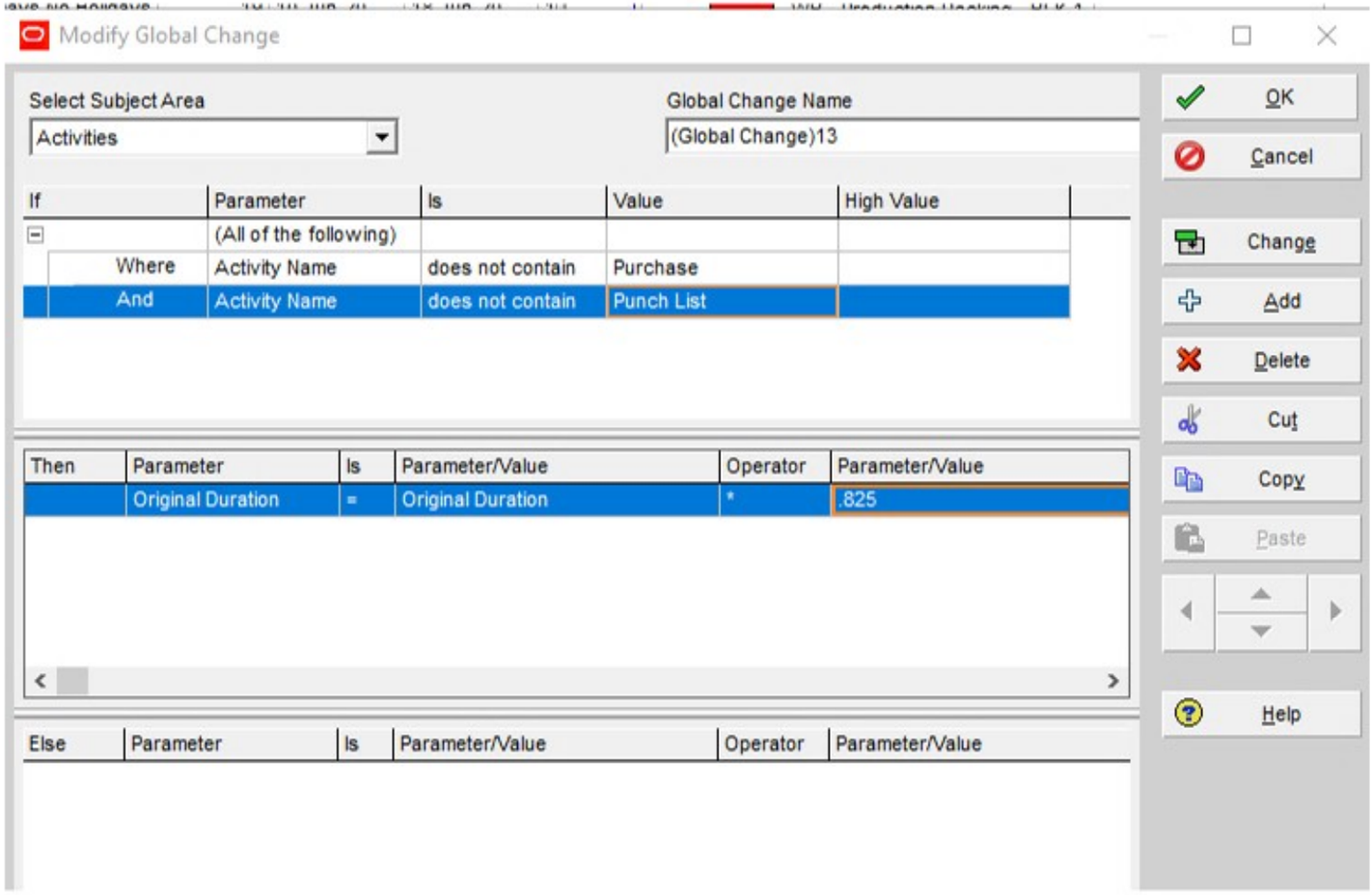
Activity ID	Activity Name	Original Duration	Remaining Duration	Calendar	Total Float	Start	Finish
1		223	182	7 Days No Holidays	-19	24-Apr-20 A	28-Nov-20
PR-DV-230	Purchase - LV AC Cable - (	15	1	7 Days No Holidays	-19	24-Apr-20 A	31-May-20
WB-AC-100	WB - LV AC Trenching & C	9	9	7 Days No Holidays	-19	01-Jun-20	09-Jun-20
WB-RC-100	WB - Production Racking -	9	9	7 Days No Holidays	-19	10-Jun-20	18-Jun-20
WB-RC-110	WB - Production Racking -	9	9	7 Days No Holidays	-19	19-Jun-20	27-Jun-20
WB-DH-100	WB - Install DC Harnesses	9	9	7 Days No Holidays	-19	28-Jun-20	06-Jul-20
WB-DH-110	WB - Install DC Harnesses	9	9	7 Days No Holidays	-19	07-Jul-20	15-Jul-20
WB-DH-160	WB - Install DC Harnesses	9	9	7 Days No Holidays	-19	16-Jul-20	24-Jul-20
WB-DH-150	WB - Install DC Harnesses	9	9	7 Days No Holidays	-19	25-Jul-20	02-Aug-20
WB-DH-140	WB - Install DC Harnesses	9	9	7 Days No Holidays	-19	03-Aug-20	11-Aug-20
WB-DH-130	WB - Install DC Harnesses	9	9	7 Days No Holidays	-19	12-Aug-20	20-Aug-20
WB-DH-120	WB - Install DC Harnesses	9	9	7 Days No Holidays	-19	21-Aug-20	29-Aug-20
WB-WR-120	WB - Connect Module Arra	9	9	7 Days No Holidays	-19	30-Aug-20	07-Sep-20
WB-CV-250	WB - Construct Road Base	21	21	7 Days No Holidays	-19	08-Sep-20	28-Sep-20
WB-CV-240	WB - Place Topsoil	15	15	7 Days No Holidays	-19	29-Sep-20	13-Oct-20
GM-WB-120	Webster Farm - Substantia	0	0	7 Days No Holidays	-19		07-Nov-20
WB-RS-100	WB - Restoration / Seeding	25	25	7 Days No Holidays	-19	14-Oct-20	07-Nov-20
GM-210	Project Final Completion - 1	0	0	7 Days No Holidays	-19		28-Nov-20*
GM-240	Punch List	21	21	7 Days No Holidays	-19	08-Nov-20	28-Nov-20



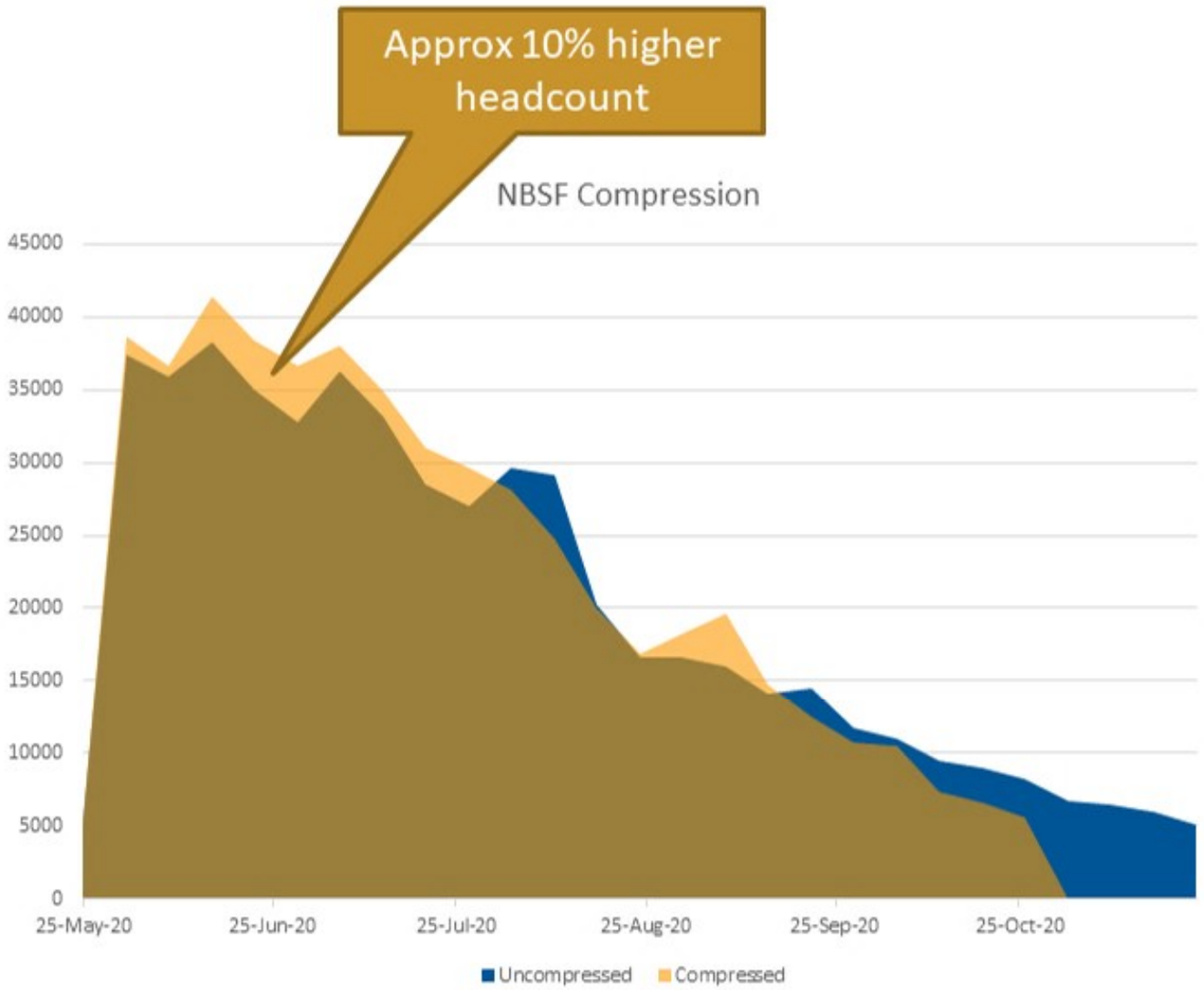
***Make sure Duration Type is Fixed Duration & Units before changing durations!**

Acceleration - Basic

(First filter for Float Path =1)



Acceleration - Basic

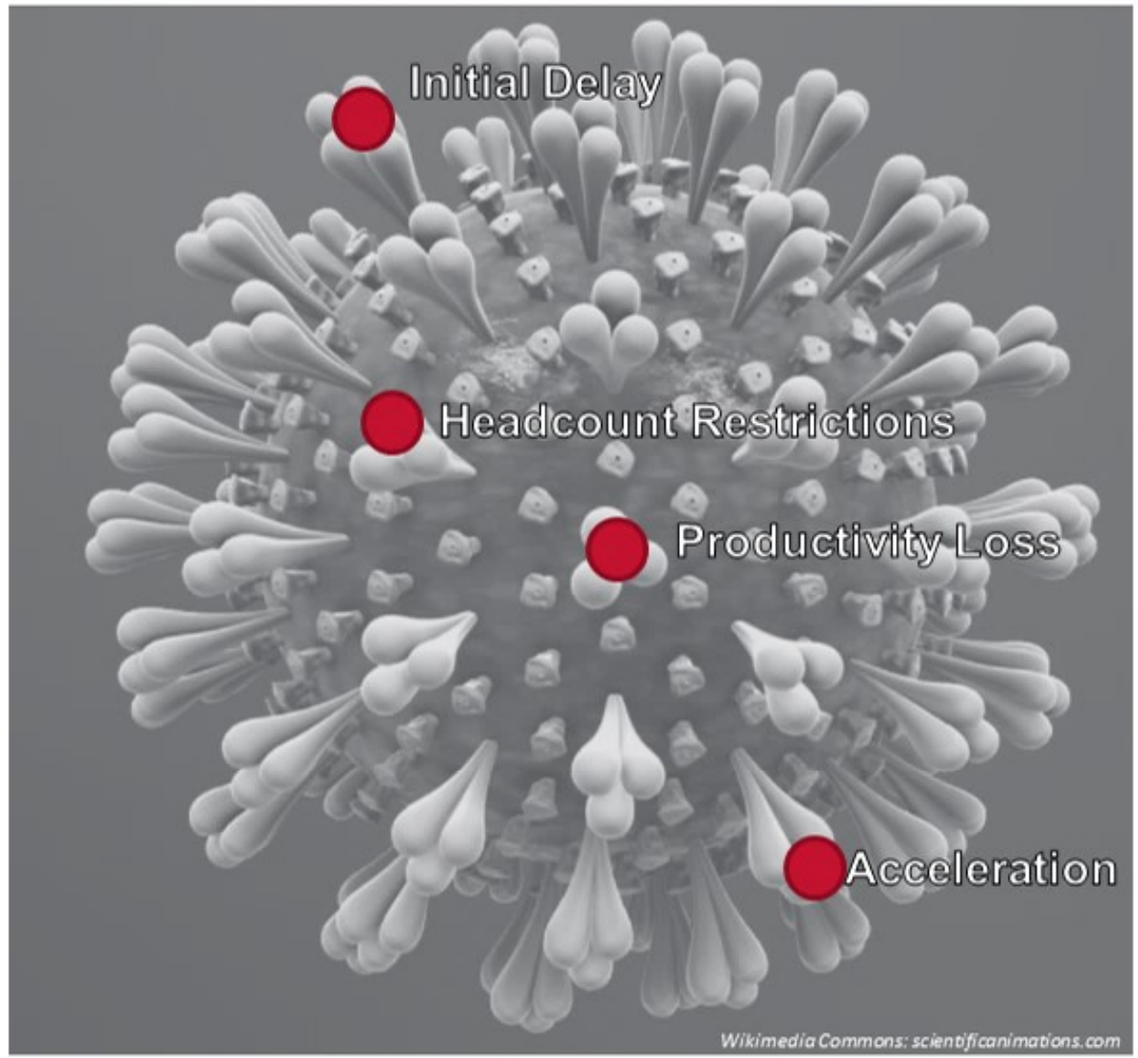


Acceleration – Auto Leveling

- Earlier I talked about how great auto-leveling was
- But with auto-leveling you can't use float paths
- So:
  - Hard-Tie and use float paths
  - Isolate 'critical' resource consumers and work on them

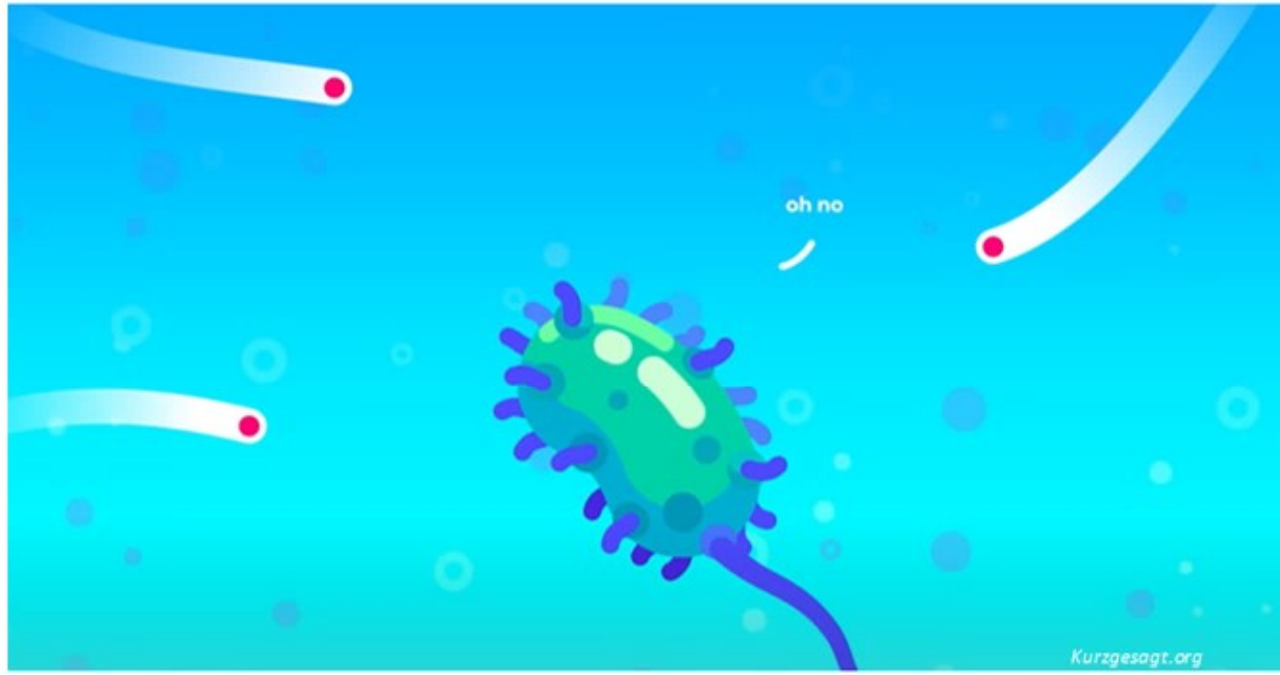
Navigating the Effects

- Summary



Follow-Up Analysis

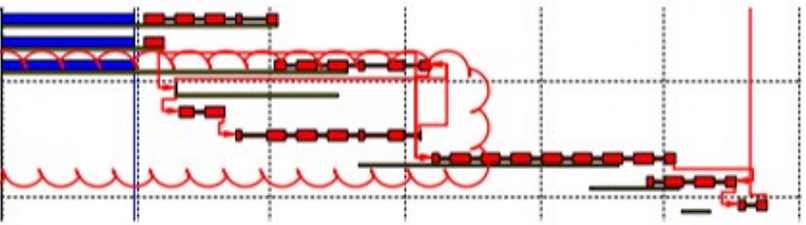
- After that ‘big change order’
- Touch-up work may be required due to later flare-ups



Follow-Up Analysis

- Job has settled into its “New Normal”
- Someone gets a positive test, triggering response
- Individuals or Crews are quarantined

PR.DLV.36	Deliver Cable Tray & Conduit	40	16-Aug-19 A	02-Dec-20	0	16-Aug-19	02-Dec-20	0
C08AQINJX8000000000D	Electrical Install Cable Tray | | Direct	50	24-Aug-20 A	06-Nov-20	0	24-Aug-20	06-Nov-20	0
C09AQINJX8000000000D	Electrical Install Cable Tray | | Direct	20	24-Aug-20 A	06-Jan-21	0	24-Aug-20	18-Dec-20	9
C08AQINJX8000000000D	Electrical Install Cable Tray | | Direct (Original Activity/Pre-Stand Down) (1 of 25 days))	1	09-Nov-20	09-Nov-20	0	09-Nov-20	16-Dec-20	24
C08AQINJX8000000_TI	Electrical Install Cable Tray | | Direct (Covid Stand Down) (9wd/12cd))	9	10-Nov-20	20-Nov-20	0			
C08AQINJX8000000_TI2	Electrical Install Cable Tray | | Direct (Post-Stand Down) (24 of 25 d))	24	23-Nov-20	04-Jan-21	0			
C09AQINJZQHVC000ZAGD	Electrical Install Wires and Cabling | HVC | HVC1.1 Direct	40	07-Jan-21	03-Mar-21	0	21-Dec-20	18-Feb-21	-9
C09AQINJ3YHVC000ZAGD	Electrical Install Terminations | HVC | HVC1.1 Direct	16	25-Feb-21	17-Mar-21	0	12-Feb-21	04-Mar-21	-9
C09AQVDJ3YHVC000ZAGD	Electrical Verification & Documentation Terminations | HVC | HVC1.1 Direct	5	18-Mar-21	24-Mar-21	0	05-Mar-21	11-Mar-21	-9



Follow-Up Analysis

- When has 'the deal' been altered too much?
- Ideally both sides have established this as part of the change order
  - Greater than anticipated positives/quarantines among craft and/or staff
  - Unanticipated further shutdowns
  - Disruption to supply chains
- In the event of a major disruption, a repeat of the initial analysis effort may be necessary

COVID- Supplier informed us on Thursday that the US Embassies in Italy are currently overwhelmed with National Interest Exception (NIE) requests…these are the waivers that allow the Italians to come to site without any quarantine requirement. We are unsure how many (if any) more NIE Supplier will be granted. We are working with Client and Supplier discussing options including utilizing North American techs from Supplier, MegaCorp(Supplier's parent company), Client and others. We will also come up with a plan for bringing the Italians to site via quarantine in Mexico or elsewhere…the impact from this could exceed $500K depending on the number of techs we are required to quarantine.

Summary

Deal with up-front delay or shutdown first

Evaluate impact of headcount restrictions / post-shutdown ramp-ups

Evaluate possible productivity losses

Establish limits to scope of up-front analysis

Adjust as new problems come to light