Managing Productivity on
Mega Projects

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Introduction to Fluor

- **A global,** publicly traded **professional and technical solutions** provider
- **Designs and builds** well-executed, capital-efficient facilities for clients on six continents
- **110-year heritage providing solutions** for clients through our Energy Solutions, Urban Solutions, and Mission Solutions business groups
- **Global execution platform** serving clients in over **60** countries
- **#196** on the 2021 **FORTUNE® 500** list
- **41,000** employees executing projects globally

Project Introduction

LNG Canada Project 85% Complete overall, on track to shipping our first cargos by mid-decade.

https://www.youtube.com/watch?v=HMQemS2k1gc

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Agenda

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2. Definition
3. Cost of Poor Productivity
4. Typical Productivity Curve
5. Elements of Poor Productivity
6. Project Status & Trend
7. Case Study Outcomes
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    II. Measurement and Reporting
    III. Organization & Accountability
    IV. Coaching & Training
    V. Communication & Team-work
8. Current Trend
9. Take-Aways
10. Open Discussion

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Background

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Background

- Productivity issues are quite common in construction industry
- Reasons vary based on project type and location and issues on the project - from aggressive / inaccurate estimate to craft / supervision skills or experience, weather, site set-up, density, interface issues, work fronts, lack of management focus, etc
- Mega projects can have site jobhours ranging anywhere from 10 million upwards.
- A 5% productivity hit will cost 0.5 million additional hours which can translate from $50 to $150 million USD in cost.
- While a better productivity by 5% can result in adding the same amount to the bottom line.
- Project in discussion started to experience deterioration in productivity at ~60% construction completion.

Definition

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Definition

- Productivity Factor = Spent Hours / Earned Hours (AACE definition)
- Or Actual Rate of Placement (RoP)/ Budget RoP

Example : Steel installation data–

- Budget Rate of Placement (RoP) = 60 hrs/T
- Earned quantity for a week = 100 T, Spent hours for the week = 5,000 hrs
- Earned hours = 100xRoP(60) = 6,000 hrs
- Spent hours = 5,000 hrs → Actual RoP = 5,000/100 = 50 hrs/T
- PF = 5,000/6,000 (or 50/60) = 0.83
- Or 83% of budget spent →17% saved
- If PF = 1.1 → 110% of budget spent → 10% over-spent

Cost of Poor Productivity

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Cost of Poor Productivity

- Assume Total direct hours = 10 million
- Hourly rate = $100/hr USD
- Productivity Factor (PF) = 1.1 or 10% over run of hours
- Additional hours spent = 10x0.1 = 1 million hours (Budget hours x PF)
- Additional Cost = 1X100 = 100 million USD (Additional hours x Hourly rate)

- PF = 0.8 or 20% under run on hours
- Hours saved = 10x0.2 = 2 million hours
- Cost under run = 2X100 = 200 million USD
- Potential addition to bottom line

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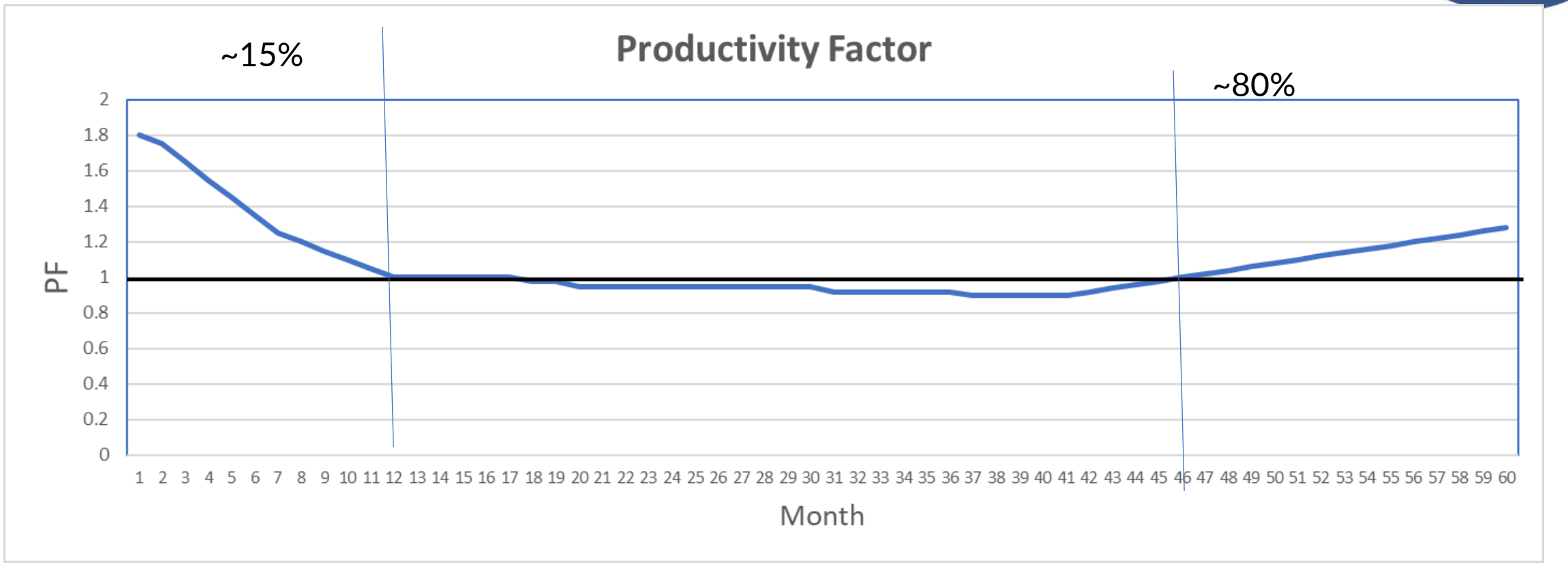
Typical Productivity Profile

Bathtub Curve:



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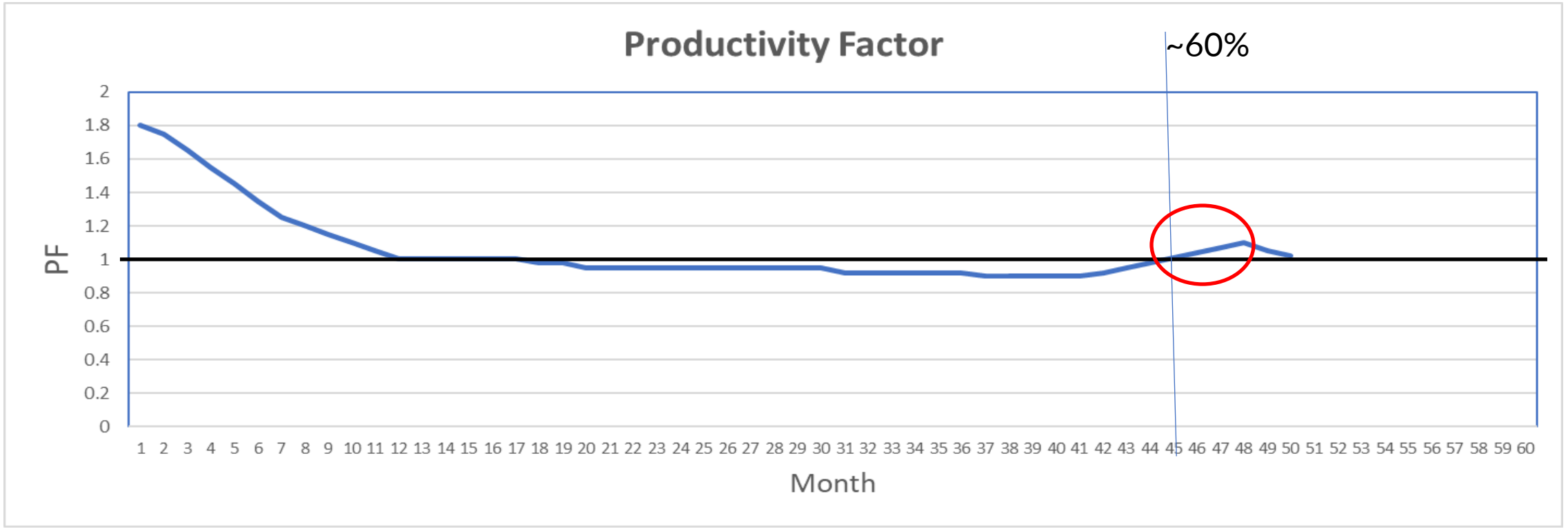
Actual Productivity Profile

Actual Trend :



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Elements of Poor Productivity

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Common Elements Poor Productivity

1. Poor Planning
2. Design changes
3. Loss of continuity
4. Change to the scope of work
5. Schedule acceleration
6. Differing site conditions
7. Adverse weather conditions
8. Fatigue or excessive overtime
9. Reorientation of staff
10. Interference by owner
11. Obsolete plans and specifications

11. Trade stacking and concurrent operations
12. Restricted access
13. Unforeseen conditions
14. Delivery delays of material & equipment; 15. Ripple impact changes
16. Work performed out-of-sequence resulting in reassignment and/or remobilization of labor
17. Multiple changes
18. Dilution of supervision
19. Site set-up
20. Communication

Project Status and Trend

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Project Status & Trend

- Project overall >70% complete
- Construction >60% complete
- UG & Civil substantially complete
- AG Work in full swing
- As project manpower approached to peak, productivity took a hit.
- The trend continued for several weeks, leading to an approximately 3% deterioration.
- This prompted attention from management
- A task force was set up to identify and address the issue.
- Task force conducted study over 4+ week period and identified several basic but important elements to address the productivity.

The Case Study

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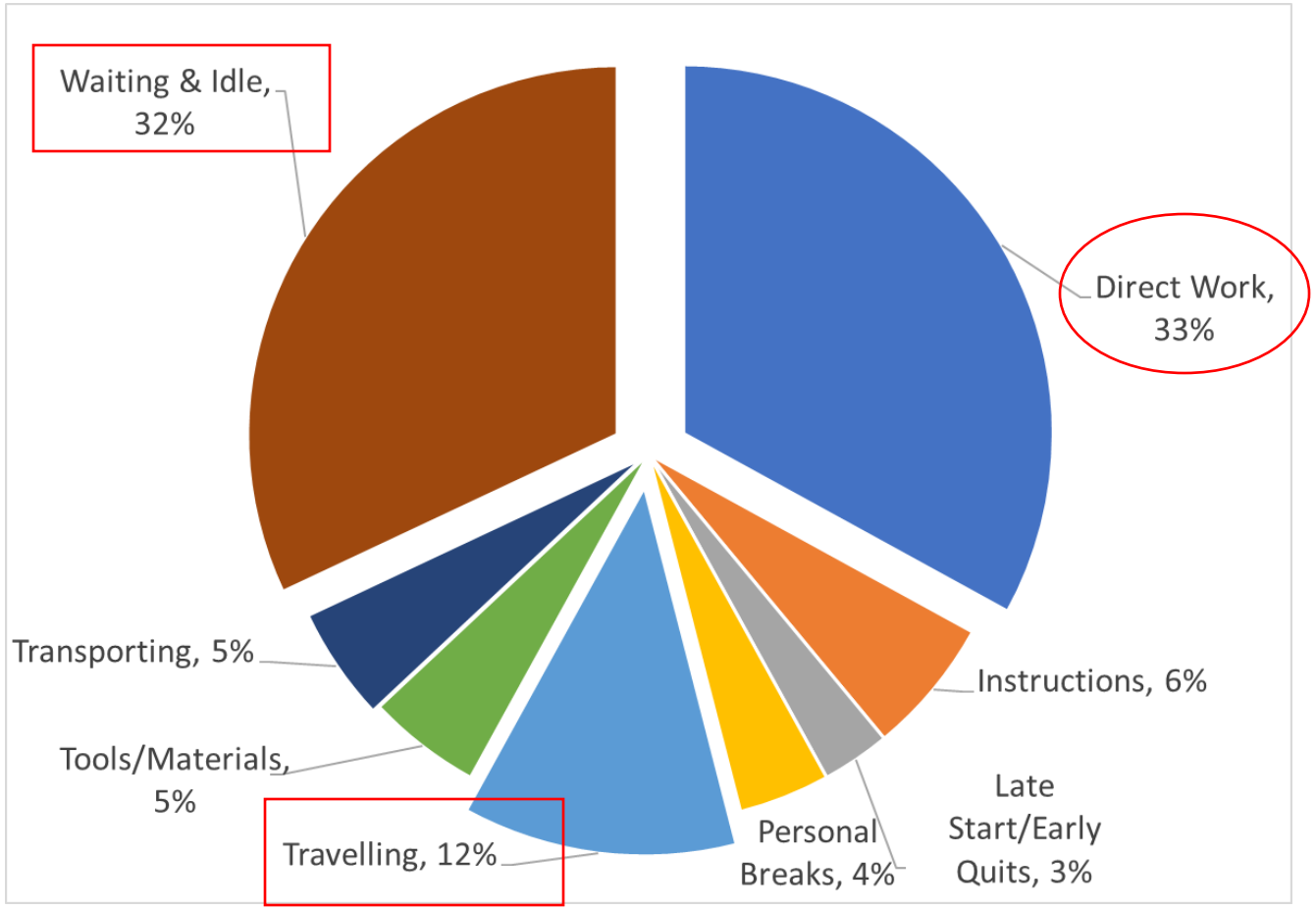
Case Study Observation

- Only ~33% of a typical construction day is productive time



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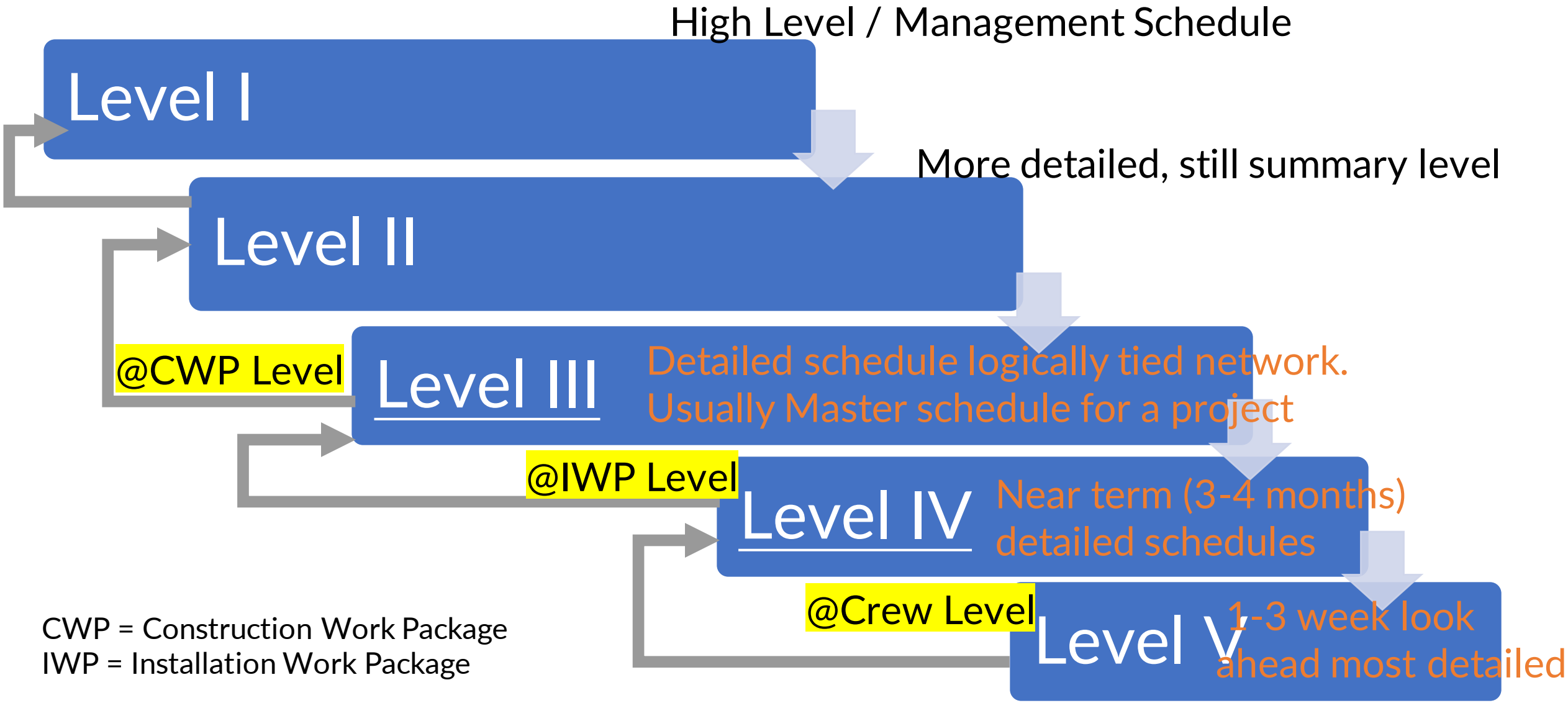
Case Study Outcomes

- After 4 weeks study, following immediate actions implemented:

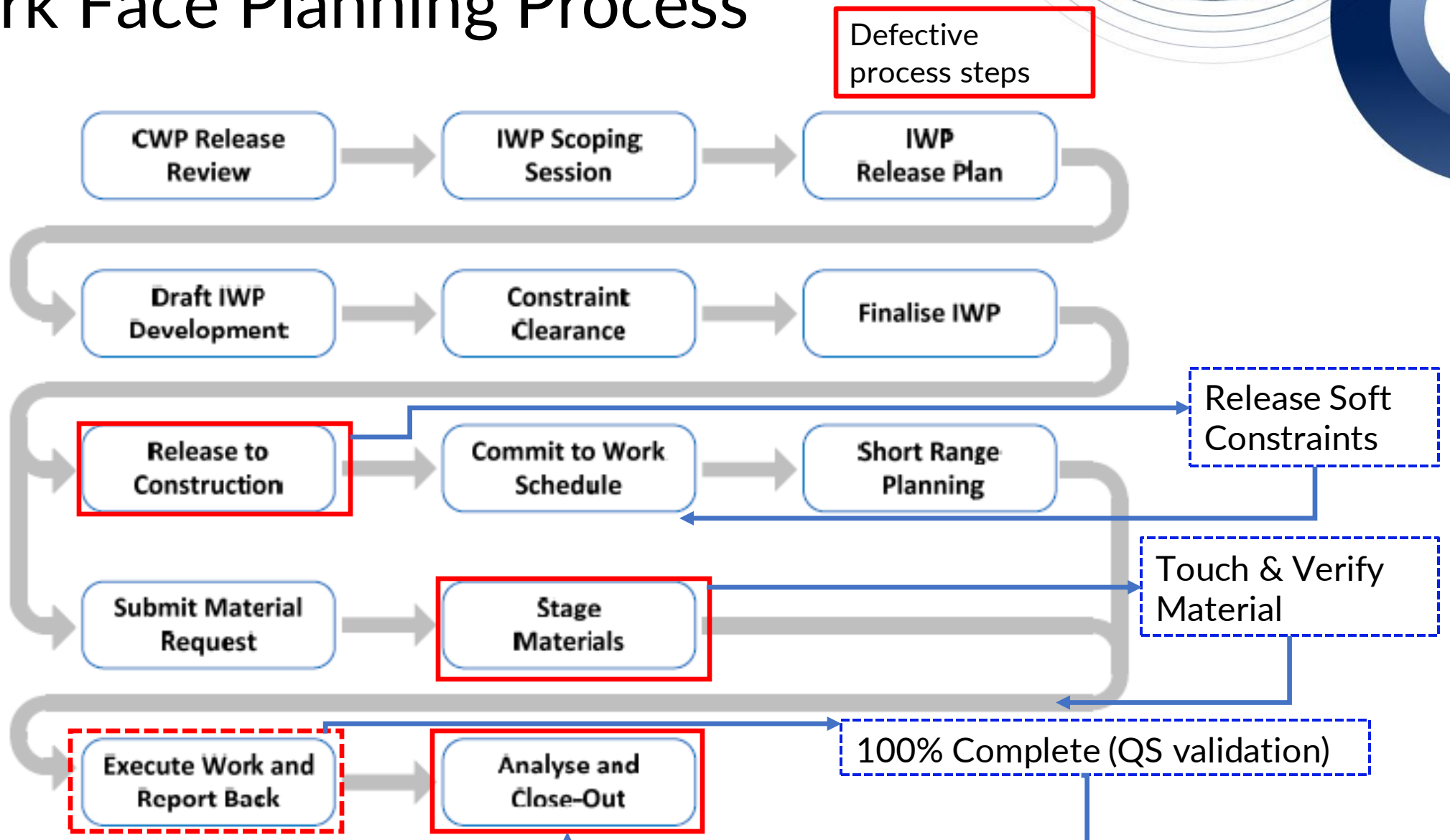
1. Improve Work Face Planning ~20%
2. Pro-active Measurement and Reporting ~5%
3. Level of Supervision in Field ~5%
4. Enforce Buy-in and Accountability ~5%
5. Periodic Competency Review ~3%
6. Coaching & Training ~5%
7. Communication & Team-work ~2%
8. Other Elements ~5%

Work Face Planning – Schedule Data Flow



CWP = Construction Work Package
IWP = Installation Work Package

Work Face Planning Process



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Process Defect Correction

- Added 3 corrective steps to remove process defects.

1. Removing Soft Constraints (~10%)
    - Manpower - Package scheduled without manpower plan impacting schedule. New process step ensured that manpower sourcing / re-assignment before committing to schedule
    - Equipment – At times, equipment were not available when the execution of IWP needed. Equipment availability was committed with equipment team prior to scheduling IWP
    - Scaffolding – Scaffold was bottleneck for most of the packages and either delayed start/completion or caused wait times. Prior to scheduling in near term plan, scaffold build was prioritized and commitment taken from the scaffolding team prior to starting the package.

Process Defect Correction

2. Touch and Verify Issued Material (~5%)
   - Material issue request submitted but not issued prior to start of execution of packages.
   - Found shortage of manpower in warehouse and addressed
   - Ensured work face planner touches and verifies material prior to scheduling in 3 week look ahead.

3. Validation of Completion (~5%)
   - Due to delay in inspection by field engineering, crews moved to next IWP without completing 100% of the IWP.
   - At times, scaffold was removed and had to be re-built.
   - Inspector shortage was addressed.
   - QS assigned to ensure work was complete and progress claimed prior to crew demobing.
   - Scaffold dismantling request routed thru the work face planner assigned to the work package (IWP). This ensure scaffold is not dismantled prematurely.

Progress Measurement and Reporting

~5%

Reporting Element	Previously	Current
Earned quantities / progress reporting by PC	Weekly	Daily
Progress reporting by PC	@CWP Level (by area by prime)	@IWP level (IWP's identified in progress system)
Communication	Plans issued electronically	Also displayed in war rooms
Progress submission from crews	Manually (hard copies)	Electronic (tablets)
Actual hour charging from crews	Incorrectly on tablets	Correctly on tablets (conducted training sessions)

Supervision Level in Field

~5%

Supervision Element	Previously	Current
Time in the field	~20% Most of the time in administrative works	~80% -Provided administrative support -Removed defects in admin processes
Supervision to craft ratio	Standard ratio for similar jobs	Increased to account for skill / experience gaps in craft
Sourcing	Local	International

Buy-In and Accountability

~5%

Accountability Element	Previously	Current
Schedule dates and progress targets	Management / project controls responsibility	Scope owners/Leads responsible for schedule and progress
3 Week Look Ahead	Prepared by work face planners	Prepared by work face planners with foremen and general foremen, alongwith scope owner
Weekly / Monthly updates	Completed by PC and Issued to team	Completed by PC, signed off by scope owners and Issued to team
Roles & responsibilities	Aware but not in written	Provided in writing
Recognition / Consequences	Rarely recognized, no feedback or consequences	Often recognized, provided feedback for missing targets

Competency Reviews

~3%

Competency Element	Previously	Current
Skill Assessment	At the time of recruitment	Post recruitment, prior to assigning to each (phase) of the job
Performance Review & Feedback	Annual	Monthly for new employees Quarterly/as needed for long term employees
Review Action	Rare or none	Promote performing employees Replace, if needed, the ones with no improvement upon feedback
Career Plans	Rare or none	Develop career development plans for consistently performing employees

Coaching & Training

~5%

Coaching Element	Previously	Current
Trade skills	At the time of hiring, if needed	Prior to assigning to new phase / type of work , as needed
Supervisory skills	None	Introduced for all supervisors with a focus on soft skills
Progress reporting	At the time of hiring (part of orientation)	Monthly refresher to all working level employees
Time charging	At the time of hiring (part of orientation)	Monthly refresher to all working level employees

Communication and Teamwork

~2%

Communication Element	Previously	Current
Working level structure	Siloed among disciplines	Reorganized to area level organization
Seating	By Trade	By Area
Meetings	Many	Focused meetings with less no of attendees
Meeting times	1 hour average	Re-zigged to ½ an hour
Teamwork	Team building at project level held rarely	Held at area level more frequently
PC role	Mostly at desk	Increased presence at site and meetings

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Other Elements

5%

1. Travel Time
   - Break trailers relocated to minimize travel time
   - Additional trailers and locations identified to be closer to work-place
2. Personal Breaks
   - Monitored by supervision
3. Instruction Times
   - Morning tool box talk time limit enforced
4. Absenteeism work around , esp, for Foremen
   - Crews re-assigned or alternate supervision identified
5. Work Assignment
   - Journey utilization optimized
   - Maximized use of apprentices

Current Trend

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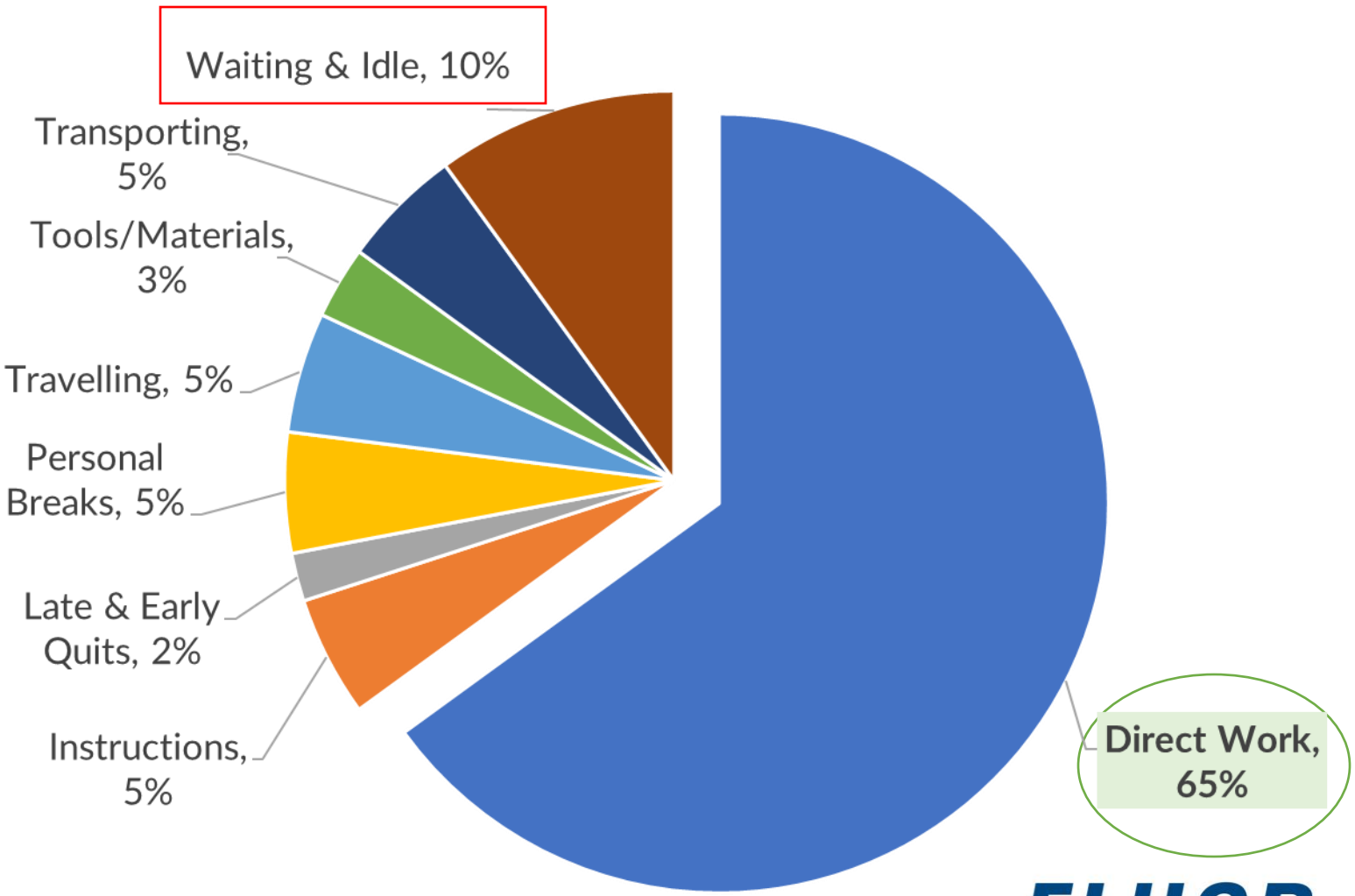
Current Trend

- ~65% of a typical construction day is productive time



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Take Aways

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Take-Aways

- Productivity (PF) Matters to the bottom line
- Productivity not linear
- Productivity is outcome of several elements on and off site
- Work face planning can be improved
- Construction industry still predominantly manual
- Old school still relevant
- Process improvement is starting point
- People make it happen
- Project controls can influence all phases and components of project
- There is always opportunity to improve!!!

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Open Discussion

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THANK YOU

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