Factory Physics

Methods for Efficient Project Management in a Scientific Environment

27 October 2021

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My Journey

BS CE, PE

40 years at Chevron in various positions

- Project engineer
- Design engineer
- Construction engineer
- Engineering manager
- Construction manager
- Project manager
- Consultant
- Project director
- General Manager Project Resources Company

General Manager Special Projects
Project Production Management and Innovation

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Chevron’s project management system was based on best practices in the oil and gas industry

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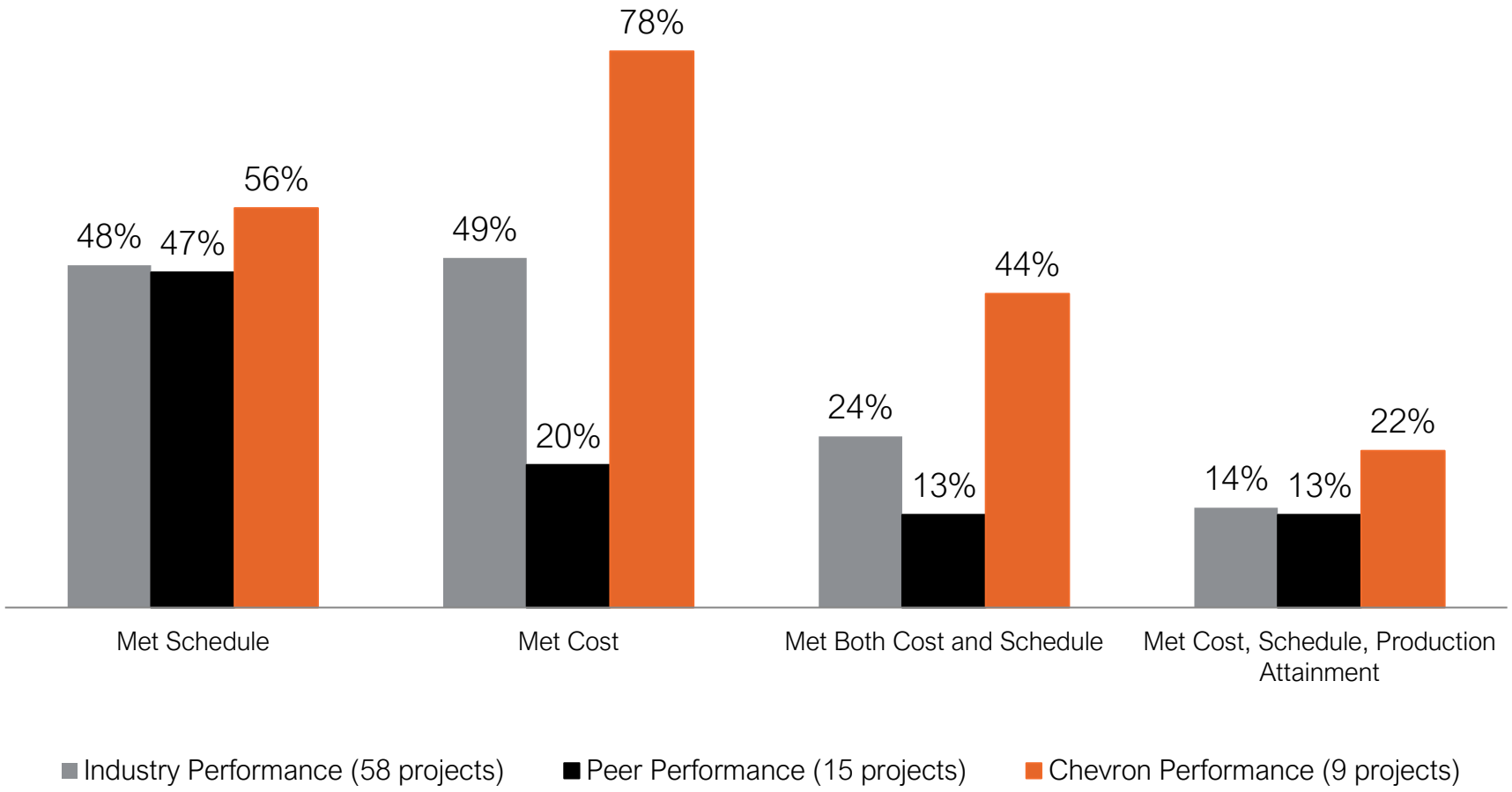

Data from IPA 2018 UIBC: MCPs AR 2010+ with cost, schedule, and production attainment data

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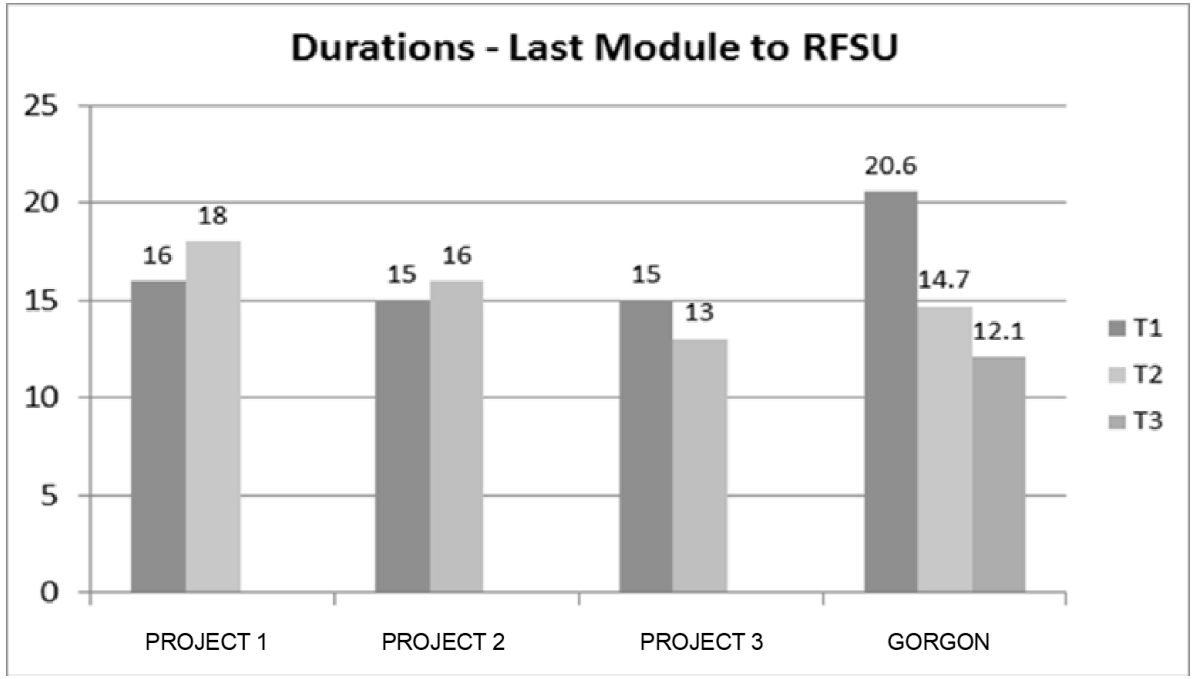
Something had to change



Compressed schedule by 08 months, saving ~$540 MM and accelerating revenue generation

Courtesy: Chevron Corporation

Current Practices - Not Science Based

ERA 1 – Taylorism

- Getting more out of workers

ERA 2 – Predictability

- Critical Path Method (CPM) scheduling and project controls
- Front End Loading
- 3D CADD
- Advanced Work Packaging

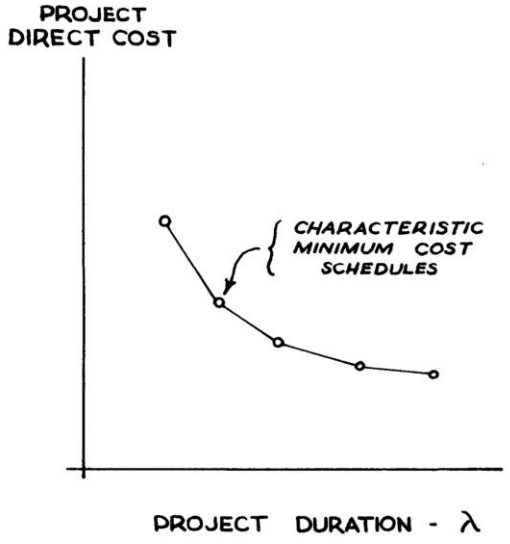
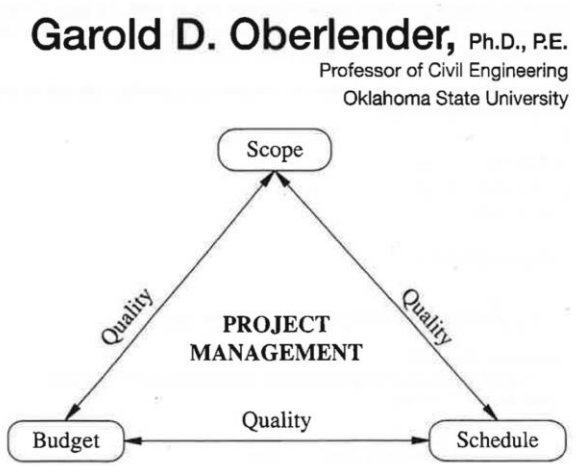


Fig. 3—Typical project cost curve.

Critical Path Planning and Scheduling Kelley & Walker



We discovered the science that governs projects

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Project Management

Cost, Time & Cash =  +  + 

Scope & Quality | Schedule | Resource Use

WHAT | WHEN | WHO

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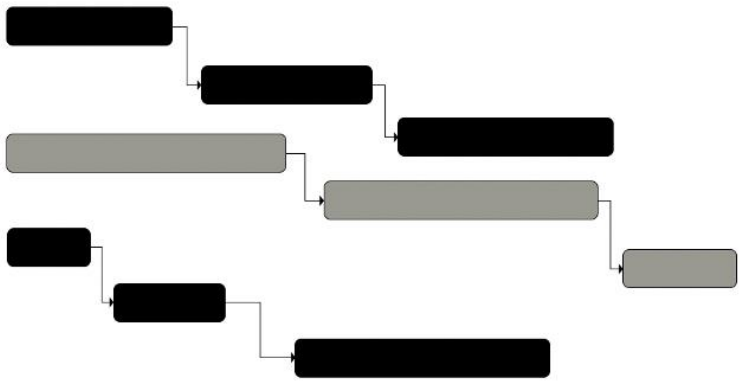
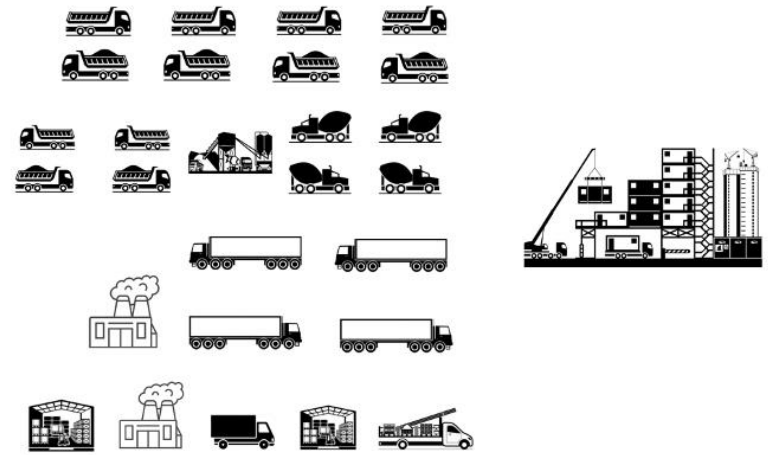
Schedule = Should Happen



Dates & Progress

Production System = Can/Will Happen



Rates / Throughput

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4 5 3

DESIGN MAKE TRANSPORT BUILD

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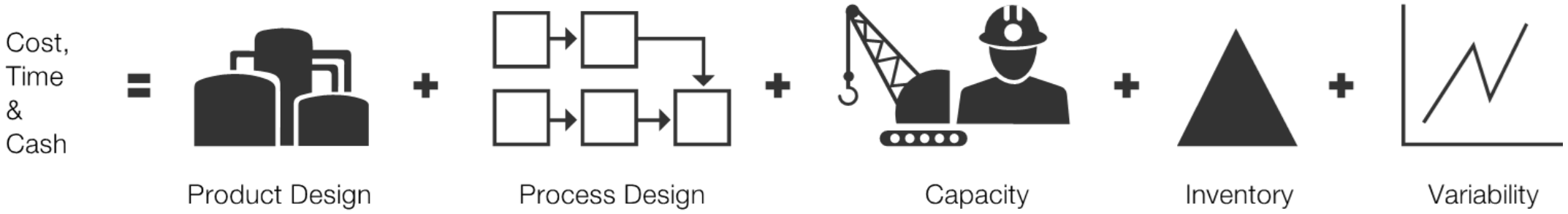
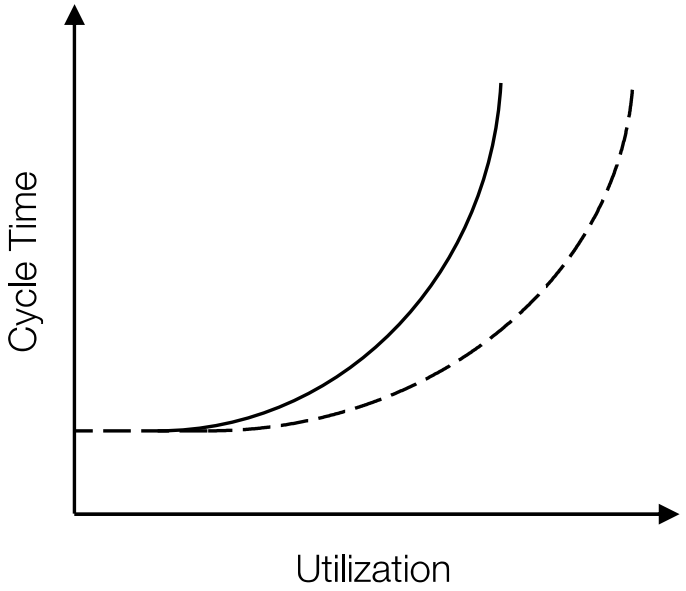
Five Levers

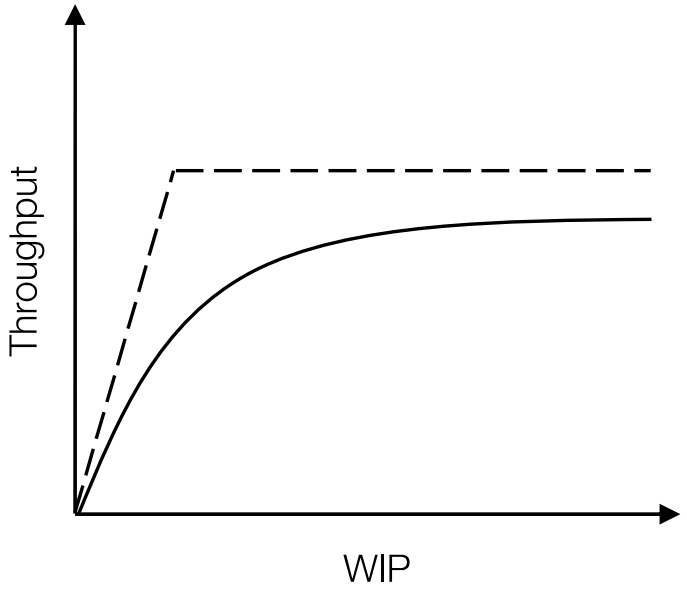


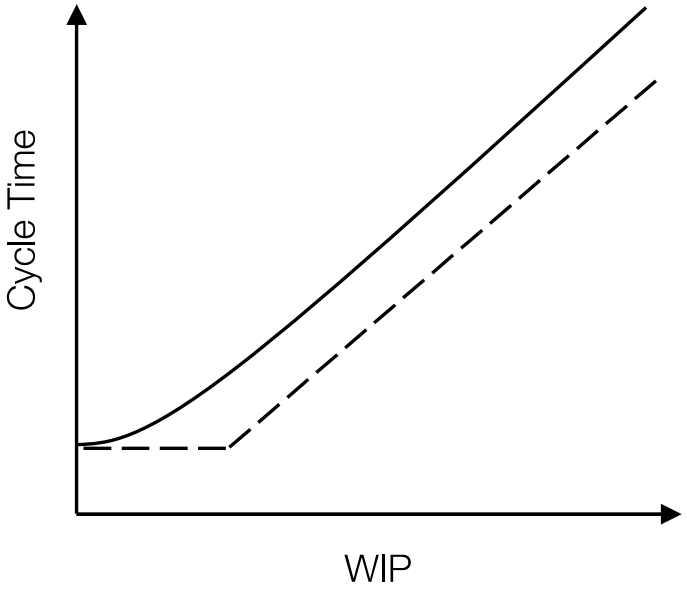
Projects Are Unrecognized Production Systems

Governed by Little's Law: Cycle Time = Work in Process / Throughput

Three Curves







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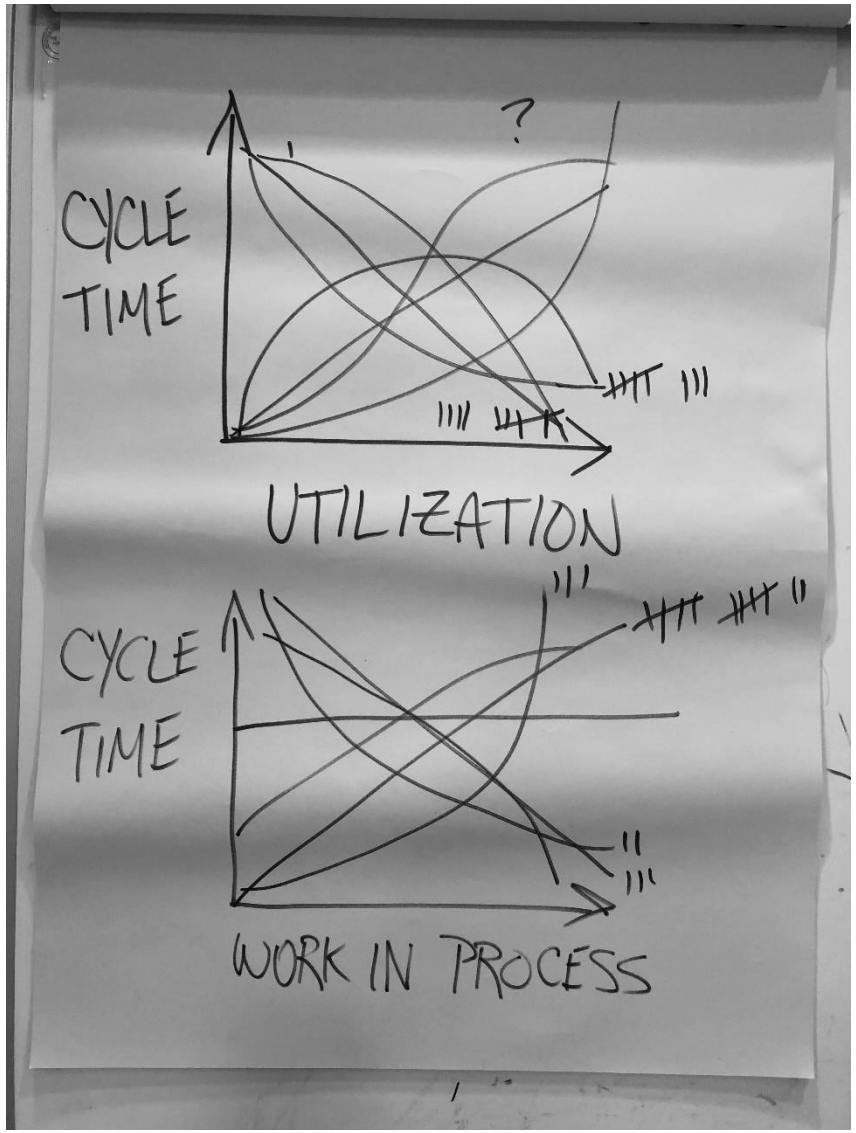

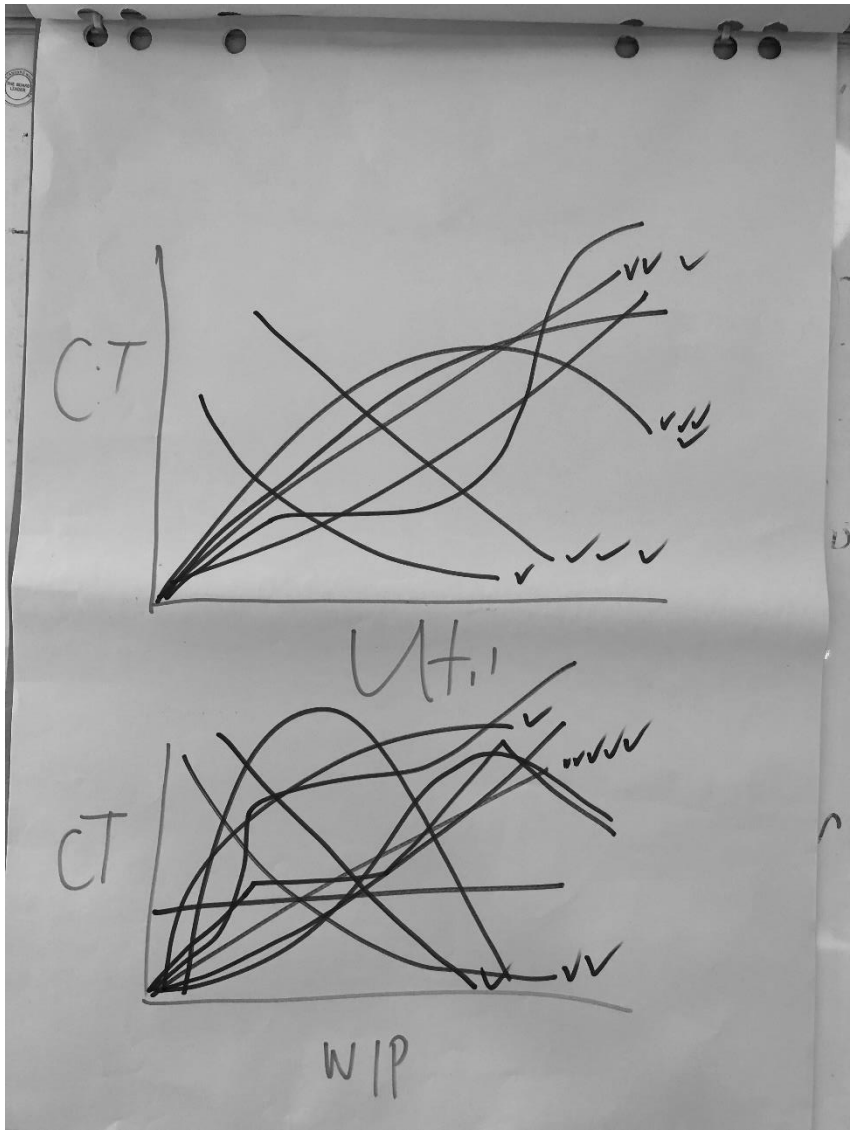

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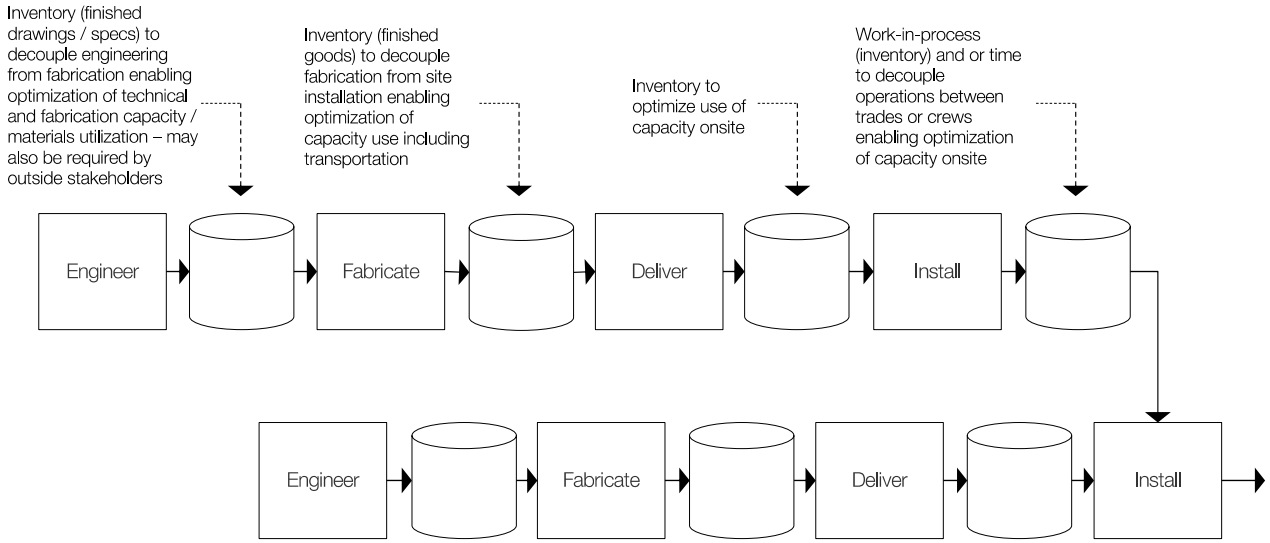
Projects Naturally Deal with Variability by Protecting Each Step in the Process with Inventory



IMPLICATIONS:

Work In Process (Inventory) = More Time

More Time = More Cost

More Time + More Cost = Lower ROI

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Piling - A Real Example of This

Unit rate contractor to drive 20,000 piles on the project in the first six months of construction, planned completion of foundations in two years

An excellent piling contractor was hired and delivered as promised for $8.9MM on a unit rate contract – big win

Success?

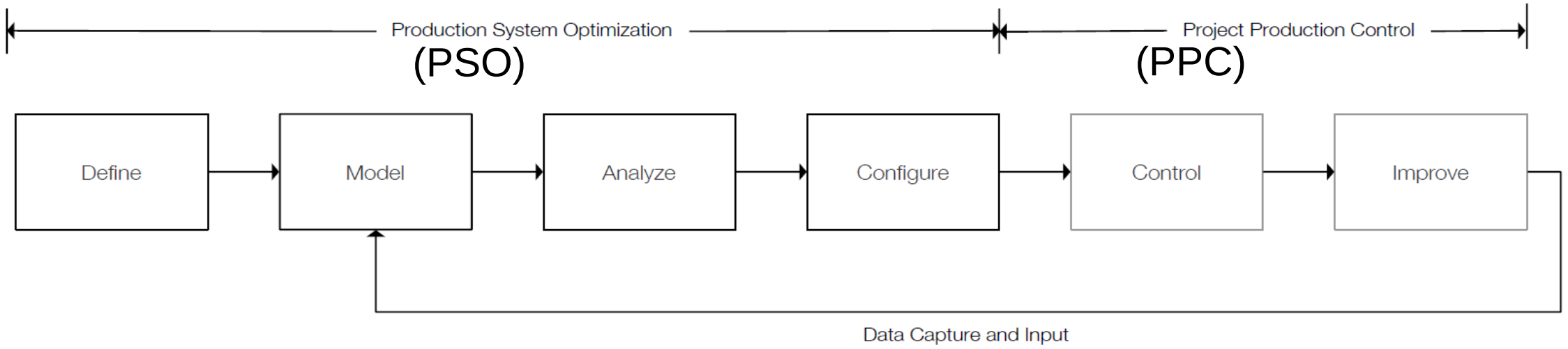
Finished Piling – Waiting for Foundations

Project Management Systems – 4 Significant Gaps

1. Whole is optimized by optimizing the parts
2. Assumes variability is a given
3. Scheduling is planning
4. Focuses on what, who and when, but not HOW the work will be done

How do we close those gaps?

OS is the project science
Project Production Management is the method



IN CONCERT WITH

Computer Aided Concurrent Production Engineering

Supply Flow Control

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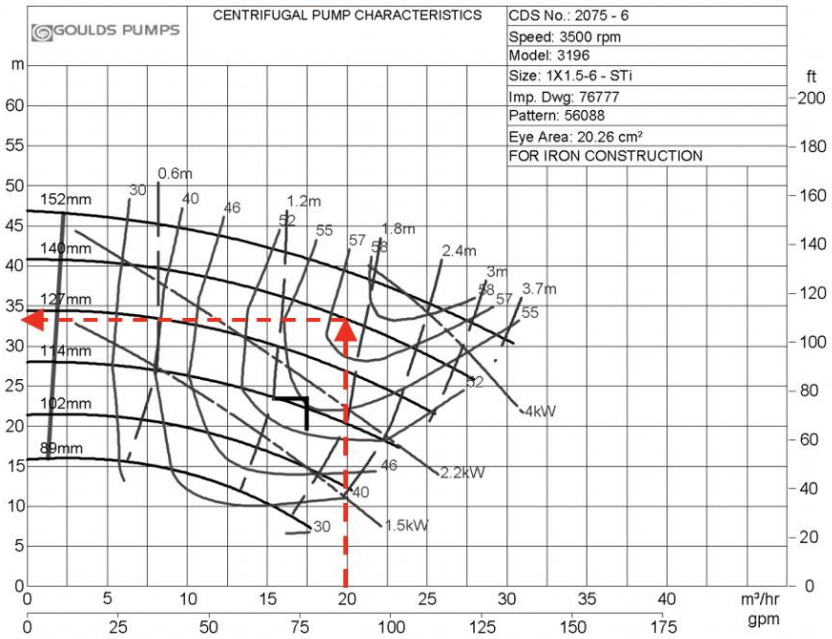
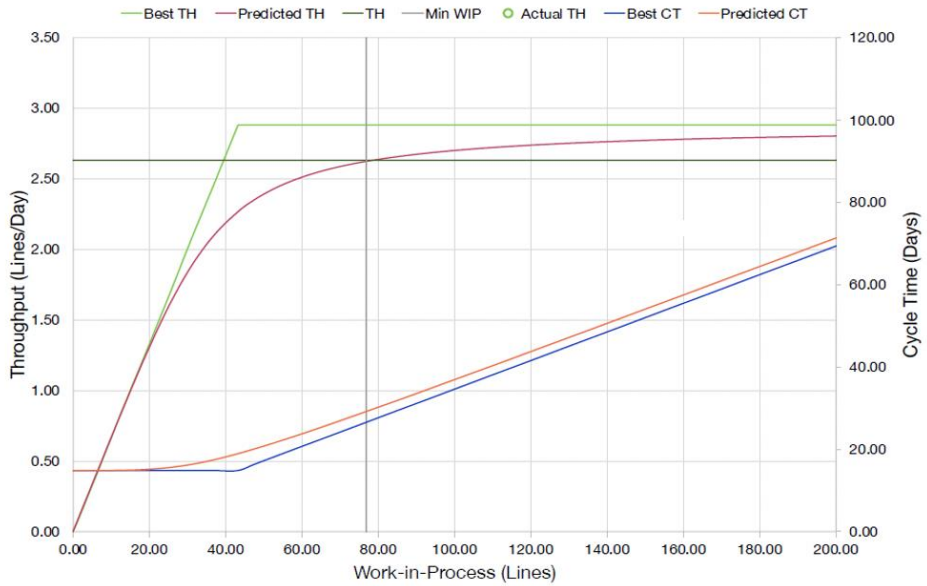
Operations Science Moment

How do we control production?

Pump curves describes the behavior of a pump with a given impellor.



Operations Science describes the behavior of a production system with given parameters (e.g., resources)

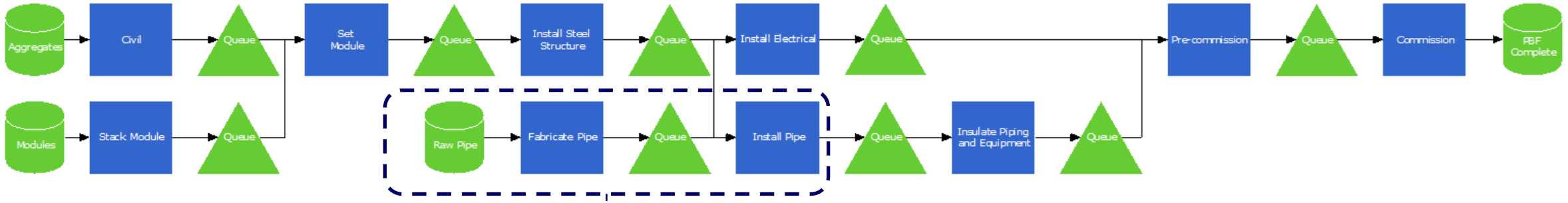


Model considers 6 Designers and 3 Engineers at a maximum capacity utilization of 90%

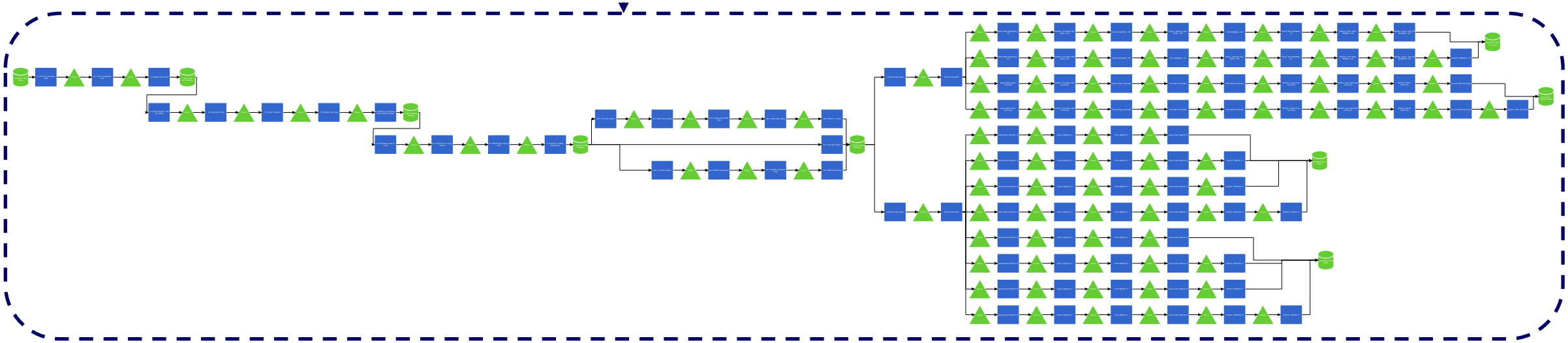
- Operations Science describes the behavior of a production system (e.g., pipe erection) with given parameters, in much the same way that pump curves describe the behavior of a pump with a given impellor.
- Production System Optimization (PSO) can identify parameters required to achieve and/ or improve schedule (e.g., throughput/ cycle-time).
- By utilizing a Operations Science mindset (controlling WIP, identifying and removing variability) we can assist in meeting required schedules

Projects are Production Systems

High Level Map



Detailed Map



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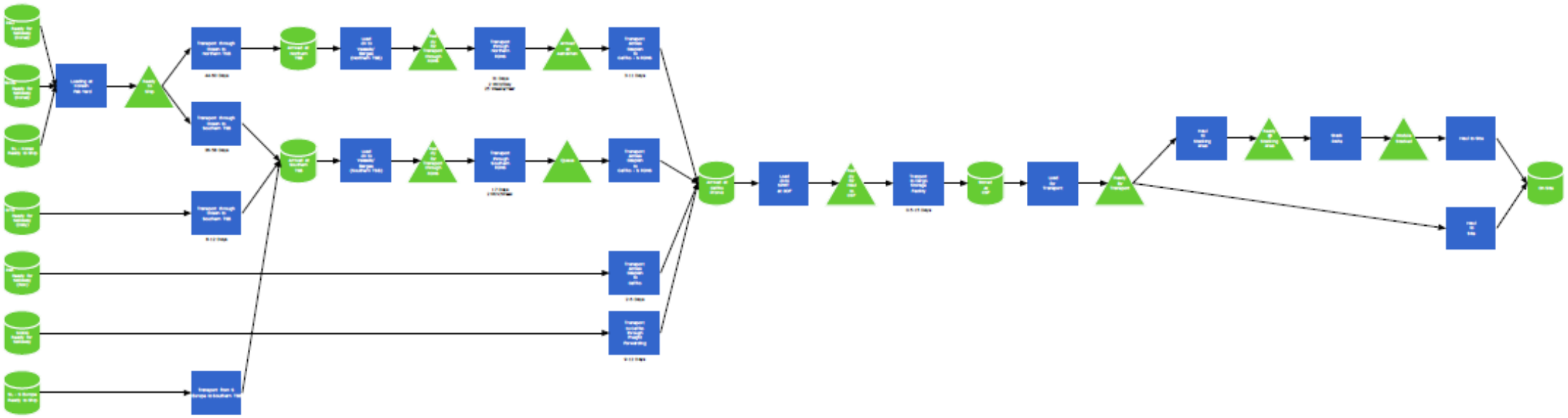
Do the logistics systems have the required capacity?

Ocean Going
Inland
Offloading and Storage
Stacking and Final Installation

What did they find?



Ocean Going Logistics	Inland Logistics	Offloading & Storage Logistics	Stacking Logistics
48%	52%	49%	140%

Potential to reduce ocean going vessels & inland logistics storage

Highest Capacity Utilization

Optimize Stacking Capacity (not number of stacking facilities)

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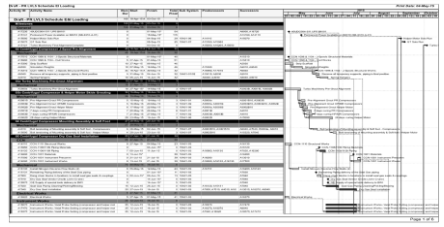
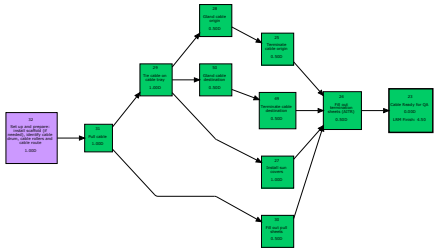
Project Production Control Approach



Should Do

Project Controls

Project Production Control



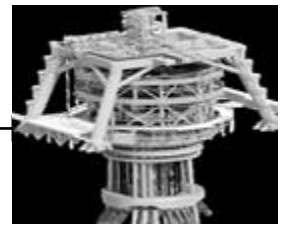
Standard Processes

Production Scheduling

Can Do

Production Planning

Will do



Execute work as per production plan

Did or Did Not Do

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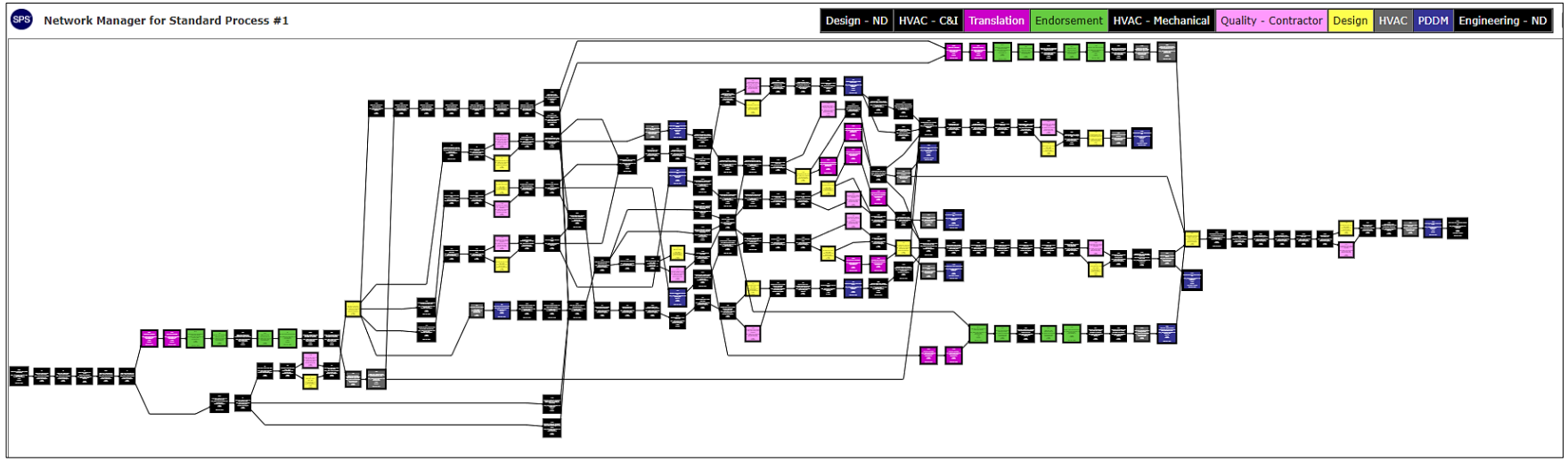
Illusion of Being in Control?

Engineering thought it was a seven-step process

Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
PLC data available (FB-area)	Wiring PLC vendor data into SPI (ND)	Assign template (ND)	Generate layout, perform self-check, do the checking and issue for FB/HO review (ND)	FB/HO to do the review and send back to ND (FB-area)	Incorporate FB/HO review. Comments if any and send final copy to PDDM for issue (ND)	Issue on POL (ND-area and PDDM)

Actual After Production Control – 200



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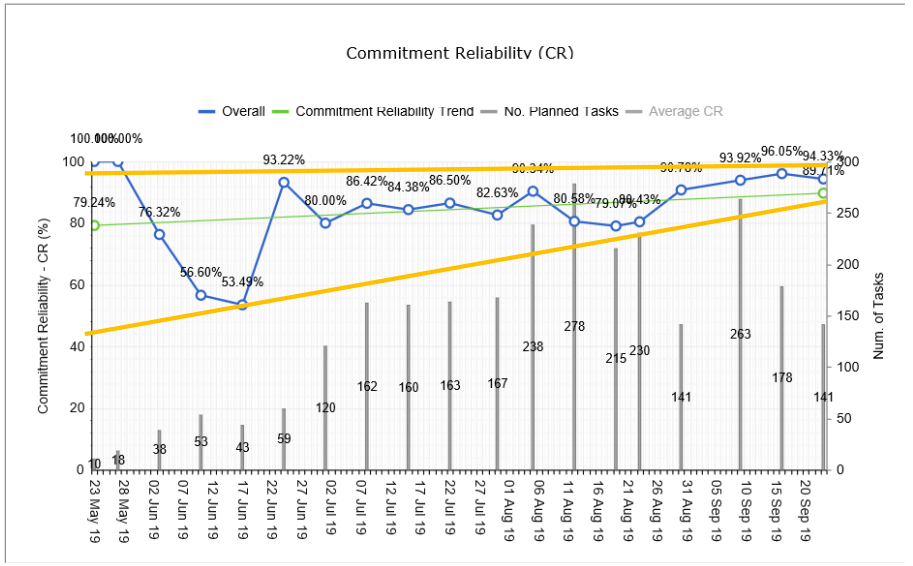
Impact of Project Production Control – Pre-FEED / FEED

IMPACT

Accelerated completion of contractual milestone to enable critical work to be completed on-time

Removed translation activities for electrical (31 items) and material requisitions (57) reducing CT for each workflow



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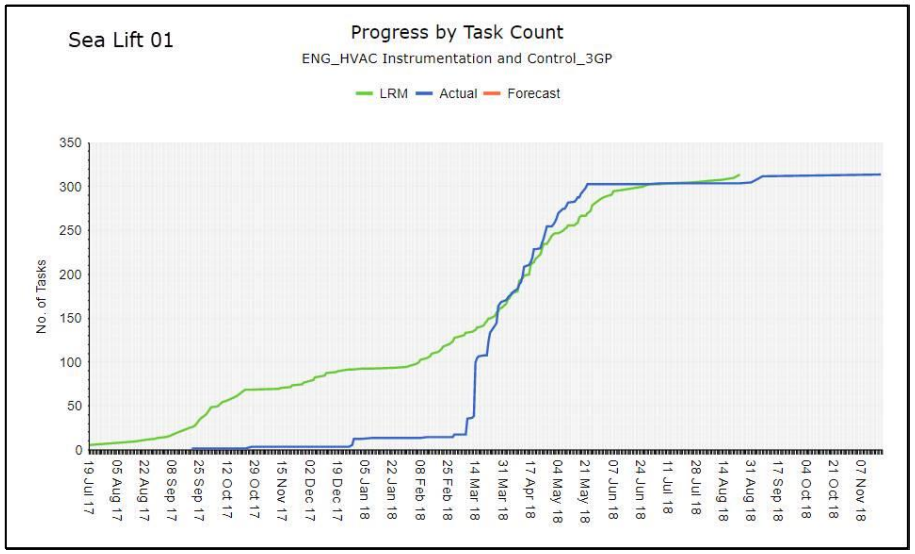
Impact of Project Production Control – Engineering

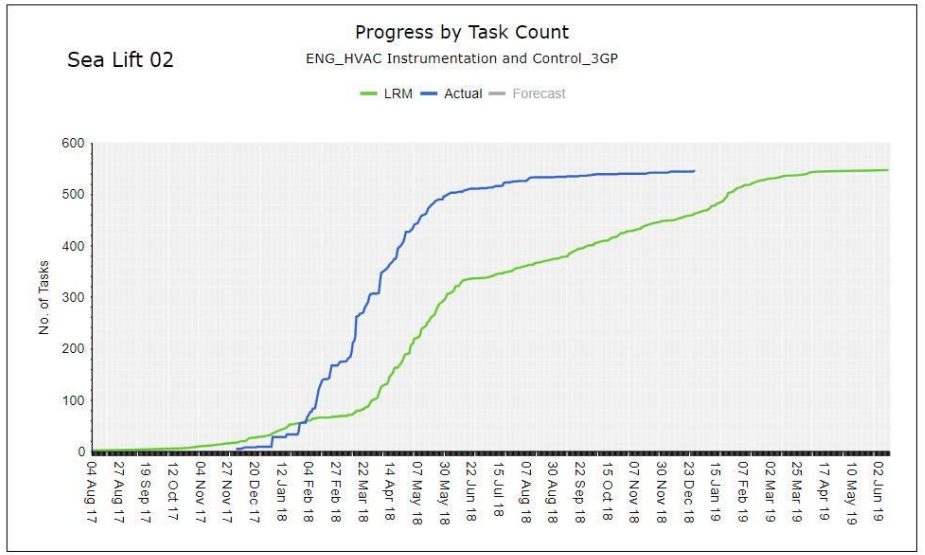
IMPACT

Schedule recovered through standard work processes, right priorities and managing variability

Resources better utilized

Discipline interfaces not previously identified were incorporated into the plan





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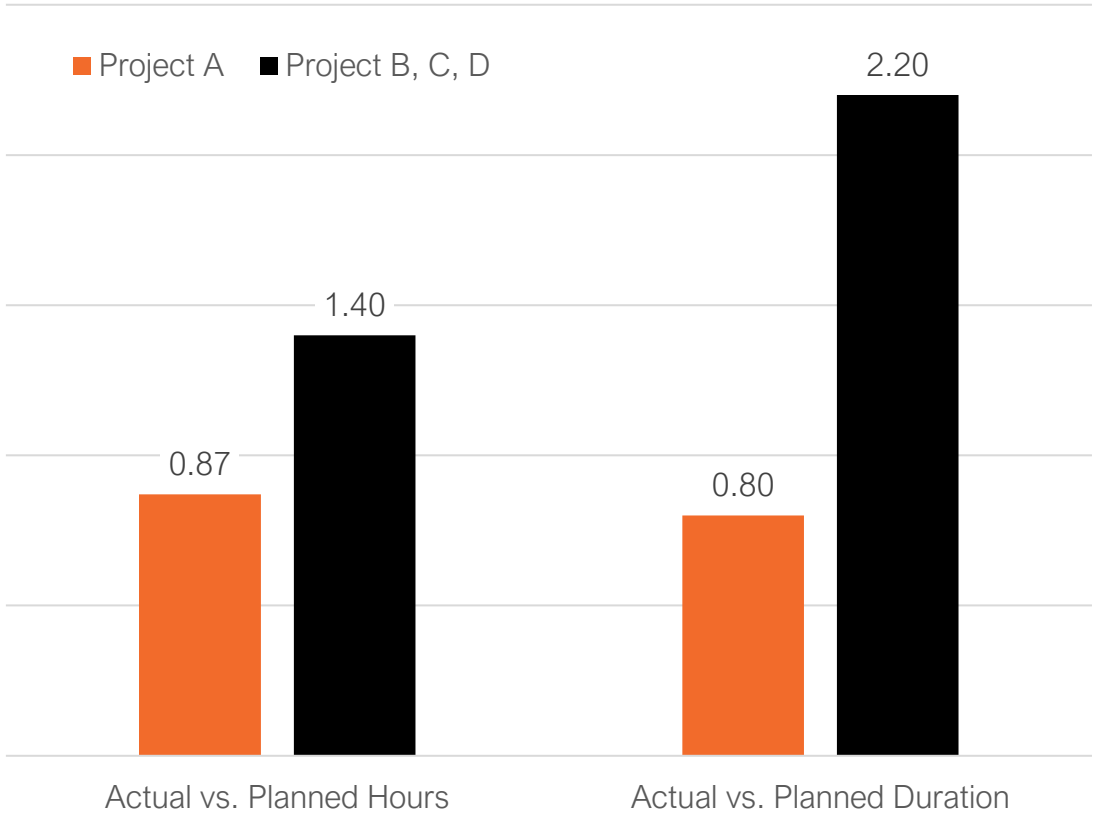
Impact of Project Production Control – Construction



Description	Project A	Project B, C, D
Base IWP inventory	100%	100%
% of open IWPs (WIP)	14%	27%
Avg hours in a IWP (Batch size)	513hrs	1173hrs
PF – cumulative to date	1.15	0.72
Duration to execute an IWP	0.8 x Plan	2.2 x Plan

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PPM requires a change in mindset

If you don't start, you can't finish

Earn and burn

Economy of scale exists

Cash flow doesn't matter

Bigger batches give shorter cycle time

More open work fronts are better

A good productivity factor means we are meeting project objectives

We have a schedule and those executing work will use it

Schedule is a plan

Workface planning improves performance

Better looking at it than for it

Behind schedule? Add more capacity – planners, craft, equipment

"I Already Do Project Production Management"

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