Factory Physics

Methods for Efficient Project Management in a Scientific Environment

27 October 2021
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
Chevron’s project management system was based on best practices in the oil and gas industry.
Industry Performance (58 projects)  Peer Performance (15 projects)  Chevron Performance (9 projects)

Data from IPA 2018 UJBC: MCPs AR 2010+ with cost, schedule, and production attainment data
Something had to change
Compressed schedule by 08 months, saving ~$540 MM and accelerating revenue generation.
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
We discovered the science that governs projects
Project Management

Cost, Time & Cash = Scope & Quality + Schedule + Resource Use

WHAT WHEN WHO
Schedule = Should Happen

Dates & Progress

Production System = Can/Will Happen

Rates / Throughput

Copyright Project Production Institute
Five Levers

Projects Are Unrecognized Production Systems

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

Cycle Time

Utilization

Throughput

WIP

Cycle Time

WIP
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
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

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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
Operations Science Moment
How do we control production?

Pump curves describe the behavior of a pump with a given impeller.

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

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- 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 impeller.
- Production System Optimization (PSO) can identify parameters required to achieve and/or improve schedule (e.g., throughput/cycle-time).
- By utilizing an Operations Science mindset (controlling WIP, identifying and removing variability) we can assist in meeting required schedules.
Do the logistics systems have the required capacity?

Ocean Going
Inland
Offloading and Storage
Stacking and Final Installation
What did they find?

Potential to reduce ocean going vessels & inland logistics storage

Optimize Stacking Capacity (not number of stacking facilities)
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

Set up and prepare: install scaffold (if needed), identify cable drum, cable rollers and cable route

Pull cable

Tie cable on cable tray

Gland cable origin

Gland cable destination

Install sun covers

Terminate cable origin

Terminate cable destination

Fill out pull sheets

Fill out termination sheets (AITR)

Cable Ready for QA

LRM Finish: 4.50
07-May-15 11:21 AM

32
Set up and prepare: install scaffold (if needed), identify cable drum, cable rollers and cable route

1.00D

31
Pull cable

1.00D

29
Tie cable on cable tray

1.00D

28
Gland cable origin

0.50D

50
Gland cable destination

0.50D

27
Install sun covers

1.00D

25
Terminate cable origin

0.50D

30
Fill out pull sheets

0.50D

49
Terminate cable destination

0.50D

24
Fill out termination sheets (AITR)

0.50D

23
Cable Ready for QA

0.00D

LRM Finish: 4.50
07-May-15 11:21 AM
**Illusion of Being in Control?**

Engineering thought it was a seven-step process

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

Actual After Production Control – 200

![Network Manager for Standard Process #1](image-url)

*Network Manager for Standard Process #1: Design, ND, HVAC, CM, Engineering, Maintenance, Mechanical, Quality, Contractor, Energy, HVAC, PCCM. Engineering, RD.*
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
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
## Impact of Project Production Control – Construction

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