

# Application of Project Controls methods in the Design & Engineering stage of major construction and infrastructure projects

Paul Waskett, Director at Adept Management

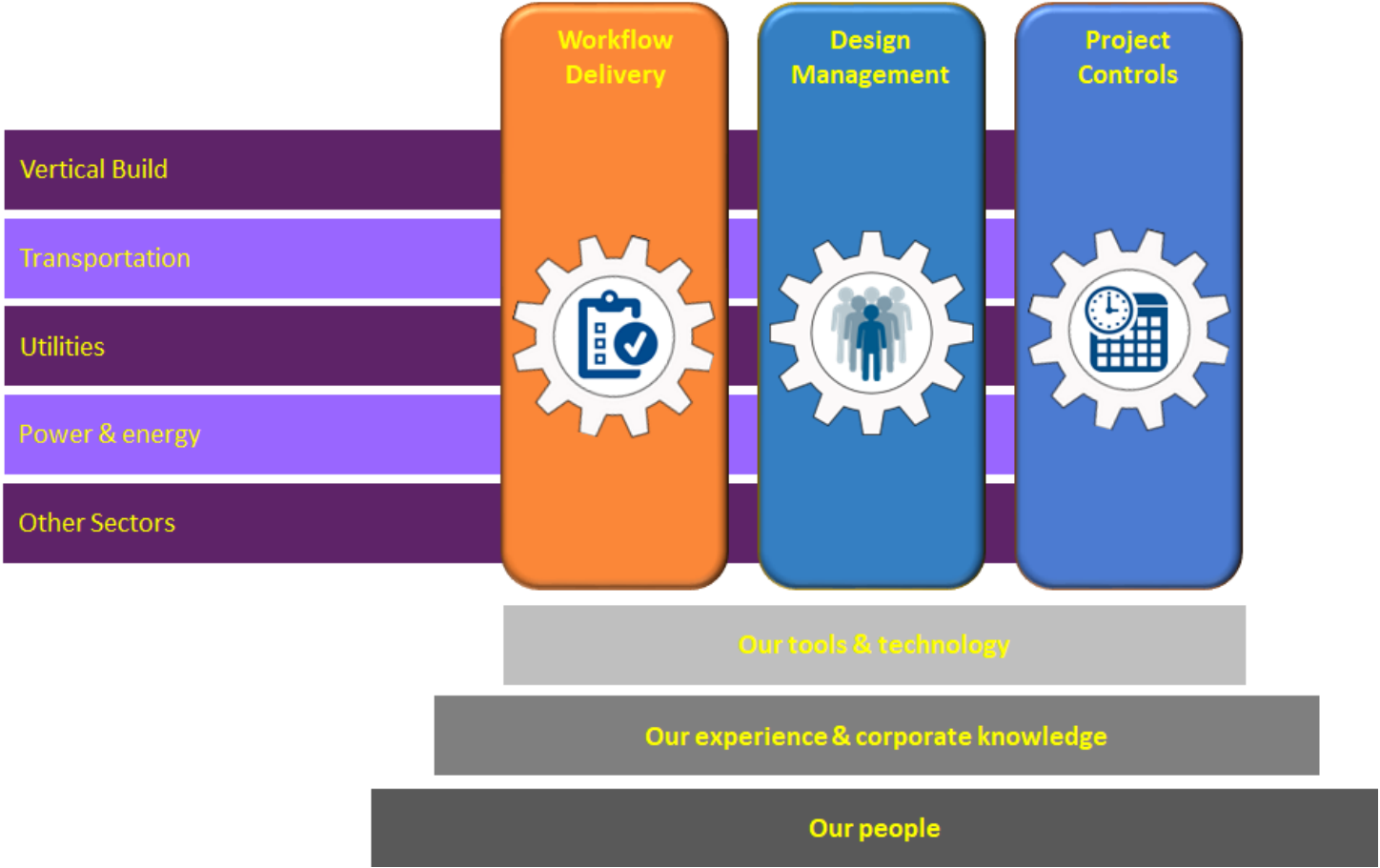


# Content

- Introduction
- The Design and Engineering Process
- Process Definition and Planning
- Design Process Management
- Change Modelling
- Lessons

# Introduction

# Our Services



# Our Experience



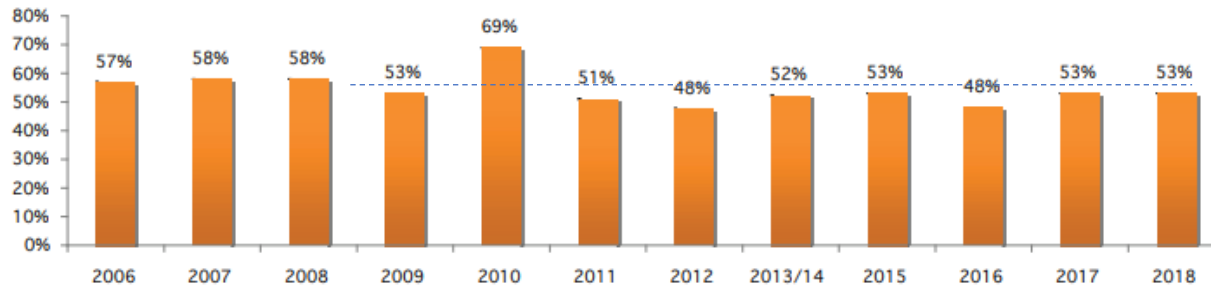
# Where we Trade



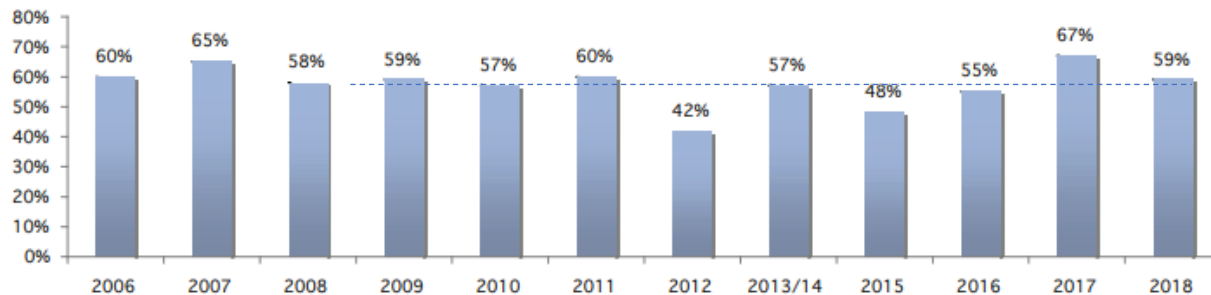
# The Design and Engineering process

# Design & Project Performance

**Predictability Time - Design**



**Predictability Time - Construction**



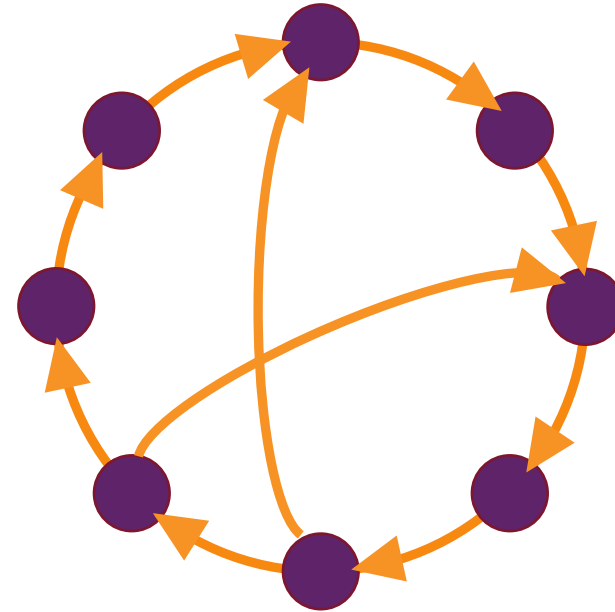
- Over the last ten years in the UK across all capital projects, big and small, **design & engineering work is as likely to be late as on time.\***
- The performance trend line over those 10yrs aligns with the performance of construction
- This is not unique to the UK

\* Data from UK Industry Performance Report 2019 (UK Construction KPI's)

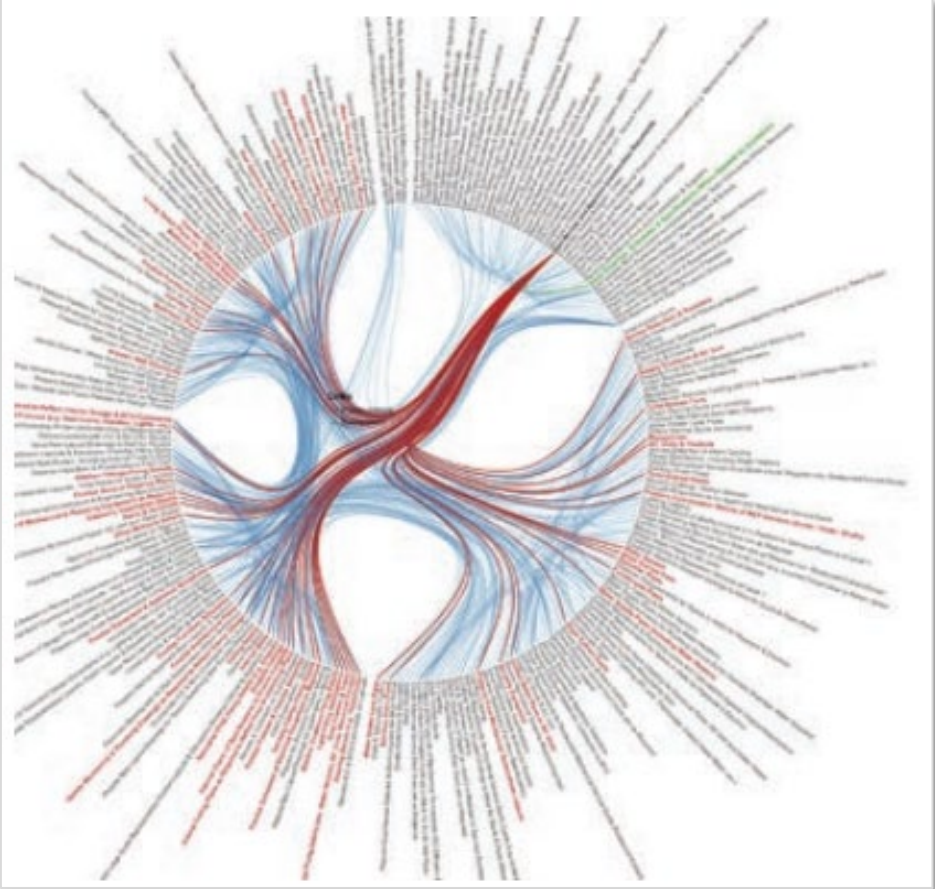
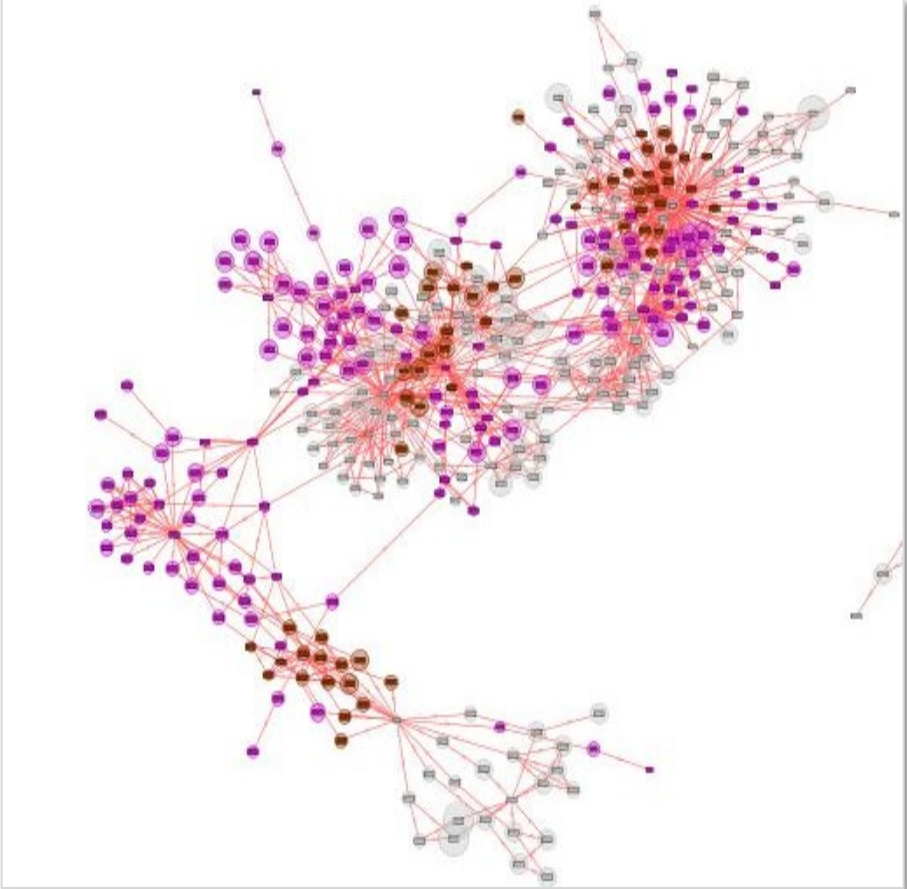


## Some characteristics of the design process

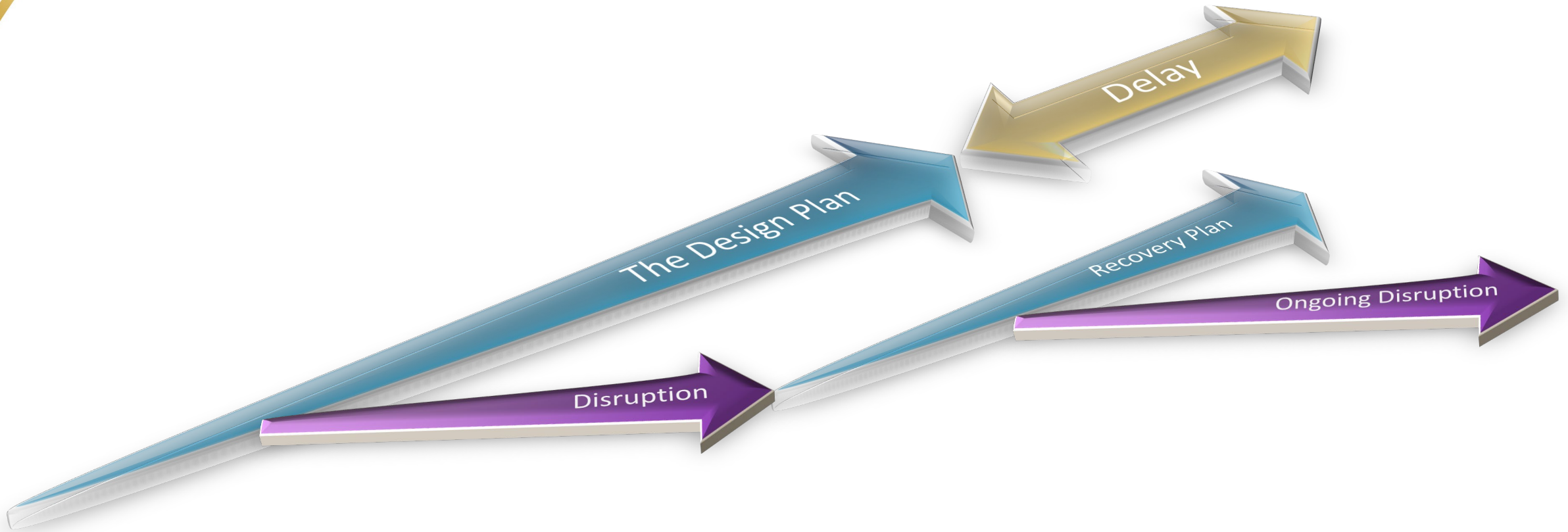
- Design is an iterative process
- Driven by intangible information
- Can be highly complex
- Silo-based dispersed teams
- Usually broken into sub-problems
- Can involve many people
- Normally undertaken in stages



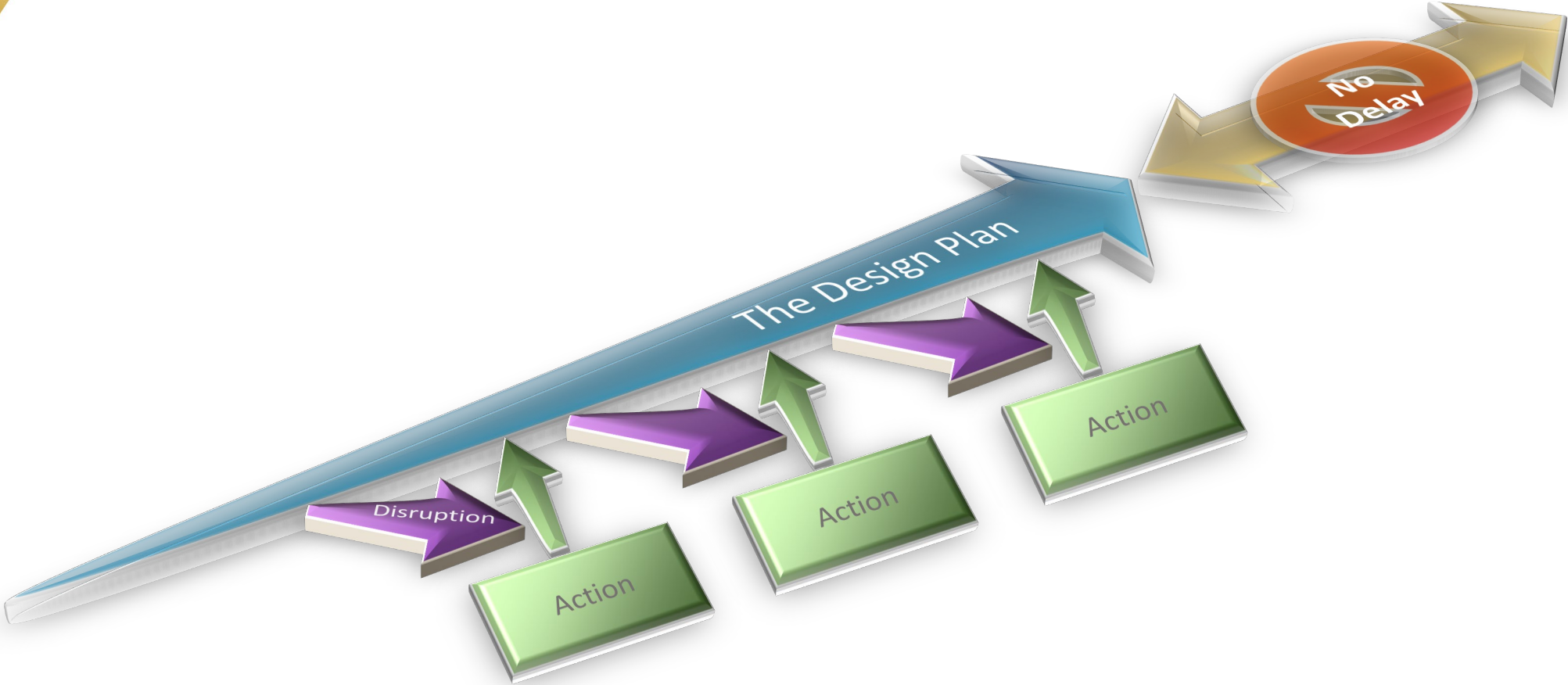
# The Complexity of the Process



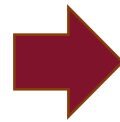
# Plan versus Reality

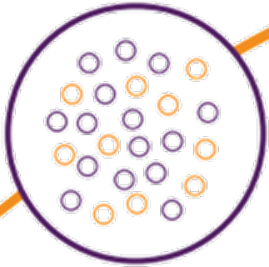


# Taking Control



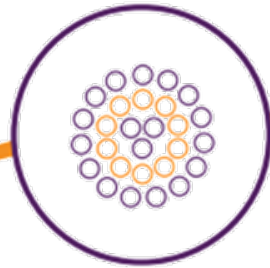
# Plan versus Action





## DEFINE

Process, dependencies  
& resources



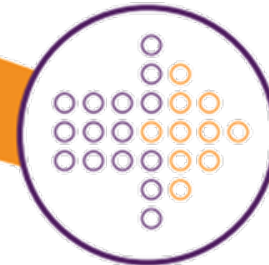
## STREAMLINE

Optimise the decision  
making process



## PLAN

Align with  
project constraints



## DELIVER

Resolve issues & actions,  
update progress,  
dashboard reporting



427 ft  
skyscraper -  
residential

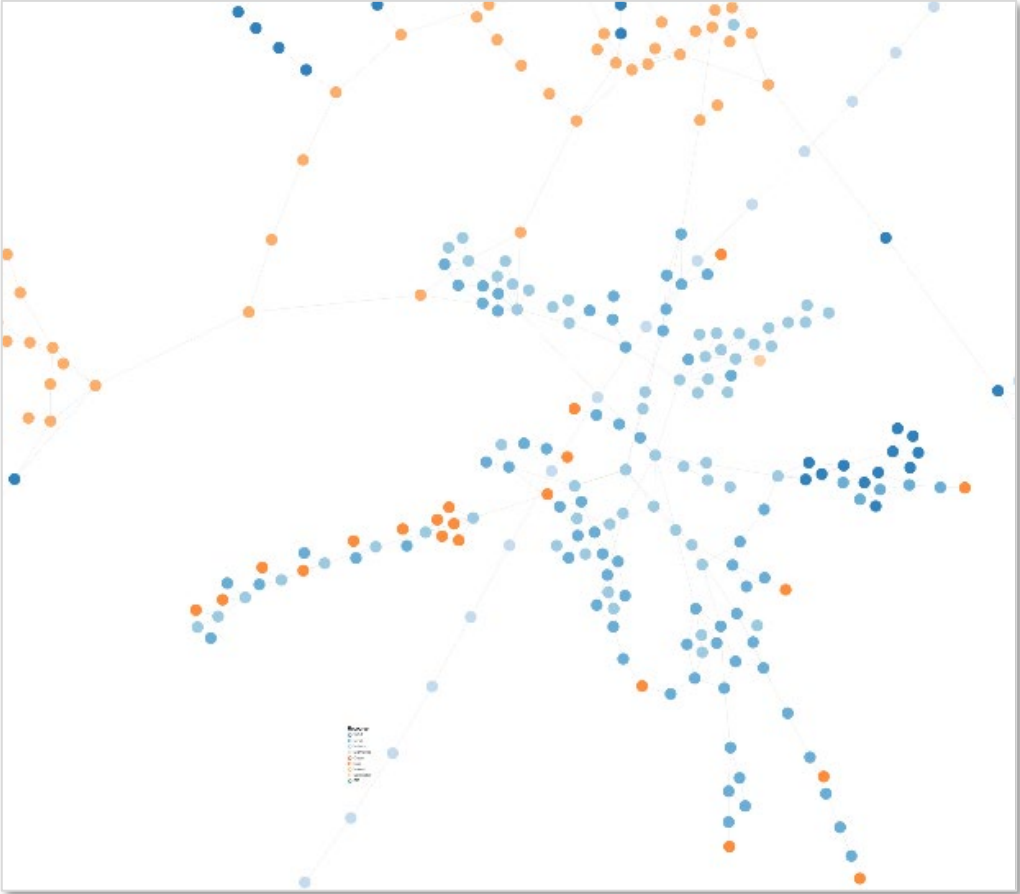
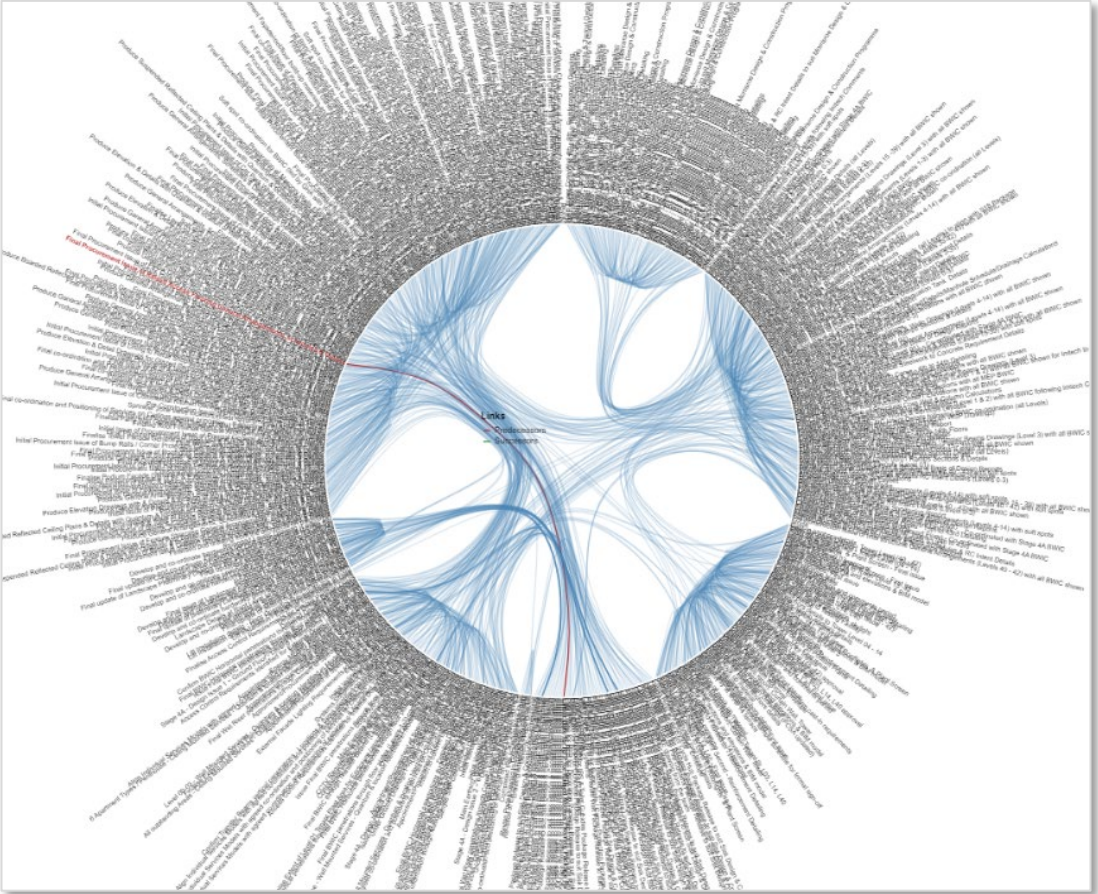


40,375 sq ft  
industrial  
facility

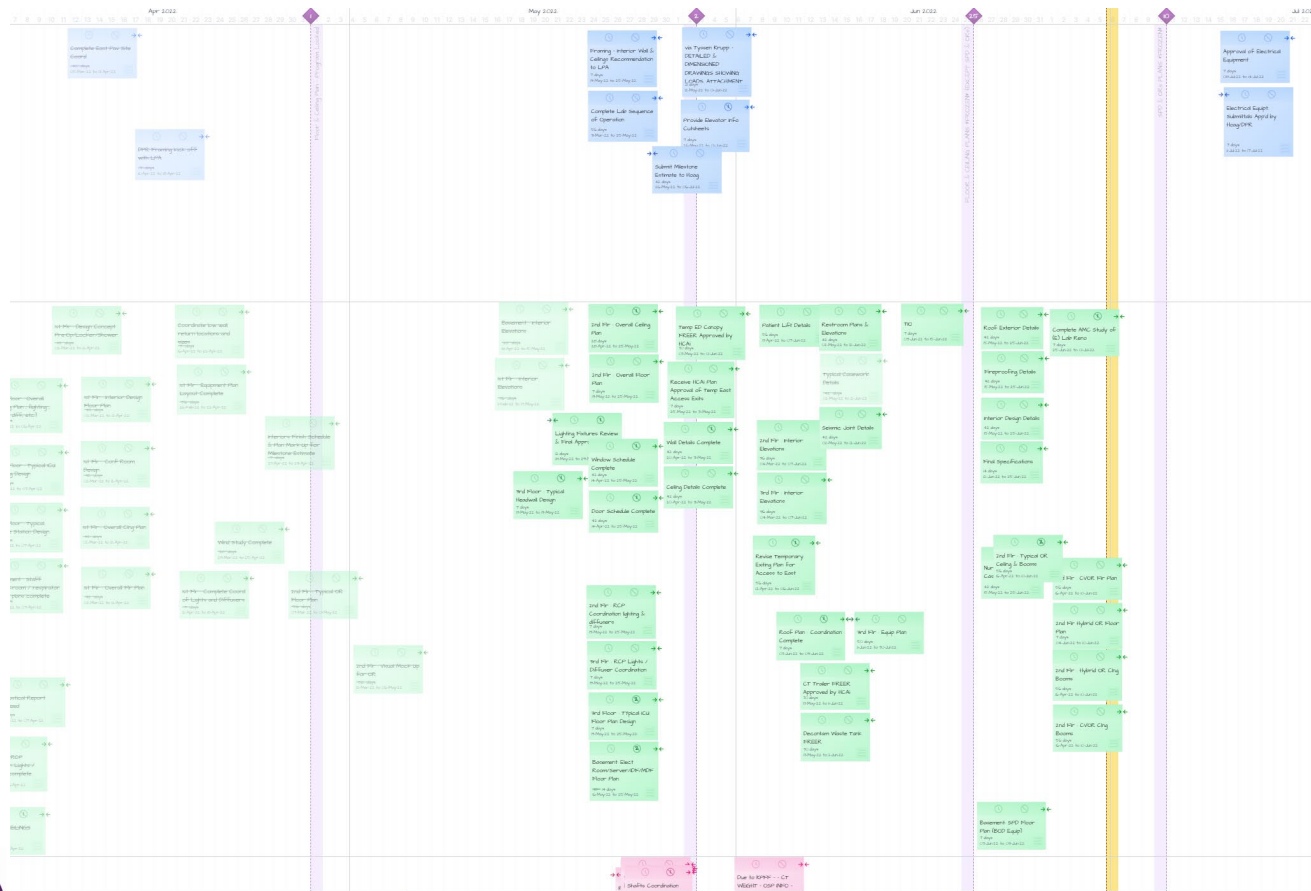
# Process Definition & Planning



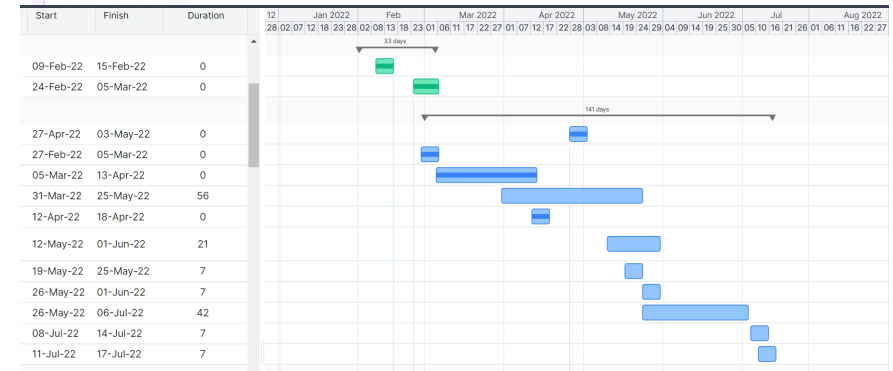
# The Complexity of the Process



# Collaborative Process Definition



project-notes.com



# 'Top-down' or 'bottom-up' resource allocation

The screenshot displays the Microsoft Project interface. On the left, a Work Breakdown Structure (WBS) tree is visible under the heading 'WBS >'. The tree includes the following items:

- P160 Solid Waste Facility
  - DESIGN PROJECT SCHEDULE
  - RQ DESIGN PROJECT MOBILIZATION
  - PREDESIGN
  - CRITICAL PATH DESIGN PACKAGE #1 - CLEAR/GRUB, ACCESS ROAD, UTILITIES
    - CONCEPT DESIGN
    - CRITICAL PATH PACKAGE #1 - 100% PRE-FINAL
    - CRITICAL PATH PACKAGE #1 FINAL DESIGN FOR CONSTRUCTION
  - DESIGN PACKAGE #2 - SITE, BUILDINGS, LANDFILLS
    - DESIGN PACKAGE #2 - CONSTRUCTION DOCUMENT (65%)
    - DESIGN PACKAGE #2 - PRE-FINAL DESIGN
    - DESIGN PACKAGE #2 - FINAL DESIGN
    - DESIGN PACKAGE #2 - FINAL DESIGN FOR CONSTRUCTION

On the right, the 'Allocate Resource to (84) Tasks' dialog box is open. It features a summary table and several configuration options:

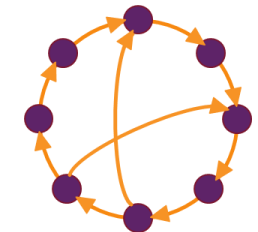
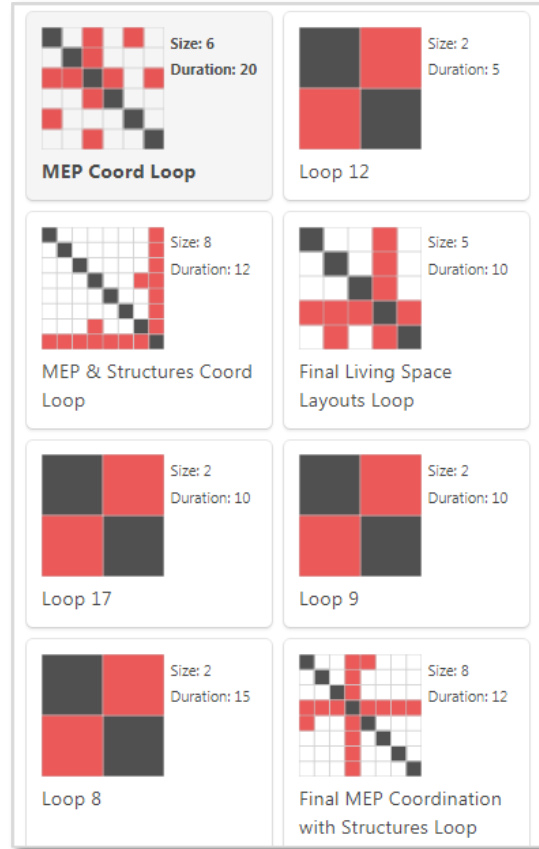
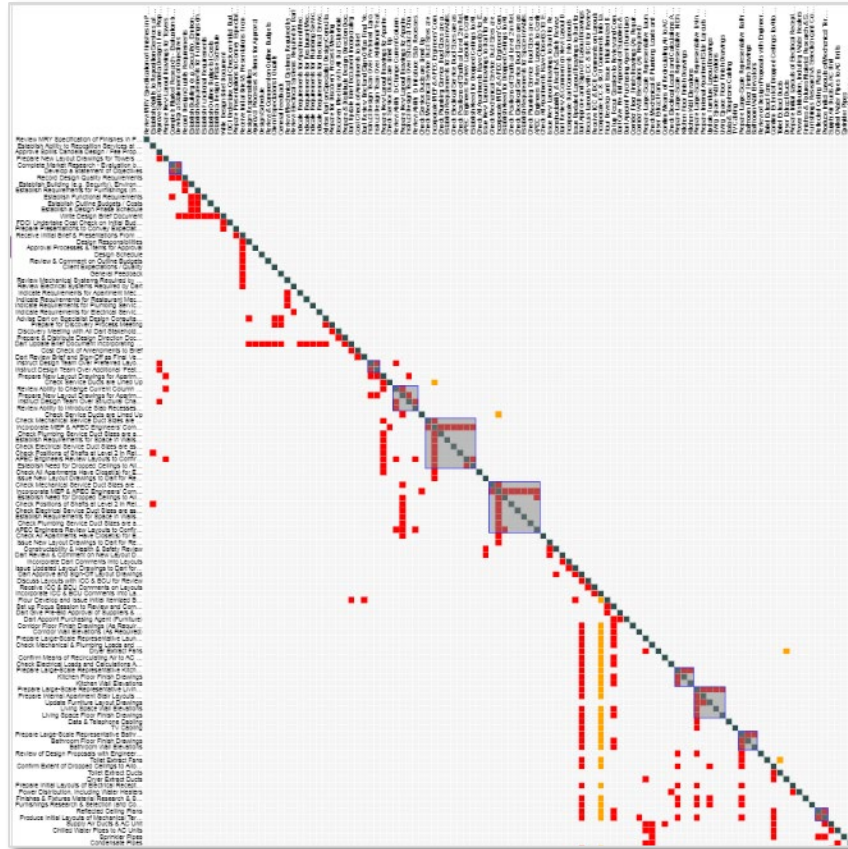
|                          | Baseline | Progress | Reported |
|--------------------------|----------|----------|----------|
| Total Remaining Duration | 1065     | 695      | 695      |
| Elasped Calendar Days    | 311      | 311      | 318      |
| Elasped Working Days     | 219      | 219      | 224      |

Below the table, the 'Resource' dropdown is set to 'Kirk Van Cleave → Architecture → Design Project Manager'. The allocation settings are:

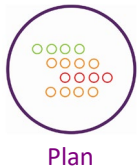
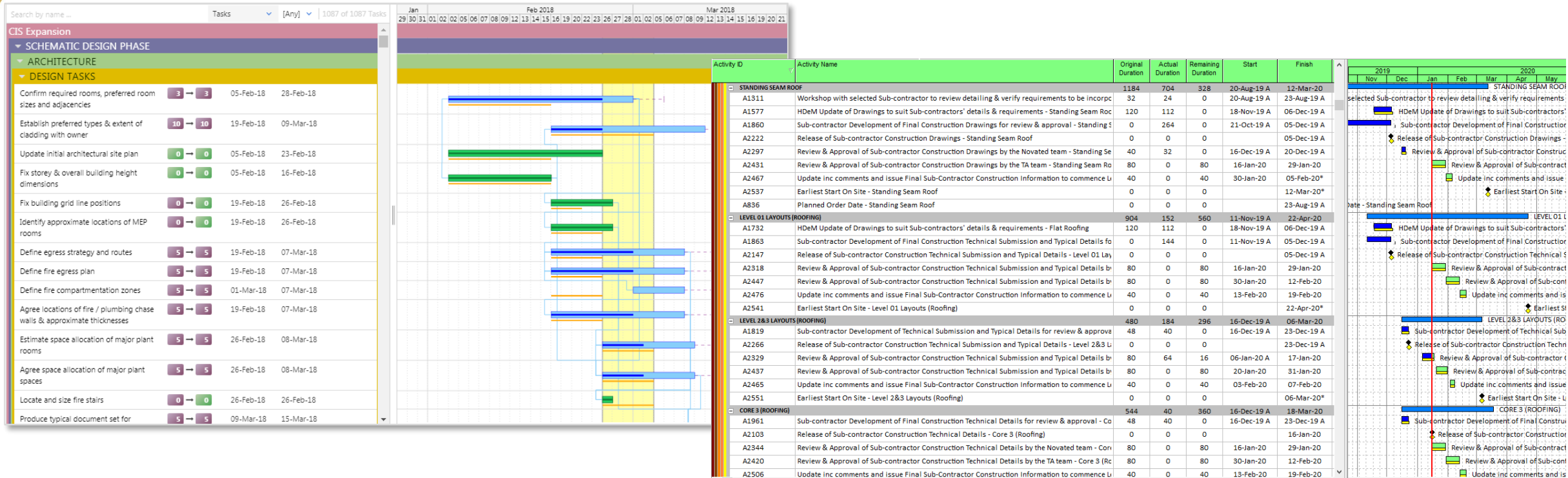
- Budget Units: 115 (Current allocation: 115)
- Remaining Units: 80 (Current allocation: 109)
- Actual Units: 48 (Current allocation: 6)
- Rate: Resource Default (0)
- Distribution: Spread based on remaining durations
- Impact: Replace allocations for this resource
- Only allocate to task with a matching primary resource

Buttons for 'Save' and 'Cancel' are located at the bottom of the dialog.

# Streamline the Process

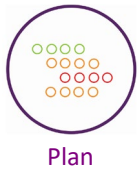
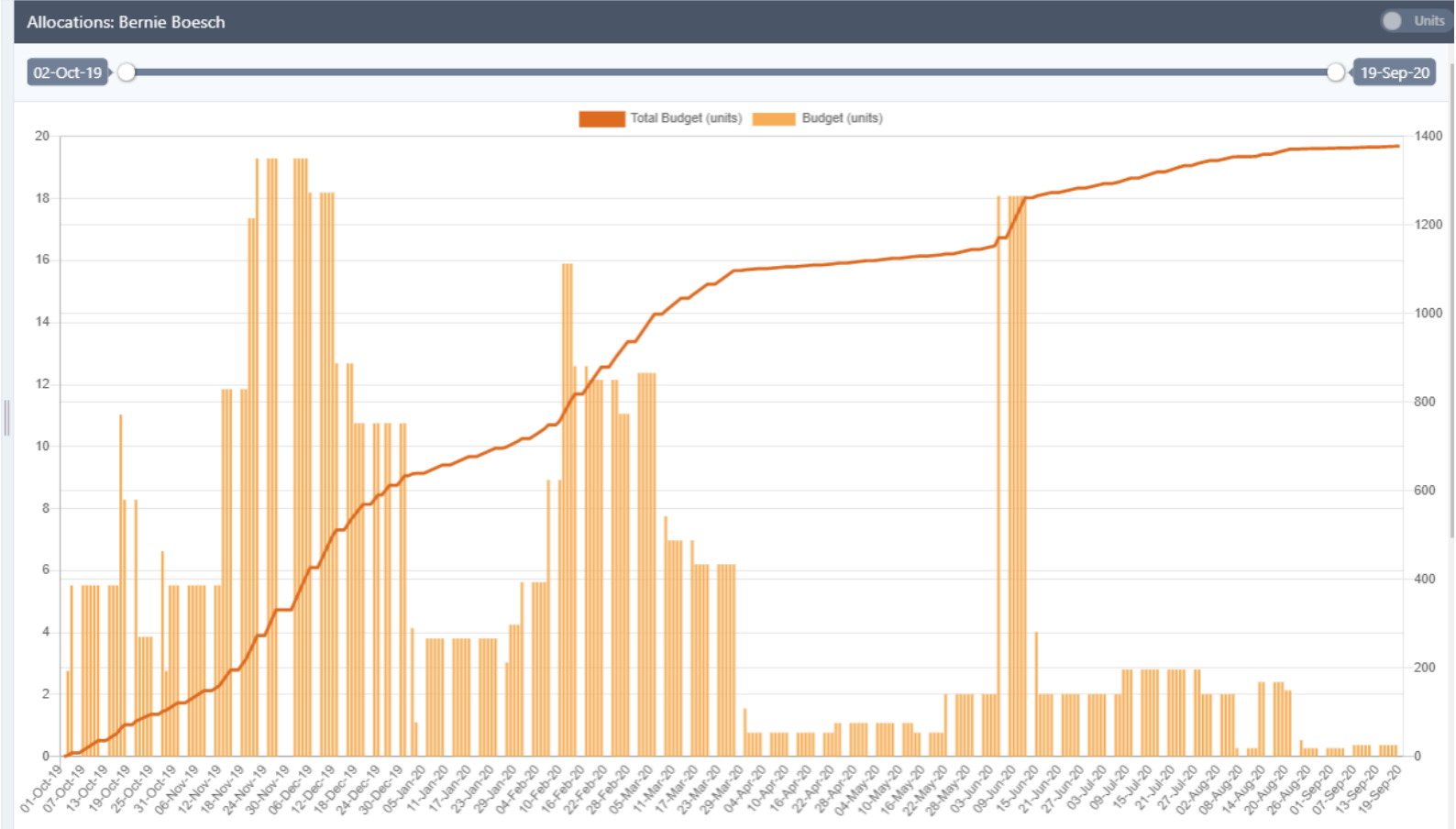


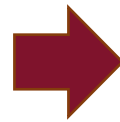
# 'Plan' the Process



# Resource allocation plan

- Architecture
  - Head of Department
  - Director of Design QC
  - Design Project Manager
    - Kirk Van Cleave
    - Stephanie Welch
    - Stacy Strand
    - Bernie Boesch**
    - Bernie Test
  - Assistant Design Project Manager
  - Project Architect
  - Senior Job Captain
  - Design Job Captain
  - Senior Design Project Coordinator
  - Design Project Coordinator
  - Design Technical Coordinator
  - Design Intern
  - Design QC Administrator
- Field Operation
- Civil Engineer
- Processing System
- Waste Treatment
- Geosynthetic Liner
- Structural Engineer
- Mechanical/Plumbing
- Electrical Engineer
- Fire Protection
- Design Pursuits





# Design Process Management





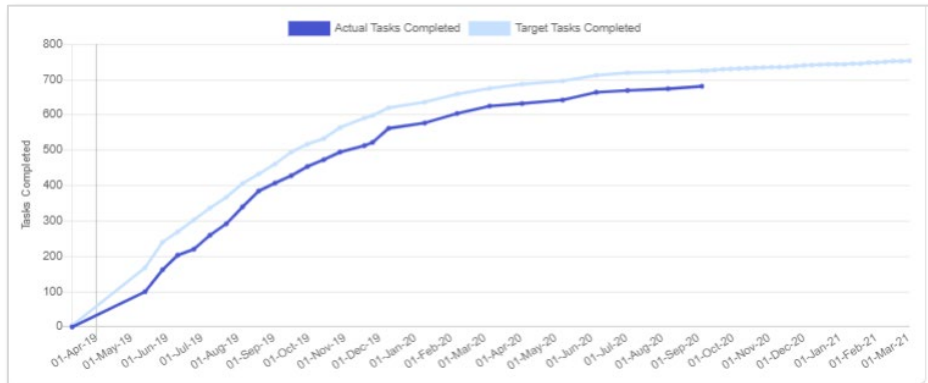
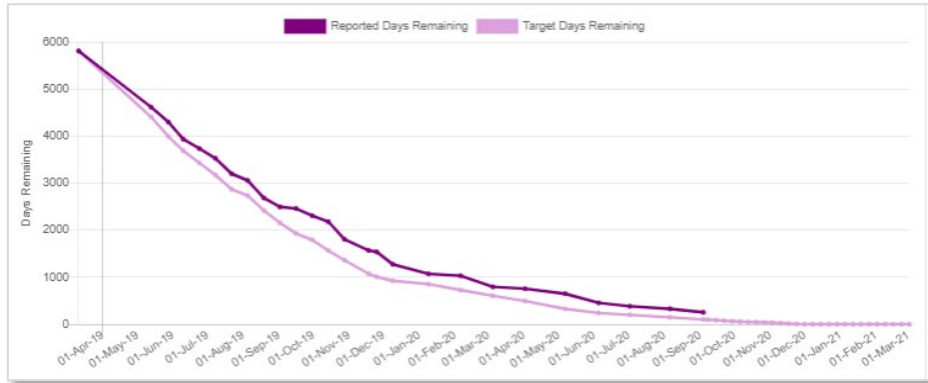
# Deliver: Progress & Issues

Progress

The screenshot displays a project management interface. At the top, it shows 'Current Period Ending: 6 days time'. Below this is a table with columns for 'Progress' and 'Task'. The 'Progress' column contains icons representing task status (e.g., yellow for 'At Risk', green for 'On Track'). The 'Task' column lists various activities related to 'SCHEMATIC DESIGN PHASE PROTECTION'. A modal window titled 'Reason For Delay' is open, showing details for a specific task: 'Produce General Arrangements, Schedules & Detail Drawings for Signage (Levels 15-42)'. The modal includes fields for 'Type' (Awaiting Client Decision), 'Description' (Client yet to issue brief on signage), 'Reported On' (01-Jul-20), 'Action' (Client to issue signage brief), 'Assign To' (Moda), and 'Due On' (10-Jul-20). There are 'Save' and 'Cancel' buttons at the bottom of the modal. To the right of the modal, a 'Status' column shows various risk levels like 'Started At Risk', 'Finished At Risk', 'Constrained', and 'Ready'.

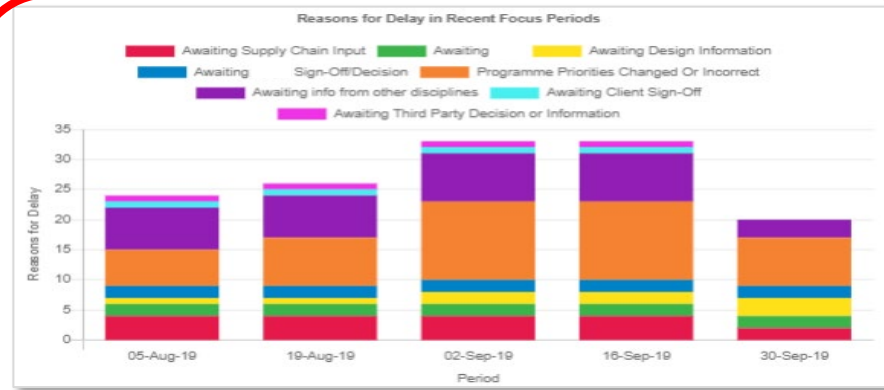
# Deliver: Performance & Forecast

Performance



| Name                          | Status              | Target    | Progressed |
|-------------------------------|---------------------|-----------|------------|
| Schematic design complete     | Missing (by 1 days) | 29-Mar-18 | 30-Mar-18  |
| Elementary School DD complete | Missing (by 1 days) | 14-Jun-18 | 15-Jun-18  |
| Elementary School CD complete | Missing (by 1 days) | 09-Aug-18 | 10-Aug-18  |
| High School CD complete       | Hitting (by 0 days) | 25-Oct-18 | 25-Oct-18  |
| Project Completion            | Hitting (by 0 days) | 25-Oct-18 | 25-Oct-18  |

Forecast






































Issues / Problems



# Deliver: Actions & Control

Actions

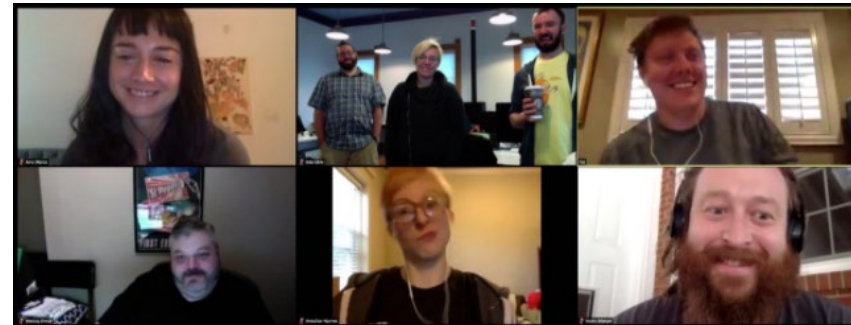
| Action   | Status ↑                                      | Action Owned By   | Relates To  | Issue Raised By   |
|--|---|---|---|---|
|   Don to issue NTP   | 21-Nov-19<br><small>Closed: 22-Nov-19</small> |  <b>Don Rogers</b><br><small>-Field Operation</small>                          | Resource Not Available: RQ waiting on PEMB builder responses for negotiations<br><small>Issue in Appoint PEMB System Specialist</small>   |  <b>Bernie Boesch</b><br><small>-Architecture-Design Project Manager</small>   |
|   Cody to finish field investigation<br><small>Gov't issued letter that Range Access Road to be per RFP making this a mute point</small>   | 27-Nov-19<br><small>Closed: 27-Nov-19</small> |  <b>Cody Phillips</b><br><small>-Field Operation</small>                       | Programme Priorities Changed Or Incorrect: reviewed and requested at CDW<br><small>Issue in Start Site Investigations</small>   |  <b>Bernie Boesch</b><br><small>-Architecture-Design Project Manager</small>   |
|   RQ to setup a meeting with SS&A  | 27-Nov-19<br><small>Closed: 29-Nov-19</small> |  <b>Bernie Boesch</b><br><small>-Architecture-Design Project Manager</small>   | Awaiting Design Information: waste oil system selection<br><small>Issue in MEP Development of Model &amp; Documents for DD</small>  |  <b>Bernie Boesch</b><br><small>-Architecture-Design Project Manager</small>   |
|   Machinex to provide floor drain location for system sorting machine  | 27-Nov-19<br><small>Closed: 27-Nov-19</small> |  <b>Simon-Pierre (SP) Therrien</b><br><small>-Processing System</small>        | Awaiting Design Information: Floor Drain and Roll-Up gate at system sorting machine<br><small>Issue in Ongoing Development of Architectural Model &amp; Documents for DD</small>  |  <b>Bernie Boesch</b><br><small>-Architecture-Design Project Manager</small>   |
|   SCS to provide response if septic tank can handle high water temperature and/or disinfection chemicals<br><small>Bob noted that is should be able to handle 170+ degrees, but not chlorine shall be used, Ken to confirm</small> | 02-Dec-19<br><small>Closed: 02-Dec-19</small> |  <b>Ken Armentrout</b><br><small>-Civil Engineer</small>                       | Awaiting Design Information: septic tank disinfection protocol<br><small>Issue in MEP Development of Model &amp; Documents for DD</small>   |  <b>Bernie Boesch</b><br><small>-Architecture-Design Project Manager</small>   |
|   Move Range Access Road from Critical Path 1 to Design Path 2   | 05-Dec-19<br><small>Closed: 02-Dec-19</small> |  <b>Bernie Boesch</b><br><small>-Architecture-Design Project Manager</small>   | P160 Solid Waste Facility<br><small>Plan in Period: 24-Aug-20 to 31-Aug-20</small>  | None  |
|   MBI to provide hot water demand for Ponds<br><small>RQ to coor. meeting with MBI and SS&amp;A (mech and elect)</small>   | 06-Dec-19<br><small>Closed: 03-Jan-20</small> |  <b>Joel Bowdan</b><br><small>-Waste Treatment</small>                       | Awaiting Design Information: Heating Hot Water Demand<br><small>Issue in MEP Development of Model &amp; Documents for DD</small>  |  <b>Bernie Boesch</b><br><small>-Architecture-Design Project Manager</small> |
|   Rick Perry to review and coor meeting between RQ an SS&A   | 06-Dec-19<br><small>Closed: 27-Dec-19</small> |  <b>RP Rick Perry</b><br><small>-Field Operation</small>                     | Awaiting Design Information: Mech BOD and system selection<br><small>Issue in MEP Development of Model &amp; Documents for DD</small>   |  <b>Bernie Boesch</b><br><small>-Architecture-Design Project Manager</small> |
|   RQ to setup meeting with coffman to discuss  | 06-Dec-19<br><small>Closed: 10-Dec-19</small> |  <b>Bernie Boesch</b><br><small>-Architecture-Design Project Manager</small> | Awaiting Design Information: RQ and Coffman to review items stored and potential RFI itmes<br><small>Issue in Fire Protection Development of Model &amp; Documents for DD</small> |  <b>Bernie Boesch</b><br><small>-Architecture-Design Project Manager</small> |

Issues / Problems

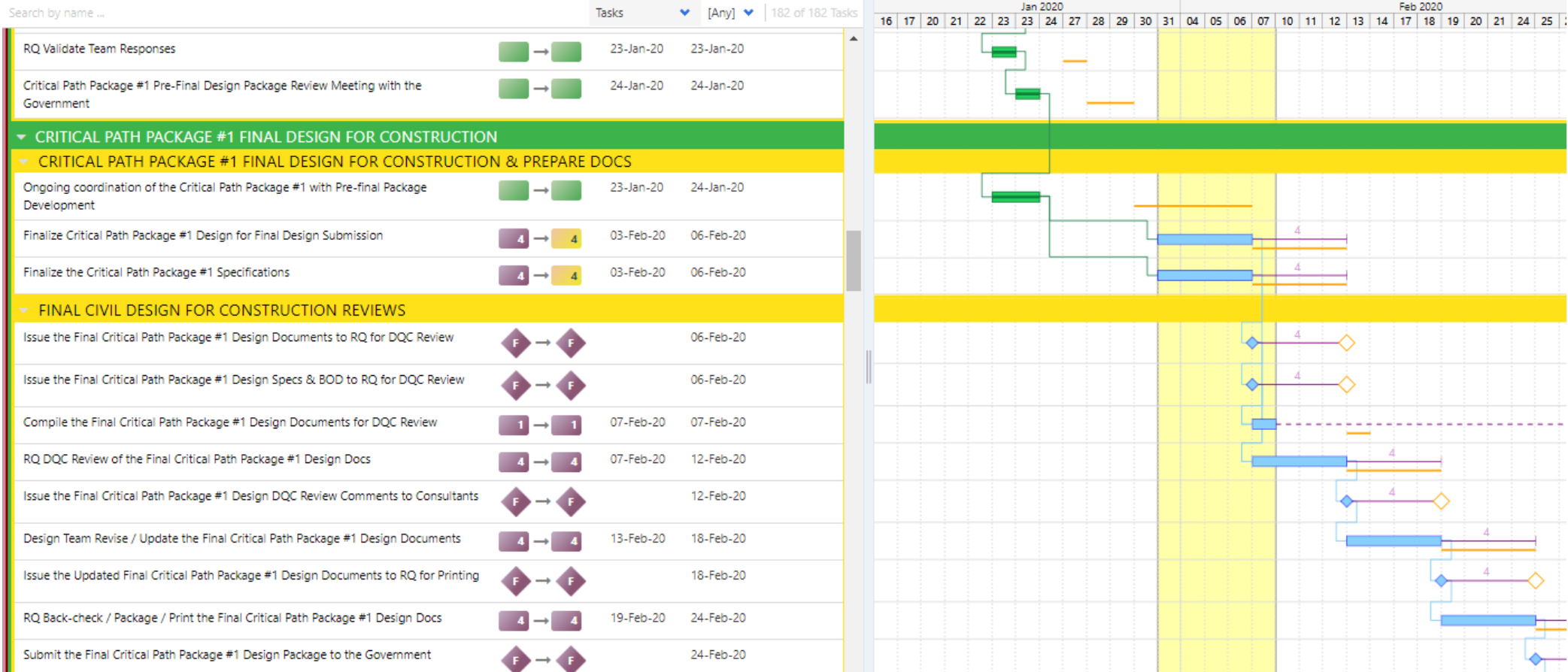


# Deliver: Actions & Control

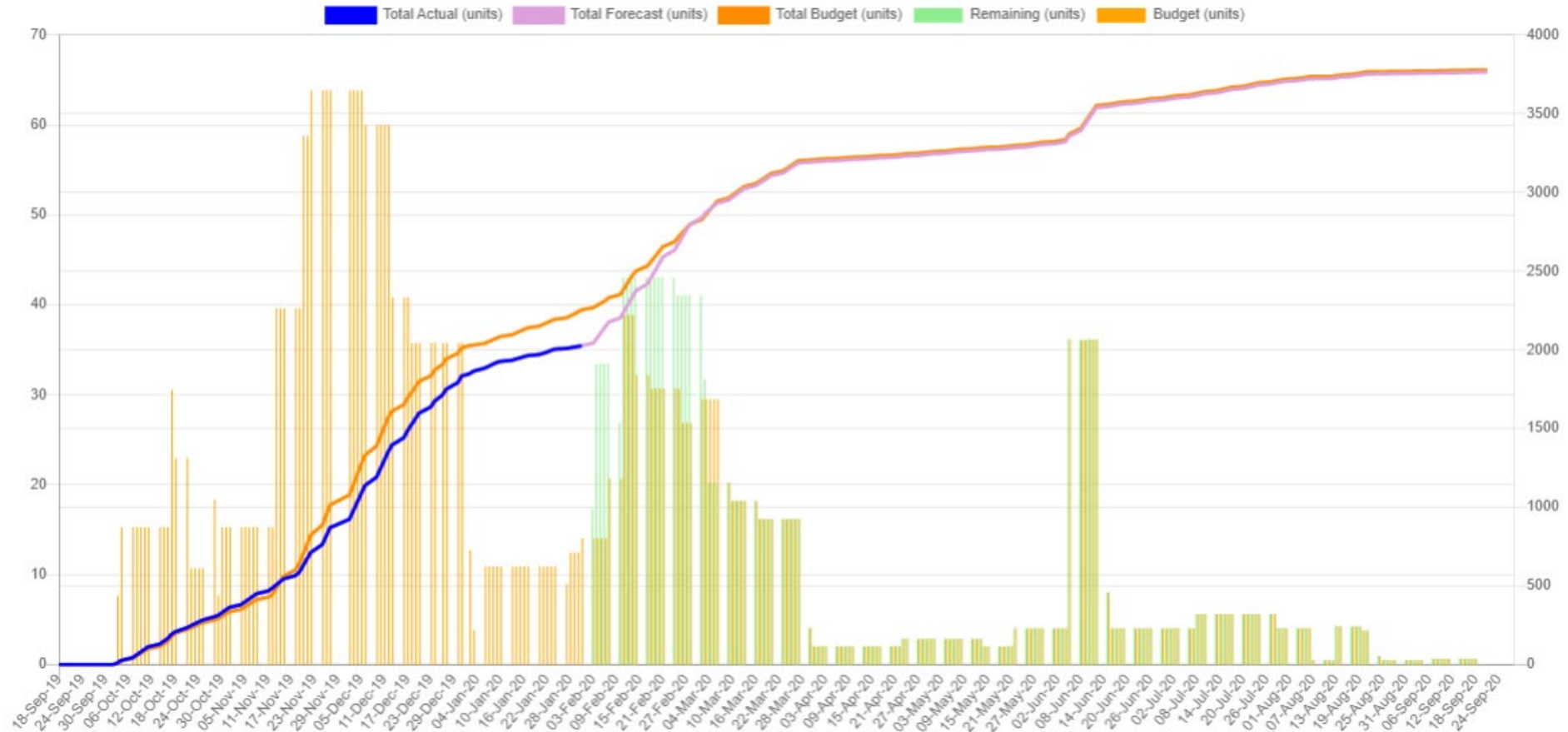
- Design Team Meetings:
  - Issues & Problems
  - Actions
  - Responsibilities & Deadlines
  - Commitments
  - Action Closure



# Progressed schedule



# Resource allocation profile inc. time booked



# Change Modelling

# Change Control Wizard

The screenshot displays the Microsoft Project interface. The ribbon at the top contains various icons, with the 'Change Control Wizard' icon (a purple square with a white 'i') highlighted by a red box. The left-hand pane shows a task hierarchy under 'WBS > CONCEPT > MEPFP DESIGN > SURVEYS'. The selected task is 'Check information on any existing services', which is highlighted in green. Below it, other tasks are listed, including 'Final check on size and location of penetrations for MEPFP services' and 'Compile Quotations Into Cost Check'. The right-hand pane shows the details for the selected task, including its name, primary resource (Mechanical Engineer), activity duration (0 days remaining), and start/finish dates (10-May-21 to 12-May-21). It also lists predecessors (0) and successors (2), with the latter including 'Prepare Concept Design Submittal' and 'Produce report on any existing services installations (if necessary)'. The bottom status bar indicates 'Ready' and shows the project name 'BIM Process Building Project Demo, 541 Tasks, 1806 Links'.



# Indicate any Rework

Change Control Wizard - Step 1

Check information on any existing services  
~CONCEPT~MEPFP DESIGN~SURVEYS

0 of 3 days

# Further Potential Rework is Identified

Change Control Wizard - Step 1

|   |   |           |
|---|---|-----------|
| Check information on any existing services<br>-CONCEPT-MEPFP DESIGN-SURVEYS                           | 1 | of 3 days |
| Prepare Concept Design Submittal<br>-CONCEPT-CONCEPT DOCUMENTATION                                    | 0 | of 5 days |
| Produce report on any existing services installations (if necessary)<br>-CONCEPT-MEPFP DESIGN-SURVEYS | 0 | of 3 days |


# Confirm All Required Rework

Change Control Wizard - Step 1

|  |                                |            |
|--|--------------------------------|------------|
| Check information on any existing services<br>-CONCEPT-MEPFP DESIGN-SURVEYS  | <input type="text" value="1"/> | of 3 days  |
| Prepare Concept Design Submittal<br>-CONCEPT-CONCEPT DOCUMENTATION   | <input type="text" value="1"/> | of 5 days  |
| Produce report on any existing services installations (if necessary)<br>-CONCEPT-MEPFP DESIGN-SURVEYS                                | <input type="text" value="2"/> | of 3 days  |
| Review & Comment on Concept Design<br>-CONCEPT-CONCEPT DOCUMENTATION   | <input type="text" value="1"/> | of 10 days |
| Fix site / building footprint dimensions and building positions<br>-PRELIMINARY DESIGN-ARCHITECTURE-GENERAL ACTIVITIES-KEY DECISIONS | <input type="text" value="3"/> | of 3 days  |
| Finalize room dimensions & layout<br>-DETAILED DESIGN-ARCHITECTURE-GENERAL ACTIVITIES-KEY DECISIONS                                  | <input type="text" value="1"/> | of 5 days  |

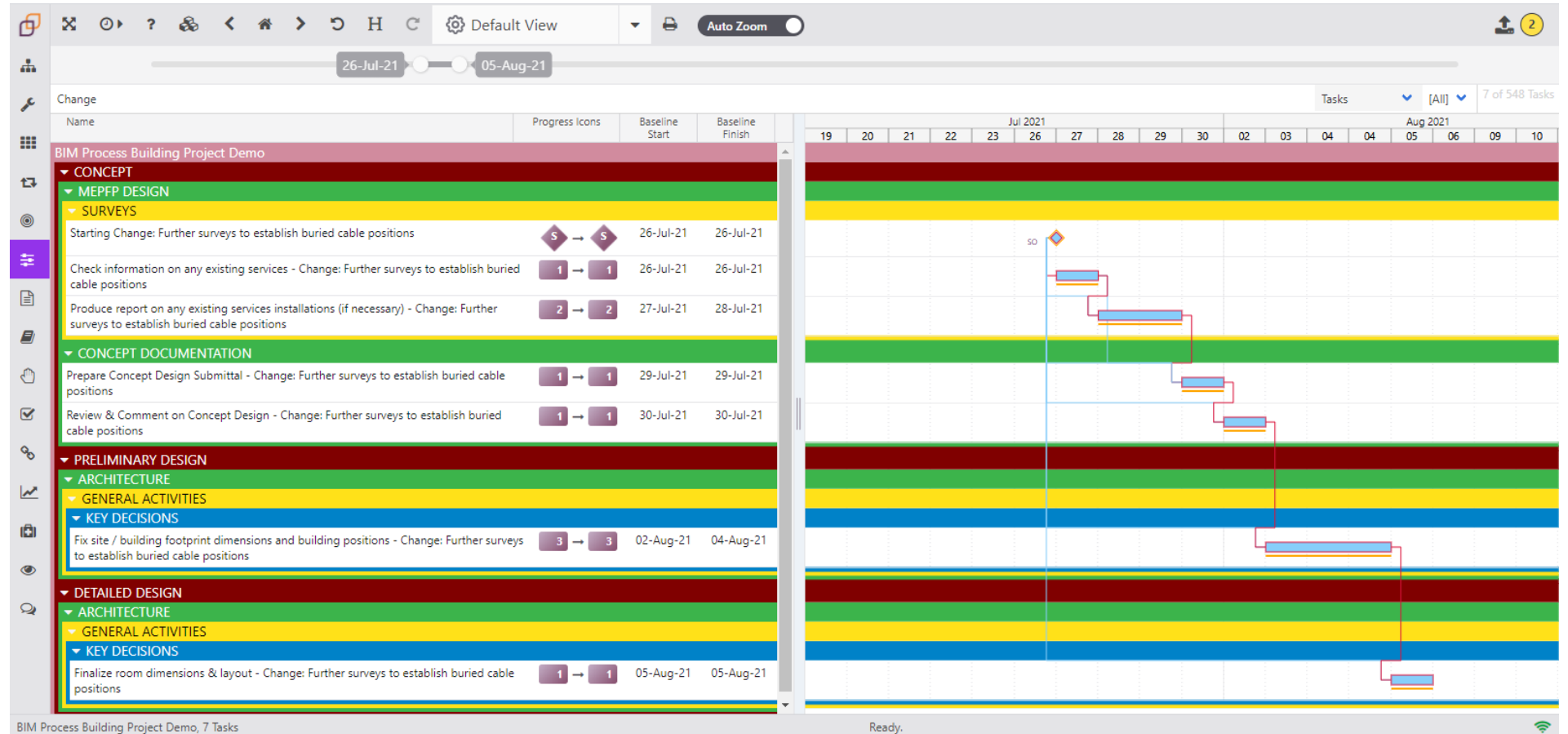
# Name the Change; Identify the Rework Start Date

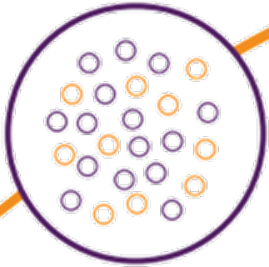
Change Control Wizard - Step 2 ✕

|          |   |   |
|----------|---|---|
| Name     | Further surveys to establish buried cable positions |   |
| Starting | 26-Jul-21   |  |

Apply Close

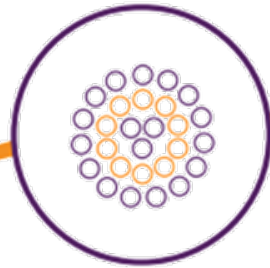
# Re-work Activities embedded into Schedule





## DEFINE

Process, dependencies  
& resources



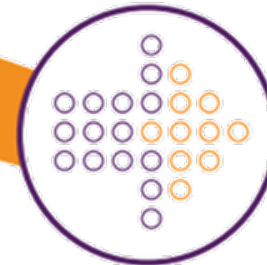
## STREAMLINE

Optimise the decision  
making process



## PLAN

Align with  
project constraints



## DELIVER

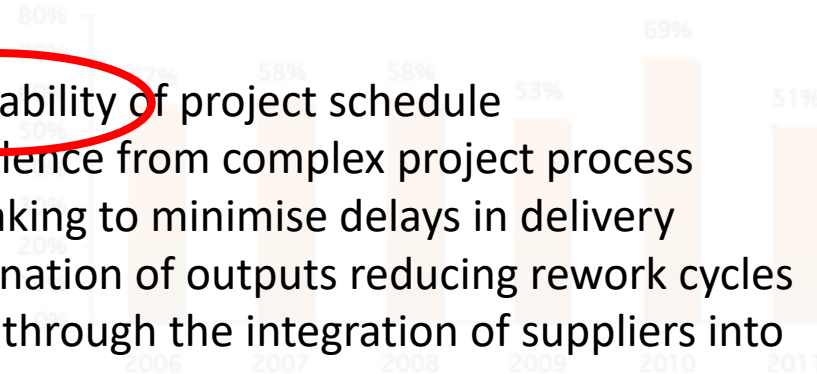
Resolve issues & actions,  
update progress,  
dashboard reporting

# Summary & Lessons

## Predictability Time - Design

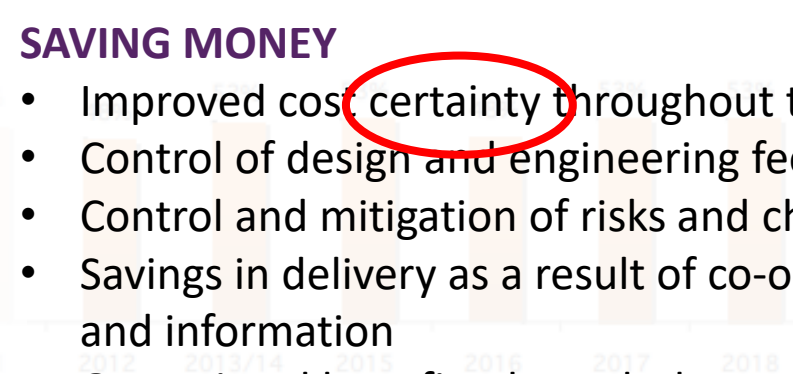
### SAVING TIME

- Improved predictability of project schedule
- Removal of turbulence from complex project process
- Agile decision-making to minimise delays in delivery
- Improved co-ordination of outputs reducing rework cycles
- Schedule savings through the integration of suppliers into the process

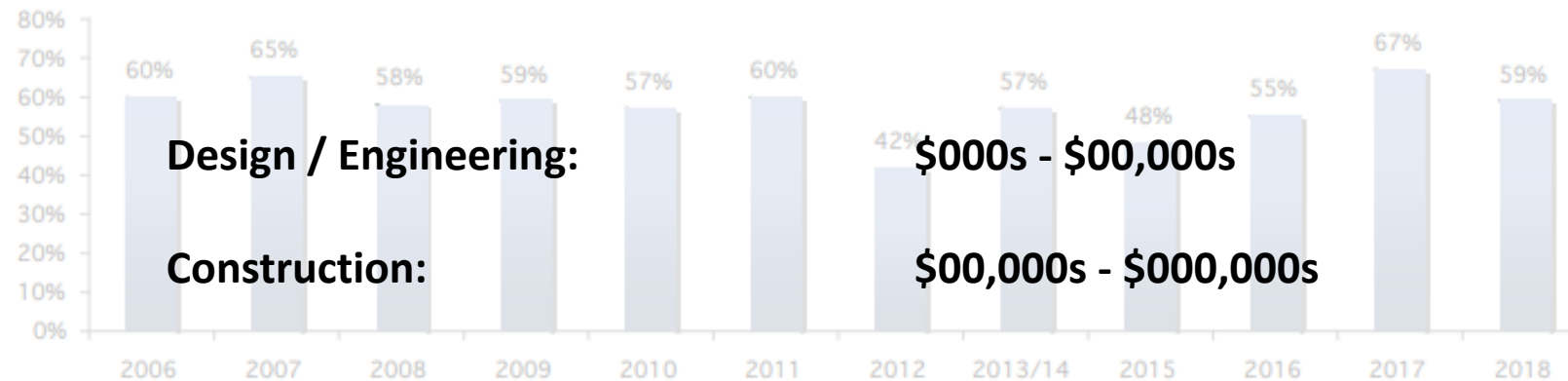


### SAVING MONEY

- Improved cost certainty throughout the project lifecycle
- Control of design and engineering fees
- Control and mitigation of risks and change events
- Savings in delivery as a result of co-ordinated processes and information
- Operational benefits through the early completion of projects



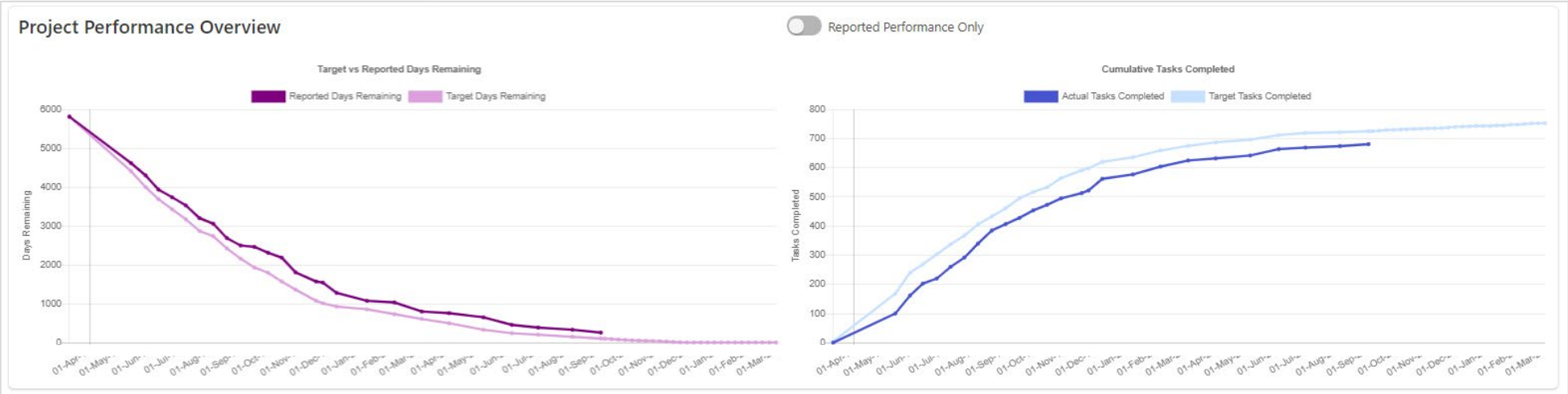
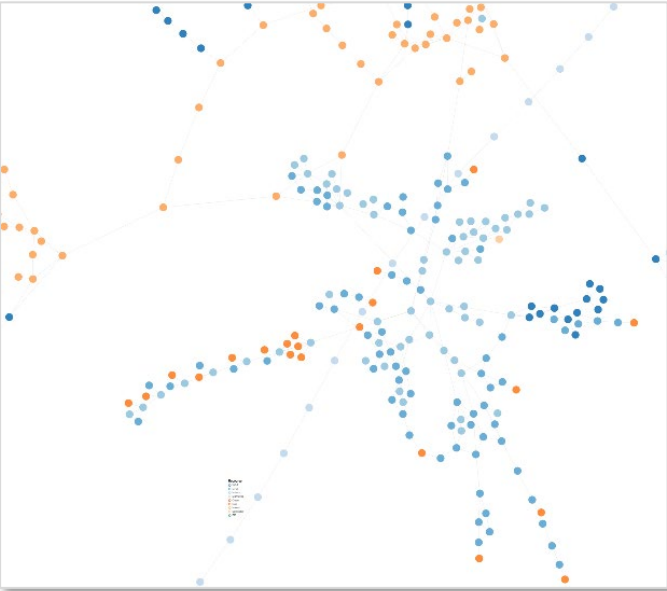
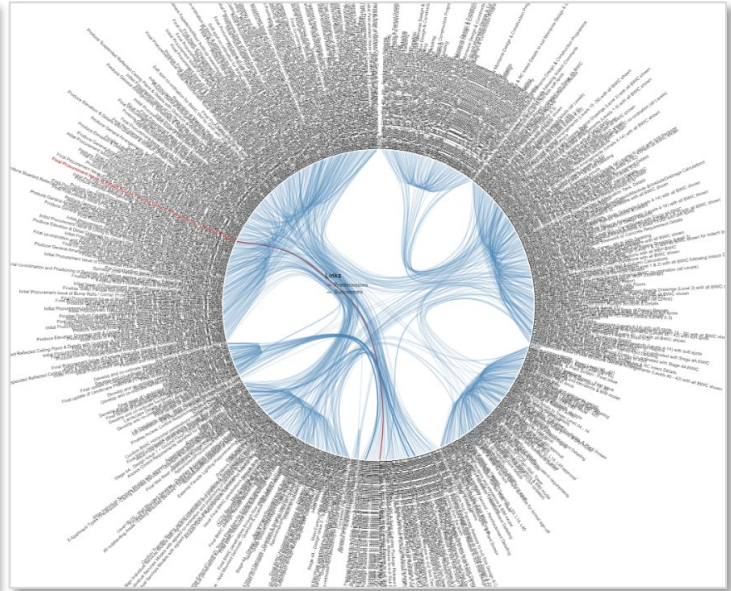
## Predictability Time - Construction



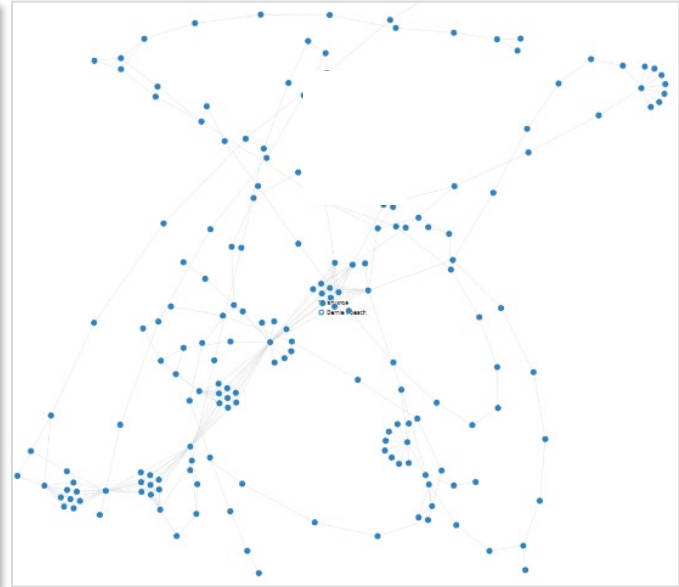
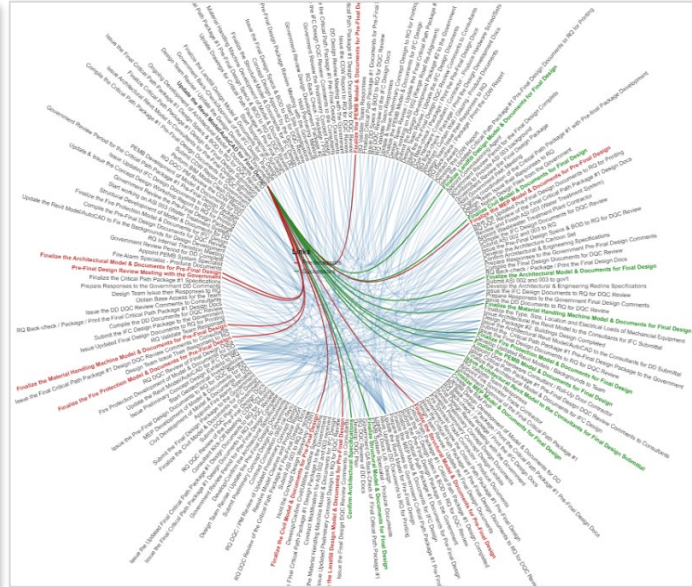




- 212 Broad Street
- Architectural Integrated Design Programme Elements (GHA)
- Landscape Architect Integrated Design Programme Elements (Oobe)
- Structural Integrated Design Programme Elements (WSP)
  - Information Required by WSP from the Wider Design Team
  - Finalise Civils Design Work
  - Raft Setting & Ramps General Arrangements & Sections
  - Finalisation of Jumpform Core Wall General Arrangements
  - Finalisation of Structural Elements - Level 1 - 3
  - Finalisation of Structural Elements - Level 4 - 14
  - Finalisation of Structural Elements - Level 15 - 42
  - Miscellaneous Structural Packages
  - Reports
  - Structural Calculations
  - Specifications
- MEP Integrated Design Programme Elements (Imtech/Hydrock)
  - Information Required by Imtech from the Wider Design Team
  - Stage 4A - Design Issues to Sisk
  - Stage 4B & Construction Issue Drawings
  - Electrical
  - Mechanical
  - Short Term Deliverables for Sub-structure Works
  - Short Term Deliverables for Super Structure Works
  - Thermal Modelling, Energy modelling
  - Stage 4 Mechanical & Public Health Design
  - CPD Specialist Systems Design Packages (Mechanical)
  - Stage 4 Electrical Design
  - CPD Specialist Systems Design Packages (Electrical)



- ▶ DESIGN PROJECT SCHEDULE
- ▶ RQ DESIGN PROJECT MOBILIZATION
- ▶ PREDESIGN
- ▶ CRITICAL PATH DESIGN PACKAGE #1 - CLEAR/GRUB, ACCESS ROAD, UTILITIES
- ▶ CONCEPT DESIGN
- ▶ CRITICAL PATH PACKAGE #1 - 100% PRE-FINAL
- ▶ CRITICAL PATH PACKAGE #1 FINAL DESIGN FOR CONSTRUCTION
- ▶ DESIGN PACKAGE #2 - SITE, BUILDINGS, LANDFILLS
- ▶ DESIGN PACKAGE #2 - CONSTRUCTION DOCUMENT (65%)
  - ▶ SPECIALIST TRADE CONTRACTOR DESIGN INPUT
  - ▶ DEVELOP DESIGN DEVELOPMENT & PREPARE DOCS
  - ▶ DESIGN DEVELOPMENT REVIEWS
- ▶ DESIGN PACKAGE #2 - PRE-FINAL DESIGN
  - ▶ TRADE CONTRACTOR PRE-FINAL DESIGN
  - ▶ PRE-FINAL DESIGN & PREPARE DOCS
  - ▶ PRE-FINAL DESIGN REVIEWS
- ▶ DESIGN PACKAGE #2 - FINAL DESIGN
  - ▶ FINAL DESIGN & PREPARE DOCS
  - ▶ FINAL DESIGN REVIEWS
- ▶ DESIGN PACKAGE #2 - FINAL DESIGN FOR CONSTRUCTION
  - ▶ FINAL DESIGN FOR CONSTRUCTION DESIGN & PREPARE DOCS
  - ▶ ISSUE FOR CONSTRUCTION DESIGN FOR CONSTRUCTION APPROVAL
  - ▶ DESIGN PACKAGE #2 - ASI 002 and 003



## Project Performance Overview

Reported Performance Only

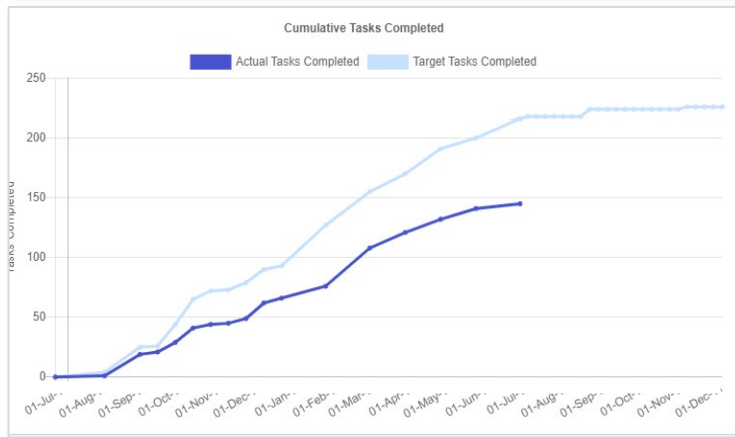
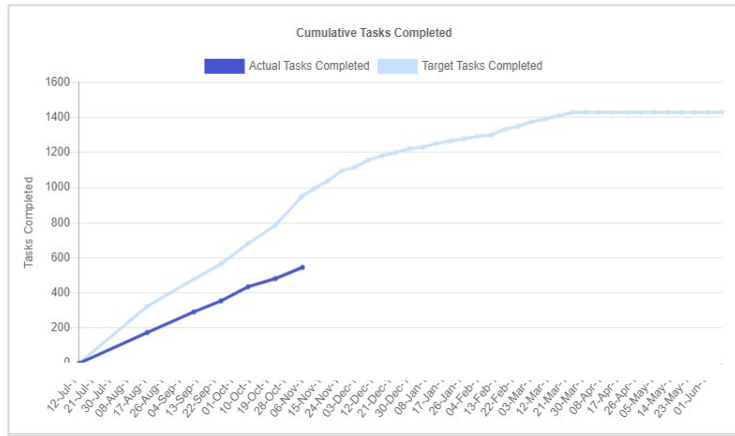


## Cost Performance Overview

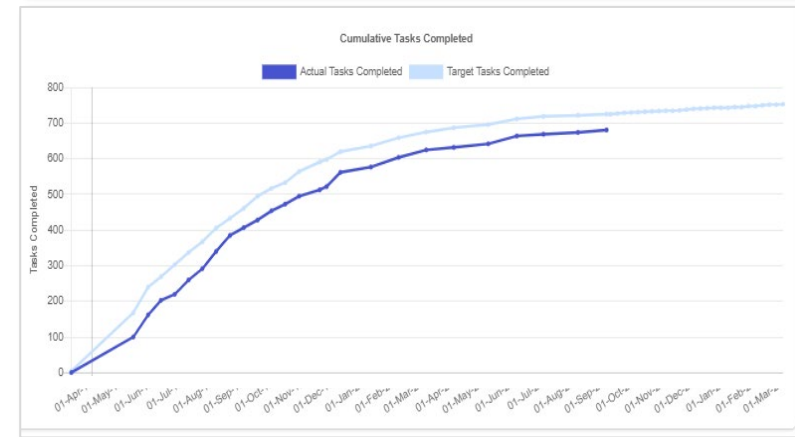
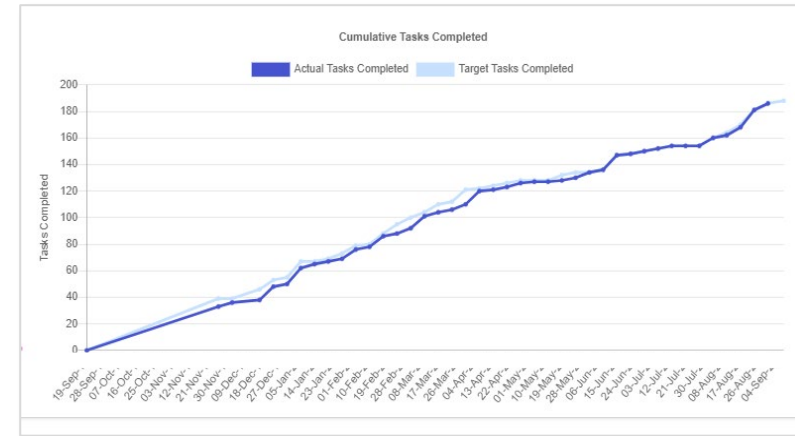
Reported Cost Only

Cost Variance: -11761    Schedule Variance: 1704    CPI: 0.956    SPI: 1.007

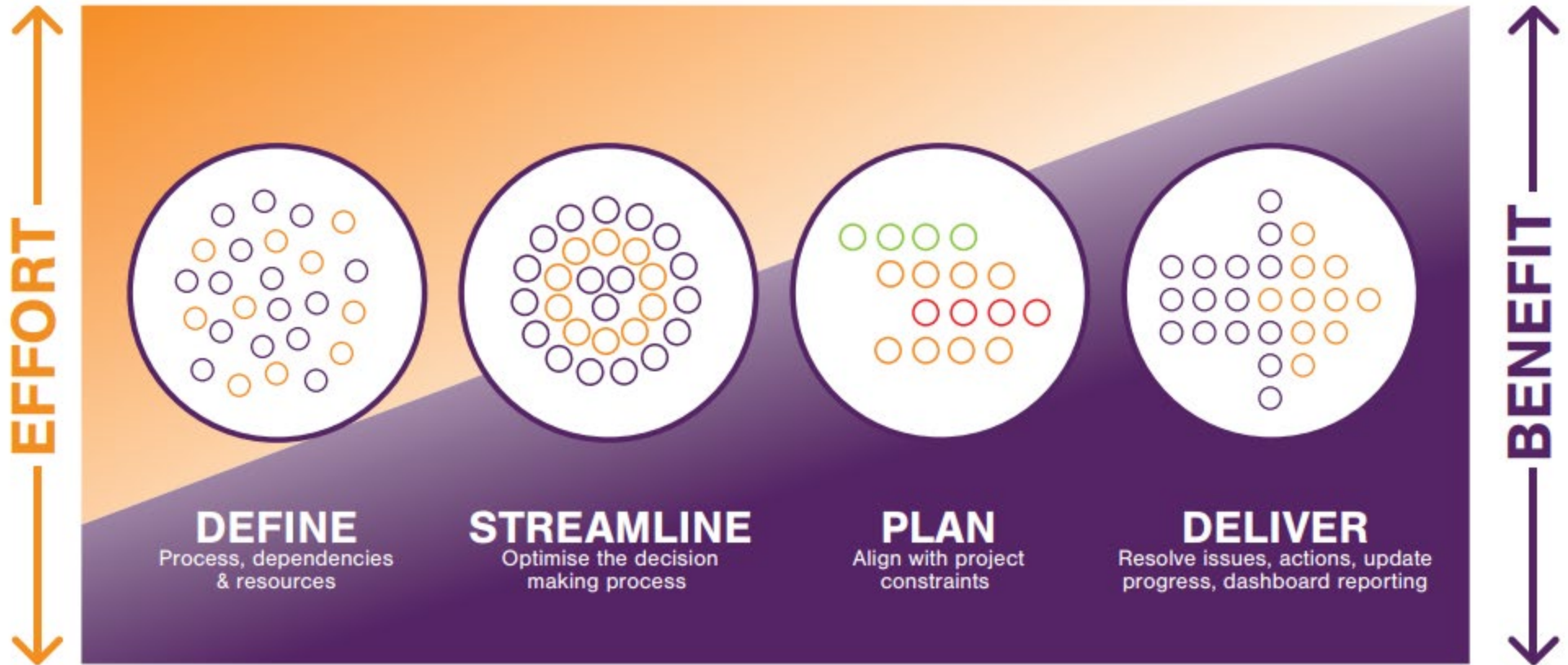
# Project Performance



Enhanced Control



# Benefit versus Effort



# Content

- Introduction
- The Design and Engineering Process
- Process Definition and Planning
- Design Process Management
- Change Modelling
- Lessons

# Application of Project Controls methods in the Design & Engineering stage of major construction and infrastructure projects

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