CS502226

How to Optimize Project, Design & Risk Management with Forge

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Learning Objectives

- Learn about how Autodesk Forge is a powerful tool to manage your projects and access data.
- Learn how to apply automated processes that increase productivity and quality, reducing costs.
- Learn about adopting standardized processes and methods that allow for scalability and higher ROI.
- Learn about implementing workflows using standard formats and automated processes to satisfy your needs and improve your outcomes.

Description

In this class, we will go through workflows and automated processes that enable us to track deliverables' development progress and compare with schedule and budget more efficiently and accurately. We will work within the ISO 19650 framework and use some of the standards' metrics in a set of dashboards to provide an overview of the sample project's development. To analyze the data, it first gets exported from BIM 360 software and Revit files using Autodesk Forge APIs. All exported data, with schedule and budget, is imported into Microsoft Power BI. For contextualization, we also embed the Autodesk Forge Viewer into Microsoft Power BI, enabling us to dynamically switch between the project's models and sheets corresponding to the data displayed on the dashboards. This approach to data and project management allows us to improve collaboration, enhance quality of deliverables, and reduce cost and risk. Throughout the course of two years, we predict saving $190,000 in one project alone.

Speaker

Figure 1: Presenter's photo

Anna Roig Escolano is a Senior Specialist in the Digital Twin Solutions group at Mott MacDonald with 10-years of experience working in the Virtual Design and Construction (VDC) and Digital Delivery field for the Architecture, Engineering, and Construction (AEC) industry.

Anna is originally from Valencia in Spain. She studied Architecture and later obtained her Masters in Structural Engineering.

She has experience in high profile projects and advanced knowledge in infrastructure design and construction. Anna is inquisitive about new applications and solutions with a passion for the future of AEC technology; a creative problem-solver with an interest in improving processes who encourages collaboration and knowledge sharing among team members. She has a strong technical skill set with a desire to expand workplace competencies and is very committed and self-motivated with the ability to push boundaries and to step out of her comfort zone.

Now with Mott MacDonald, Anna's focus is on implementing new digital delivery technologies, developing custom made tools and optimizing digital processes globally.

About Mott MacDonald

The **Mott MacDonald Group** is a consultancy headquartered in the United Kingdom. It employs 16,000 staff in 150 countries. Mott MacDonald is one of the largest employee-owned companies in the world.

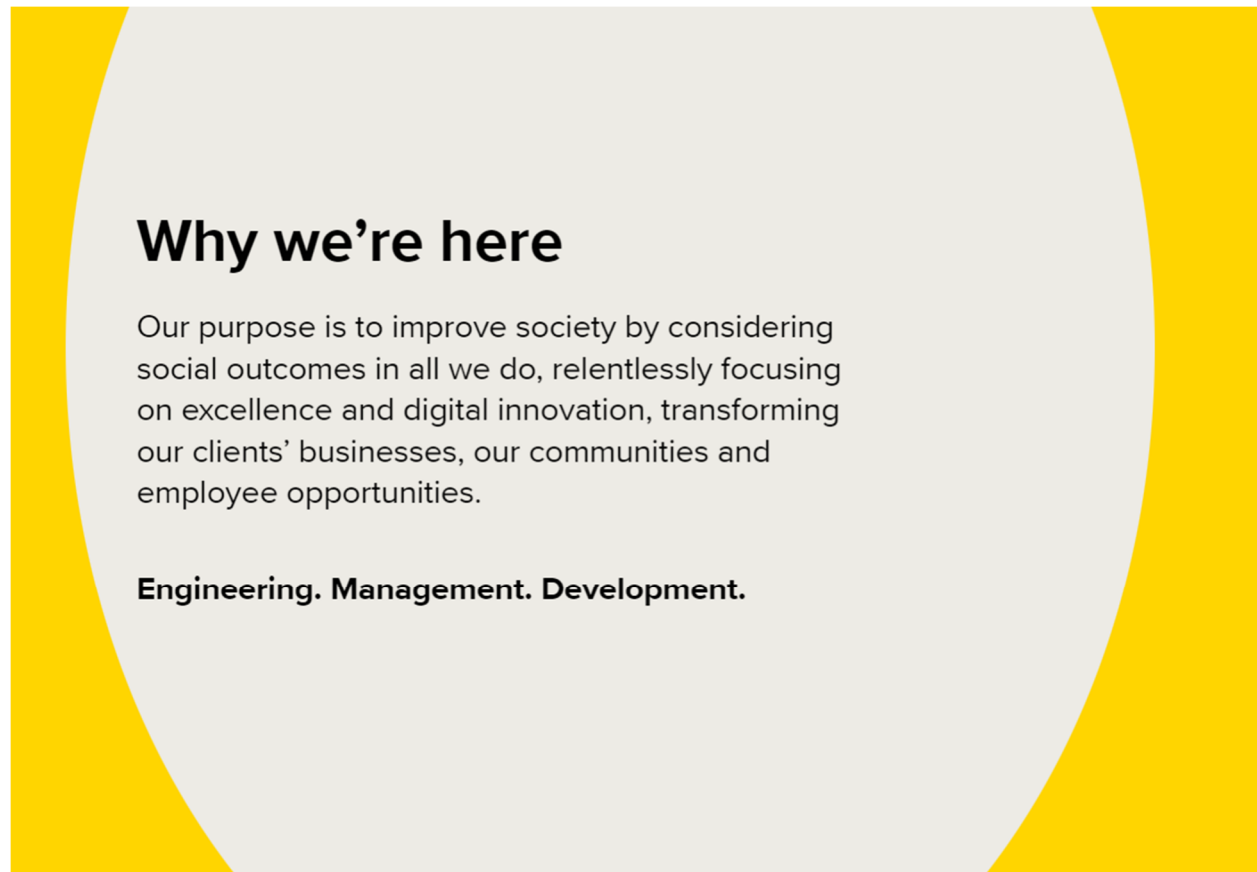**Find out more at** www.mottmac.com

Figure 2: Mott MacDonald's purpose

Introduction

This class provides insight into why and how Autodesk Forge, used with industry standards and best practices, can be an incredible tool for Project and Design Management. By providing an example project, this handout will serve as a reference for any firm looking to step up their visual management tools. This makes it a great class for attendees in a management position looking for innovated automated workflows for project and business management.
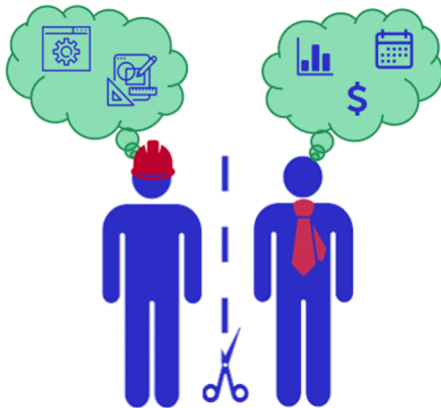
Case Study

The case study project for this class is the restoration of a major linear infrastructure. The infrastructure is 92 miles or 148 km long, it is over 100 years old and services water to one of the biggest cities in the world. Mott MacDonald provides condition assessment, detailed design, facility planning and design services during construction.

For the application of this management tool idea, a project with a high level of digital maturity and standardization and of substantial size is needed to make sure that the solution is scalable. The case study is a multi-year, multi-discipline project with lots of different models and deliverables, which makes an ideal candidate.

Another big factor for our solution and Mott MacDonald's Digital Delivery Strategy, in general, is the use of ISO 19650 standards.

Problem

In large scale projects, it is common that the engineers working on the job don't have a lot of transparency into the project financials; specifically, at the discipline level. They might have an overall view of the scope, schedule and budget of the project, but are missing the link to understand if their deliverables are at the right level of development compared to other metrics.

On the other hand, project managers rely on the technical capabilities of the design team to deliver a good quality product. With the project manager's efforts solely focused on client care, ensuring deliverables are produced in a timely manner, that budget goals are hit, etc.

A major disconnect between Project Management and Design Management.

Figure 3: Project Management & Design Management disengagement

Goal and Solution

The goal of this course is to improve the engagement and collaboration of the Design Team and Project Management Team by creating a unique environment where everyone, regardless of project role, can access complete and relevant information.

The objective is to make the commercial side of the project accessible and meaningful to designers and the design side (models, drawings, etc.) easy to view for managers. This platform will combine all project components into a single source of truth for higher accountability and better understanding and communication within the team.

In other words: **Build an easy and intuitive common project team environment.**
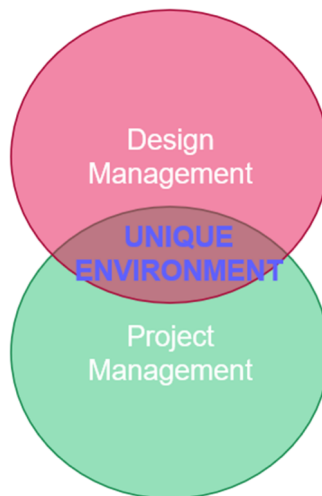
Figure 4: Unique environment

Process for Automation

Standardized Framework

Standardization allows for scalability and a higher profitability of an investment for automation.

Application of ISO 19650 information management standards in BIM 360 and Revit

ISO stands for International Organization for Standardization. The 19650 standards' title is: Organization and digitalization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling and provides standards to manage information using BIM during the entire life cycle of an asset.

In the case study used for this class, there are 16 different sub-contractors all using the ISO 19650 standards. When the entire project team is using the same standard, it allows not only to control information properly but obligates everyone involved to manage their data in the same way.

Links have been provided below to the ISO 19650 Standards:

- [ISO 19650-1:2018 – Part 1: Concepts and principles](#)
- [ISO 19650-2:2018 – Part 2: Delivery phase of the assets](#)
- [ISO 19650-3:2020 – Part 3: Operational phase of the assets](#)
- [ISO 19650-4:2022 – Part 4: Information exchange](#)
- [ISO 19650-5:2020 – Part 5: Security-minded approach to information management](#)
- [ISO/AWI 19650-6 – Part 6: Health and Safety](#)

ISO 19650 Workflows in BIM360

In May 2021, Autodesk released new features and functionalities in BIM360 Docs that allow the user to setup the project in accordance with ISO 19650 Standards.

- [Set Up a Naming Standard](#),
- [Naming Standard Template](#),
- [Attributes](#),
- [Status Codes](#),
- [Revision Codes](#);

These features and functionalities are only available for new projects. Our case study's data environment (including BIM360) was setup prior this release; therefore, these new workflows will not be shared in this handout and class.

The relevant ISO 19650 standards used in this exercise, as well as the resulting benefits, are covered in the following sections of this handout.

ISO 19650 Standards

The relevant ISO 19650 standards used in this example are the following:

- **Information container identification (ID) or naming convention**

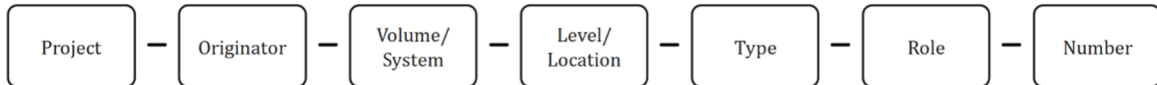| Project | — | Originator | — | Volume/ System | — | Level/ Location | — | Type | — | Role | — | Number |

Figure 5: *Identification of information containers within a common data environment*. Taken from *BS EN ISO 19650-2:2018*.

- **Status or suitability codes**

Code	Description	Revision
Work in progress (WIP)		
S0	Initial status	Preliminary revision and version
Shared (non-contractual)		
S1	Suitable for coordination	Preliminary revision
S2	Suitable for information	Preliminary revision
S3	Suitable for review and comment	Preliminary revision
S4	Suitable for stage approval	Preliminary revision
S5	Withdrawn	N/A
S6	Suitable for PIM authorization	Preliminary revision
S7	Suitable for AIM authorization	Preliminary revision
Published (contractual)		
A1, A*n*, etc.	Authorized and accepted	Contractual revision
B1, B*n*, etc.	Partial sign-off (with comments)	Preliminary revision
Published (for AIM acceptance)		
CR	As constructed record document	Contractual revision

Figure 6: *Status codes for information containers within a common data environment*. Taken from *BS EN ISO 19650-2:2018*.
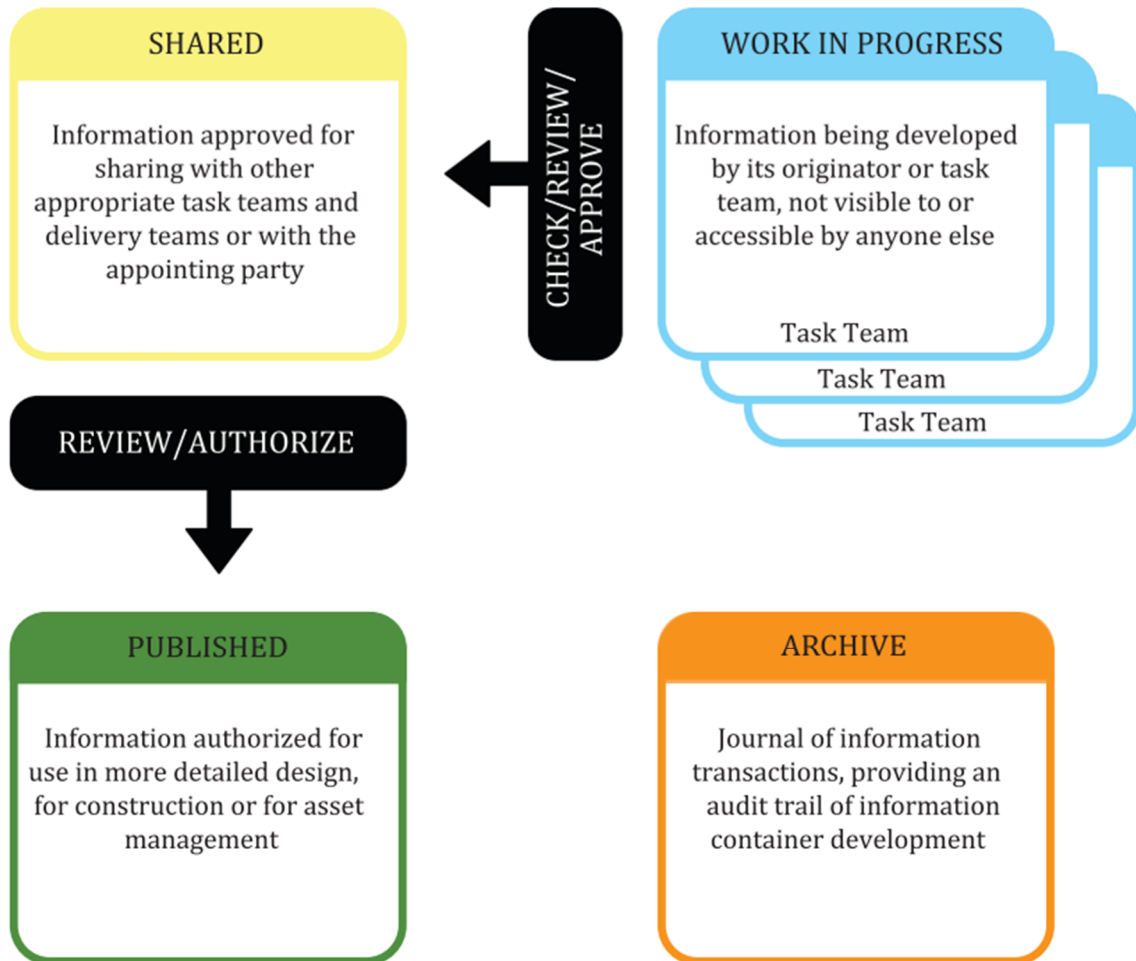
- **State**

Figure 7: *Common data environment (CDE) concept*. Taken from *BS EN ISO 19650-1:2018*.

- **Stage -** In our case study, the stage is defined as one of the following project milestone deliverables: 30%, 60%, 90% or 100%.

Benefits
- Naming and folder structure convention provides a uniform approach towards information and data management.
- Status or suitability codes give the team an understanding of the maturity of the data and what this data can be used for.
- State provides transparency in the status of a file.

Specifically for this class, these are the metrics that we have extracted using Forge API's and used to track design progress. (For further information on Forge, please reference page 12 of the handout.)

Other metadata attributes
To the previously mentioned ISO 19650 standards, we have added "Percent complete" and "Hours to completion". These give us metadata to quantify design progress.

Digital Delivery Architecture

In a Digital Delivery (DD) project, a DD Architecture Map needs to be setup. It lays out the tools and systems where the data resides and how the information flows from system to system.

For the case study used in this exercise the tools for Project Management are:

- **Deltek** for the financials,
- a **Master Information Delivery Plan** to manage deliverables,
- an **excel risk register**,
- and **Microsoft Project** for scheduling.

As per the Design Management the tools are:

- **Civil3D** and **Revit** as design tools to develop models and drawings,
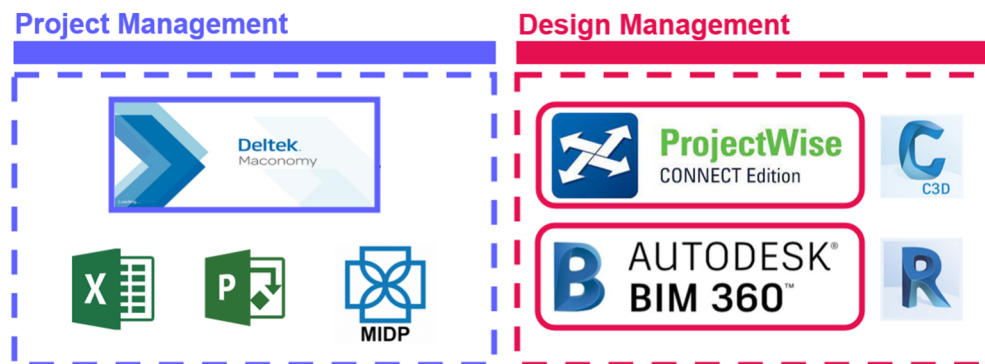- and **ProjectWise** and **BIM360 Docs** as document management tools.

Figure 8: Digital Delivery Architecture

Moata

Traditionally, the Project Manager sets up the management visual tool that allows them to supervise project operations. For that we used **Moata**.
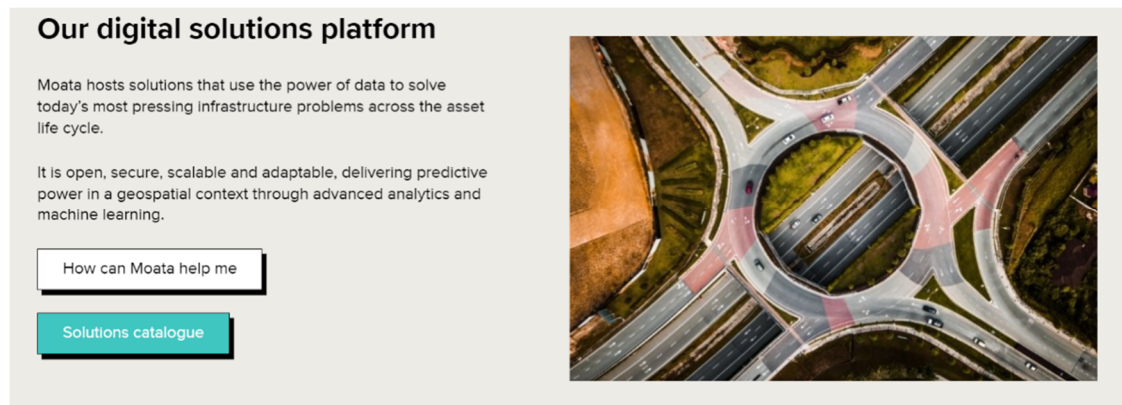
What is Moata?

Figure 9: Moata

Find out more at www.mottmac.com/digital/moata

These dashboards contain Project Management data only and illustrate the lack of connectivity between Project and Design Management. *(See Figure 10)*
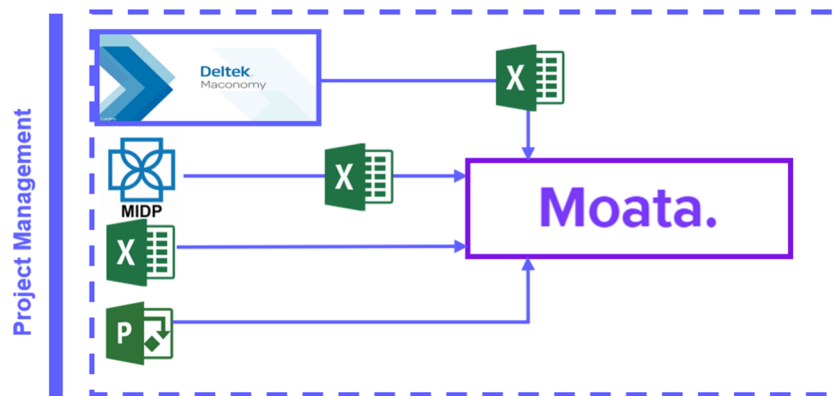

Figure 10: Project Management data flow

Data Extraction with Forge

To combine Project and Design Management data, we automated the process of extracting the data from the Revit files and BIM360 using Forge API's.

Forge is a platform that provides API's, services and apps that allow you to automate industry workflows in a customizable way.

Learn more about Forge here.

When all the data needed is in the desired format, budget, schedule and design information can be compiled in a unique environment using Power BI. *(See Figure 11)*
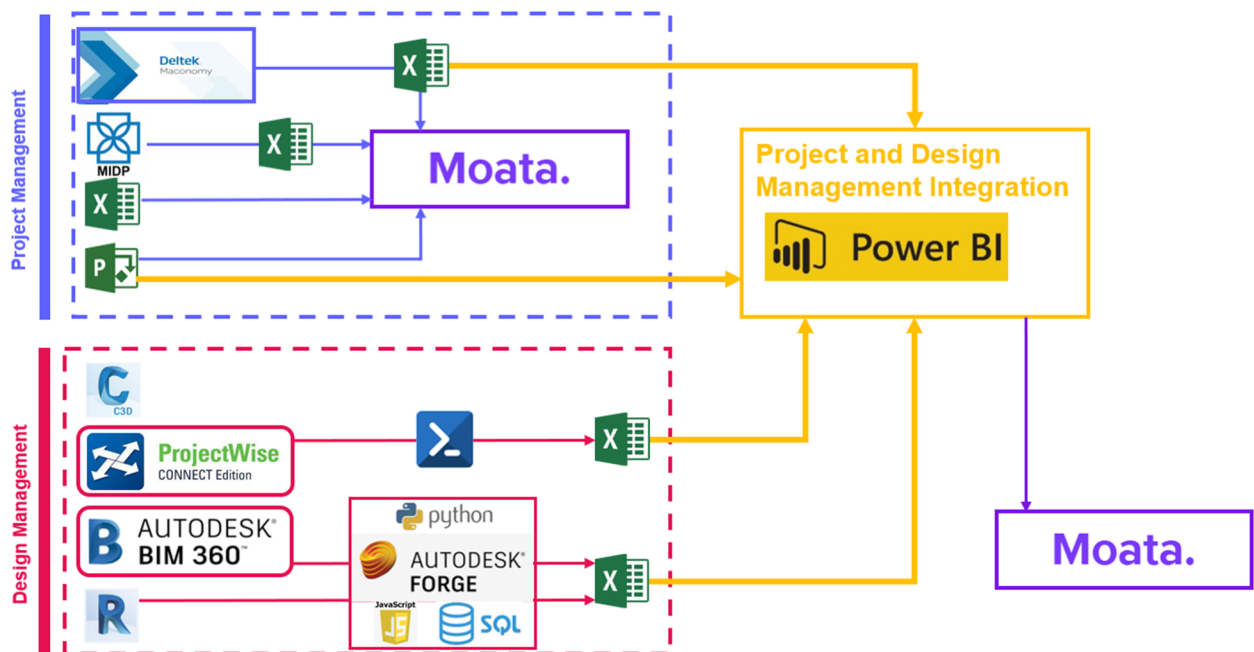

Figure 11: Project Management and Design data flow

For the automated workflow developed to extract the data from Revit and BIM360, the main tools and technologies used were:
- Forge API's
  - Authentication
  - Data Management
  - Model Derivative
- Programming
  - Python,
  - SQL query and,
  - Java Script
- And Power BI

Built Integration

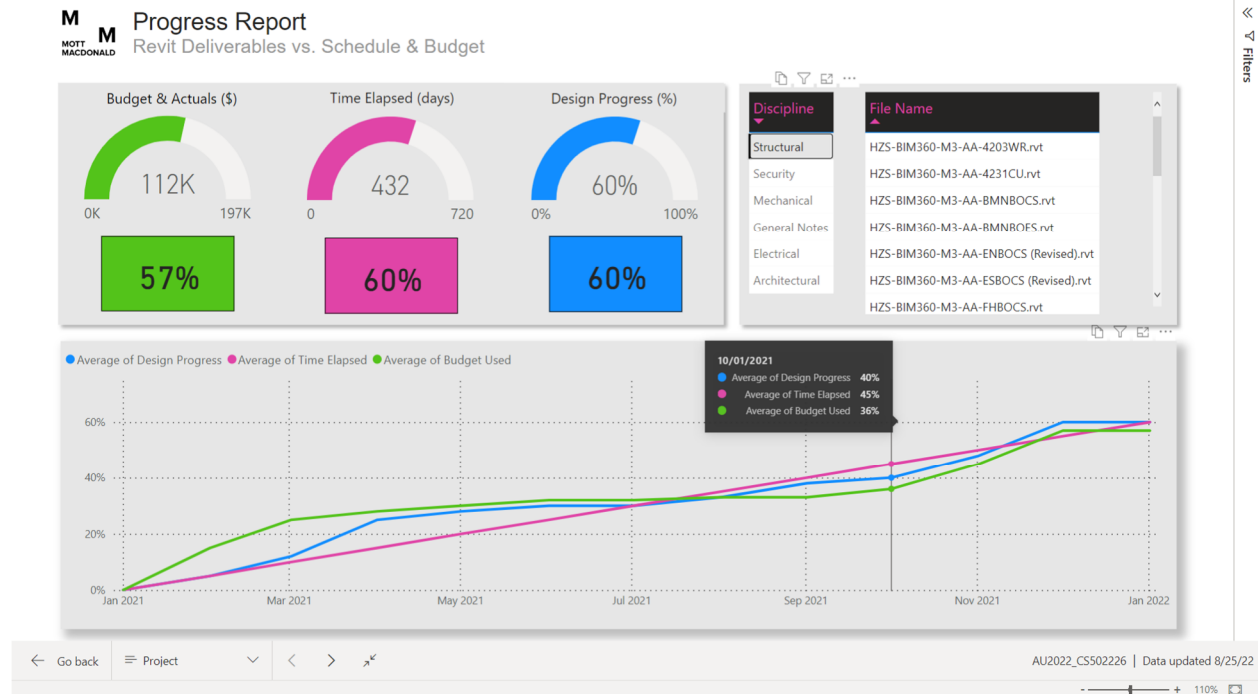### Revit Deliverables vs. Schedule & Budget

Figure 12: Revit Deliverables vs. Schedule & Budget dashboards

The first set of developed dashboards are the "Revit Deliverables vs. Schedule & Budget".

These dashboards represent three different metrics:
- Budget and Actuals, in dollar amounts;
- Time elapsed, in days; and
- Design Progress, in percentages. These are obtained extracting data from BIM360 and Revit with Forge.

These metrics are displayed in absolute values, as well as in percentages, to be easily compared to one another. Additionally, we can see their variations over time on the same graph.

By default, all dashboards reflect the overall status of the project. However, the same data for each discipline separately, or even each model, can be interrogated. It becomes possible to drill down to that level of detail by clicking on any of the items in their corresponding lists. These lists contain all the different disciplines, as well as all the Revit models that constitute the project.

These graphics help the team to assess if budget spent and design progress are adequate at any moment throughout the design phase. They allow for early identification of design progress falling behind or project resources being overspent. This workflow assures a complete and high-quality delivery of contract documents that is within budget and schedule, avoiding unexpected change orders and money loses.

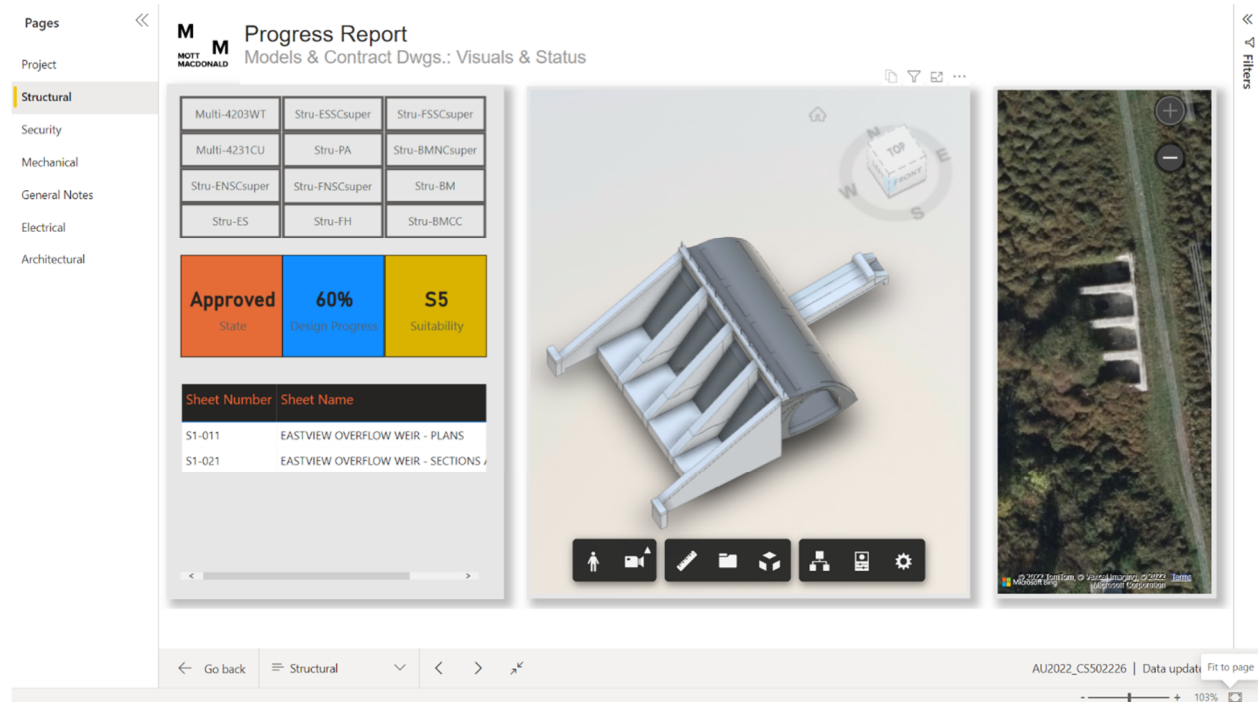## Models & Contract Drawings: Visuals & Status

Figure 13: Models & Contract Drawings: Visuals & Status dashboards

The other set of dashboards are the "Models & Contract Drawings: Visuals & Status".

For contextualization purposes and to provide an easy visualization of models and drawings, the Forge Viewer is embedded into Power BI allowing us to dynamically switch between the models and sheets corresponding to the data displayed on the dashboards.

The embedding of the Forge Viewer into Power BI was achieved with JavaScript code that can be found in this GitHub repository:

Xiaodongliang/forgeviewer_embed_in_powerbi_report

There is a different page for each discipline, in which it is possible to navigate between different models, by clicking on the buttons named after them. The State, Design Progress percentage and Suitability Code are also displayed. As well as the list of drawings produced in the Revit file we are currently interrogating, and their exact location on a map satellite view.

Benefits

Financial Gain

Investment:
- 1 FTE x 13 weeks = 520 hours
- 520 hrs. x $110/hr. = **$57,200**

Money saved per week:
For the case study project, there is a 2-hour weekly meeting, with 20 attendees. The time saved with the use of dashboards in these meetings is 30 minutes.
- 20 people x 0.5 hours/week = 10 hours/week
- 10 hrs./week x $237/hr. = **$2,370/week**

ROI:
- $57,200 (investment) / $2,370/week = **24 weeks**

Long term savings:
The design phase is scheduled for 2 years.
- Life of design phase = 2 years = 104 weeks
- $2,370/week x (104 – 24) weeks = **$189,600**

Scaled savings:
Since the workflow has been implemented in a very scalable way and developed within the ISO framework, it can be applied to any project. Making the financial benefits exponential.
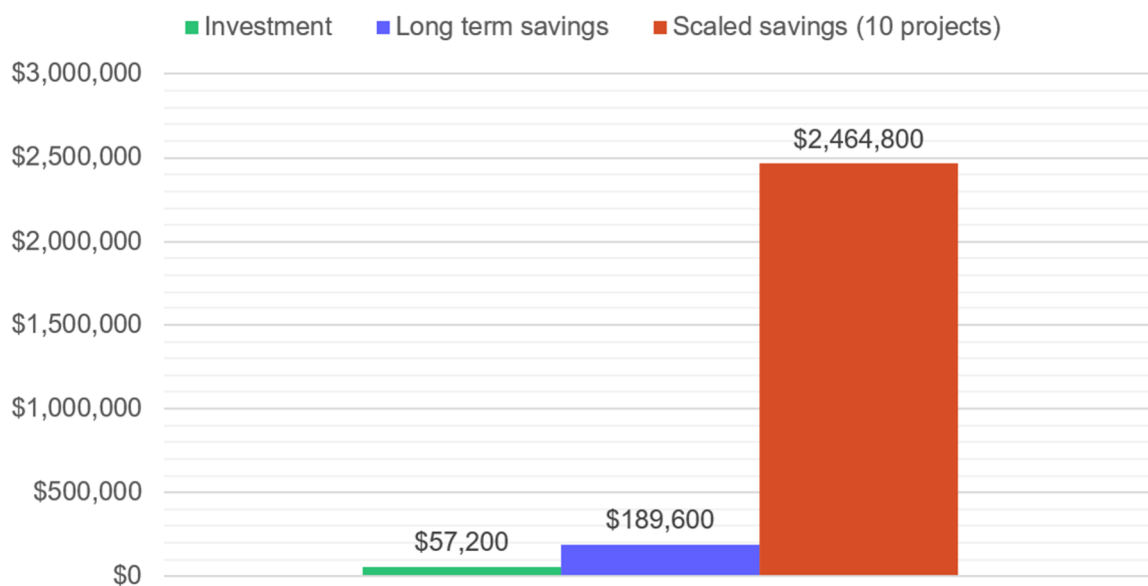- $2,370/week x 104 weeks x 10 projects ≈ **$2.5M**

Figure 14: Investment and savings graphic

Other Benefits

A few other benefits are:

- Reduced risk at missing deadlines
- Reduced risk at overspending
- Higher client satisfaction
- Higher deliverables quality
- Higher accountability
- Better data management and oversight

This solution gives the team a much higher degree of control of the project. The number of problems avoided down the road is incalculable. Overall:

"What you get is **proactive project management** rather than **reactive trouble shooting**."

Summary of concepts learnt

- Autodesk **Forge** allows us to **access and manage** project **data**
- To implement custom **automated workflows** to satisfy our needs and i**mprove** our project **outcomes**
- Automated workflows **increase productivity and quality**, and **reduce costs**
- **Standardization** allows for **scalability and a higher profitability** of an investment for automation