Case Study Title: Project Delivery through 4D and 5D BIM Integration

Company Overview | LINESIGHT | linesight.com

Linesight, founded in 1974, is a global leader in professional consultancy services, providing cost and project management for the construction industry. Headquartered in Dublin, Ireland, with offices across Europe, the Middle East, Asia Pacific, and the USA, Linesight employs over 1,000 professionals. Specializing in sectors such as Data Centres, Life Sciences, Commercial, and Infrastructure, the company delivers strategic advice and management support from concept to completion.

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Overview & Background to the Lean Initiative

The Architecture, Engineering, Construction and Operation (AECO) industry relies on data-rich Building Information Models (BIM) to drive decisions. However, as a project transitions from design intent to construction, the model must also evolve to meet the specific requirements of construction sequencing (4D) and cost analysis (5D).

For instance, elements like walls or columns may span multiple levels, and some key parameters might not be fully standardised yet. This can lead to gaps in data continuity, requiring additional manual input to ensure alignment between the model, schedule, and cost plan. Linesight's BIM team identified several opportunities for improvement in the project BIM models, noting that variations in geometry and data completeness can impact the efficiency of project planning, quantification, and simulation.

To address this, an internal lean initiative was developed which focused on automating model enrichment using Dynamo. This workflow simplifies geometry by dividing elements (e.g., walls, floors, roofs, columns, beams, ducts, pipes, etc.) by levels and zones, enabling accurate quantities and activities to be aligned with Primavera P6 schedules.

The initiative enriches the model with standardised shared parameters for easy data access, supporting 4D (time) and 5D (cost) BIM integration. By driving the project timeline directly from the enriched BIM model, the team eliminates silos and creates a single source of truth.

Currently piloted internally, this approach aligns with lean principles by reducing waste through automation, improving data flow, and enhancing collaboration. The goal is to prepare models for seamless export to tools such as RIB CostX, Navisworks, or Synchro for 4D/5D simulations, to ensure projects are completed on time and on budget.

Figure 1: Original BIM Model with Poor Geometry (e.g., Undivided Wall Spanning Multiple Levels and Roof Crossing Multiple Zones).

Lean Initiative Undertaken – Lean Thinking, Tools, Techniques

The core of this initiative was to enhance efficiency from the earliest stages of construction planning by ensuring the right information flows seamlessly throughout the process. By applying lean principles, a standardised and automated workflow was developed that promotes consistent, reliable data exchange transforming the BIM model from a visualisation tool into a central driver for project controls.

1. Automated Model Correction and Preparation: The process begins upon receiving the BIM model. Opportunities are then identified to enhance efficiency in geometry preparation, which was previously a time-intensive task. To address this, a Dynamo-based solution was developed that automates the model preparation process.

- **Geometric Division:** The script intelligently analyses model elements. For instance, a single wall element spanning multiple floors is automatically divided by level. Similarly, elements are split by predefined construction zones. This is applied to walls, floors, roofs, columns, beams, ducts, and pipes. This automated division ensures that the model geometry accurately reflects the real-world construction sequence, which is essential for generating precise quantity take-offs and site-aligned activities.

2. Standardised Data Enrichment: Once the geometry is corrected, the next automated step is to enrich the model with a comprehensive set of shared parameters. This ensures every element contains the necessary data for 4D and 5D analysis. Our

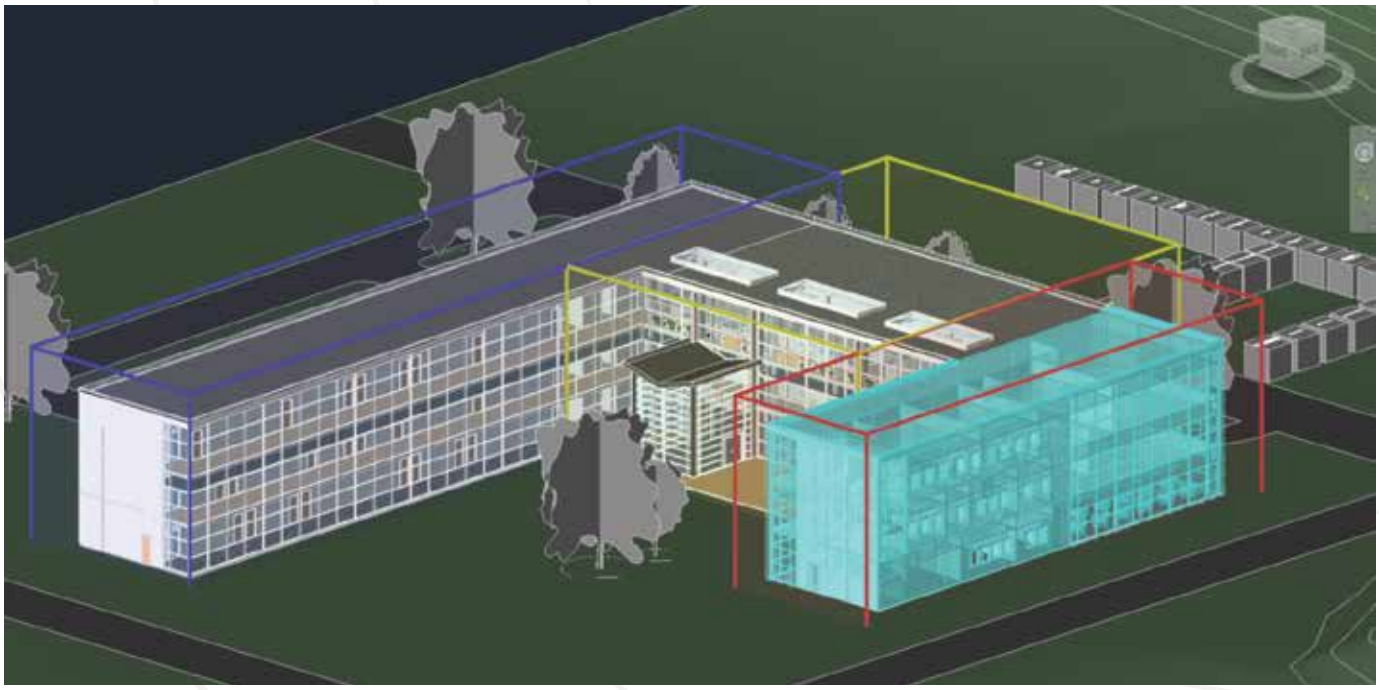

Figure 2: Automated Model Correction and Geometric Division by Zones and Levels.

Figure 3: Conceptual flow from a data-poor model to an enriched, integrated model.

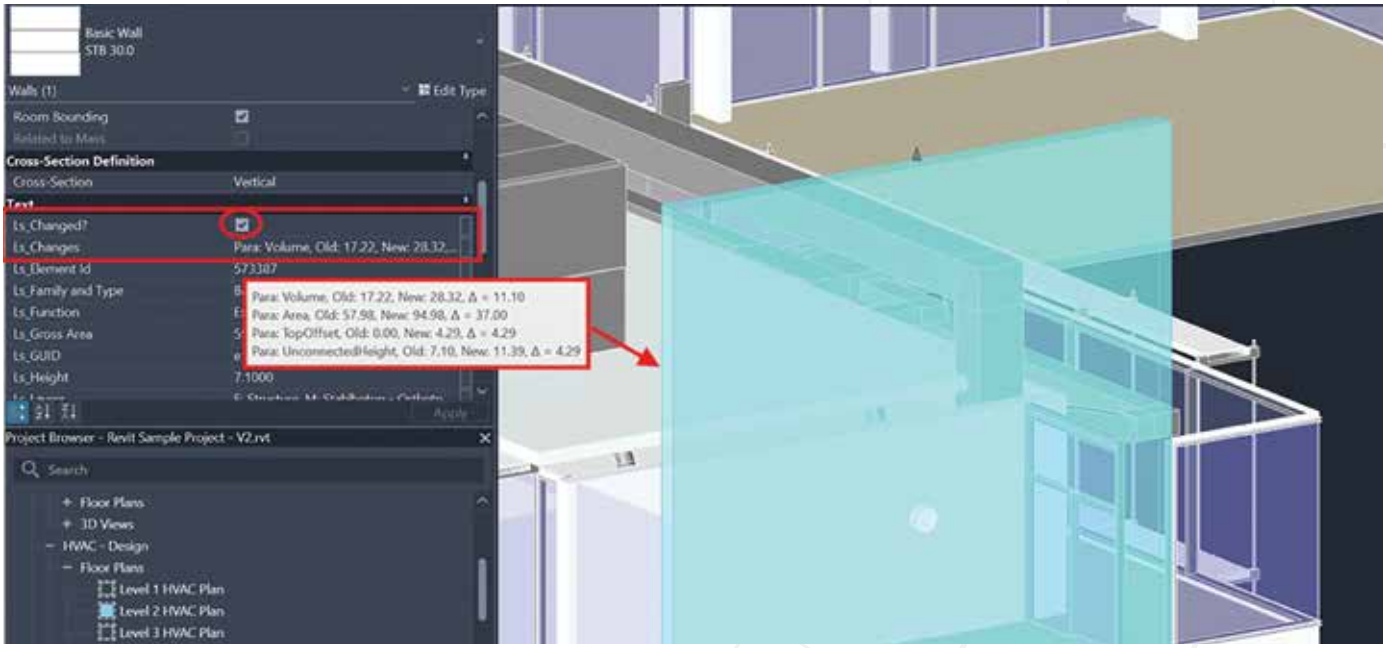

Figure 4: Integrated Version Control: BIM Model for Tracking Changes.

standardised parameter includes:

- **Level & Zone:A**utomatically assigns the correct level and construction zone to every element after the geometric division.
- **Gross Area / Size:** Calculates critical dimensions for elements like walls, doors, and windows, which are often difficult to access in Revit, providing reliable data for cost managers.
- **Layers:** Deconstructs composite structures (like walls or floors) to list out their individual layers for detailed quantification.
- **NRM1 / ICMS:** Embeds standardised cost classification systems directly into the model elements.
- **WBS / Activity / Work** Package: Establishes the foundational link between the model and the schedule by embedding the Work Breakdown Structure, specific activities, and material work packages into each element. This makes the model the backbone of the schedule.
- **Cost:** Allows the final cost data from the cost plan to be written back into the model, closing the 5D loop.

3. Integrated Version Control (Changes): Another cornerstone that has been developed is the "Changes" parameter, which creates a powerful version control system within the model itself. It automatically tracks changes between versions, flagging elements as new, deleted, or modified. This provides unprecedented transparency and accountability.

This provides a clear and auditable trail of design evolution. Cost managers can see exactly what has changed between model versions, allowing them to update only the affected quantities and costs. This targeted approach eliminates the need for complete re-evaluations, saving significant time and preventing rework.

4. The Model-Driven Workflow: With a corrected and enriched model, we can drive the entire project controls process:

- **P6 Schedule Generation:** Using the embedded WBS and activity data, we can automatically generate a highly accurate P6 schedule baseline. This is then handed to the project manager for refinement of durations and logic. This approach ensures activities match P6 schedules, with the

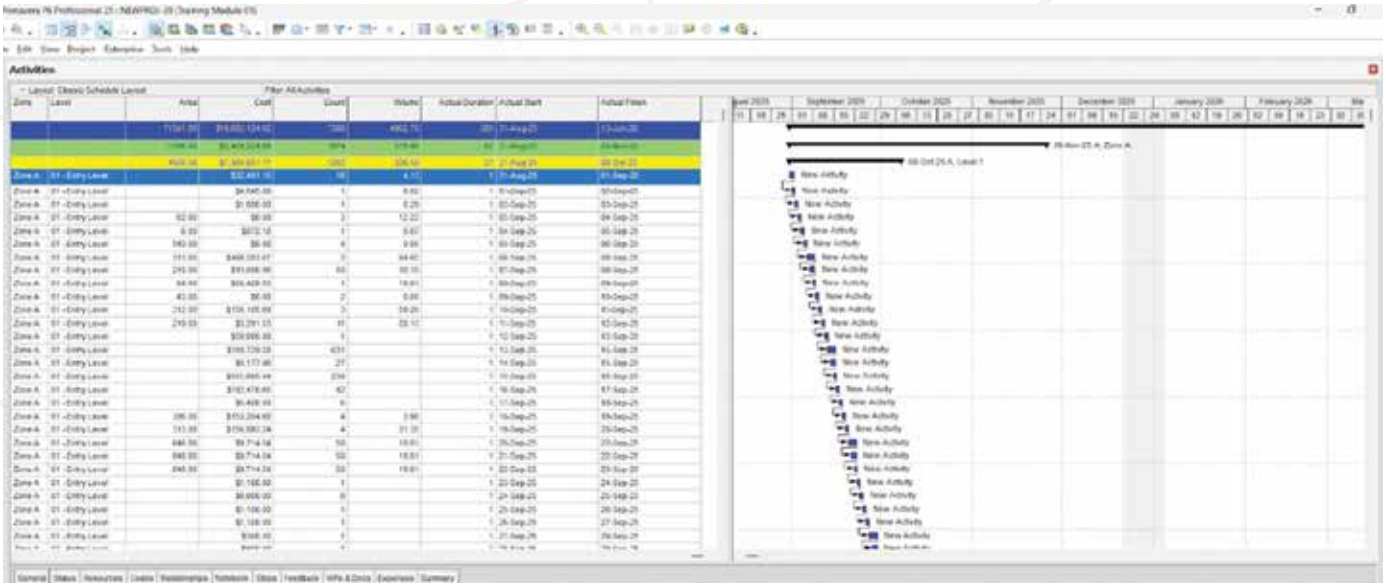

Figure 5: P6 Schedule Generation: Automated Baseline Creation Driven by BIM Model.

BIM model as the core driver for project timelines.

- **Centralised Reporting:** The model and its vast repository of data are hosted in Power BI, creating an accessible single source of truth for the entire project team. Power BI integration foster's team transparency and reduces communication silos. This results in faster decision-making and fewer errors.
- **4D/5D Simulation:** The enriched model is seamlessly imported into software like Navisworks or Synchro for full 4D/5D simulation, clash detection, and progress tracking.

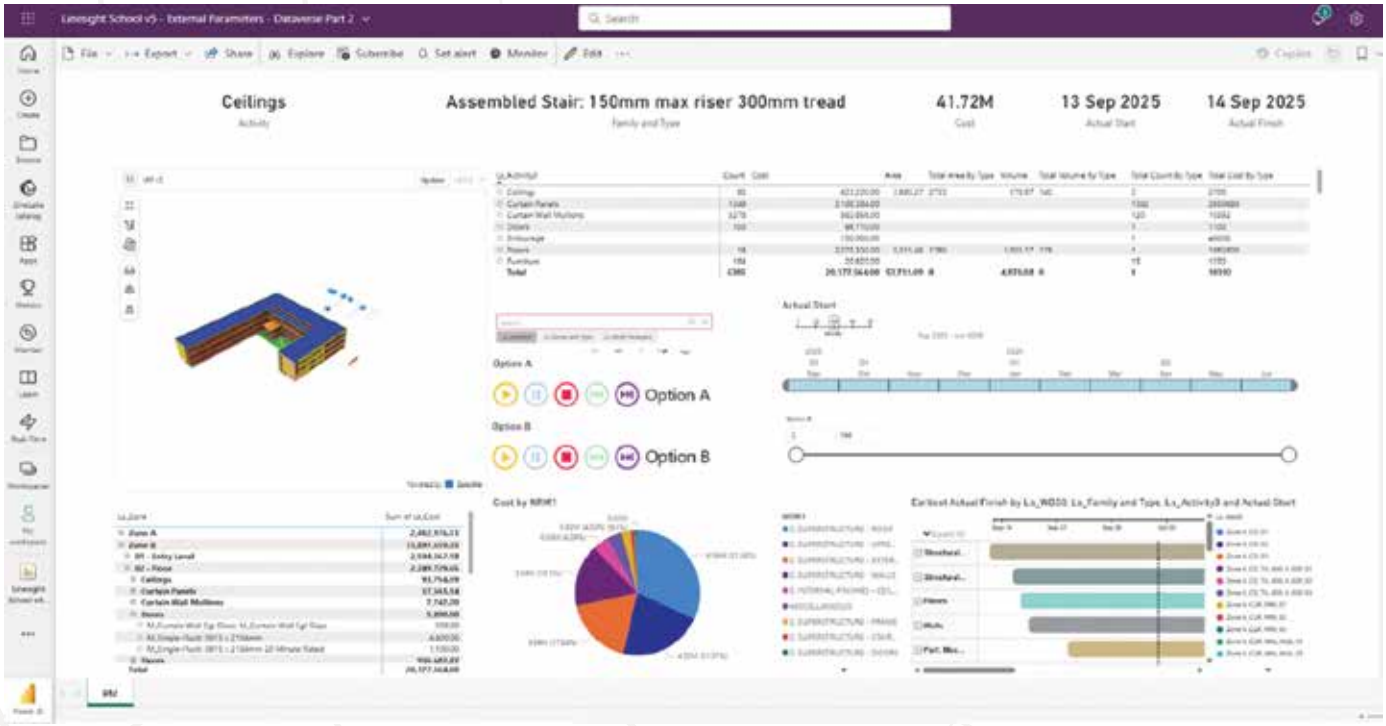

Figure 6: The automated workflow from model reception to Power BI dashboard

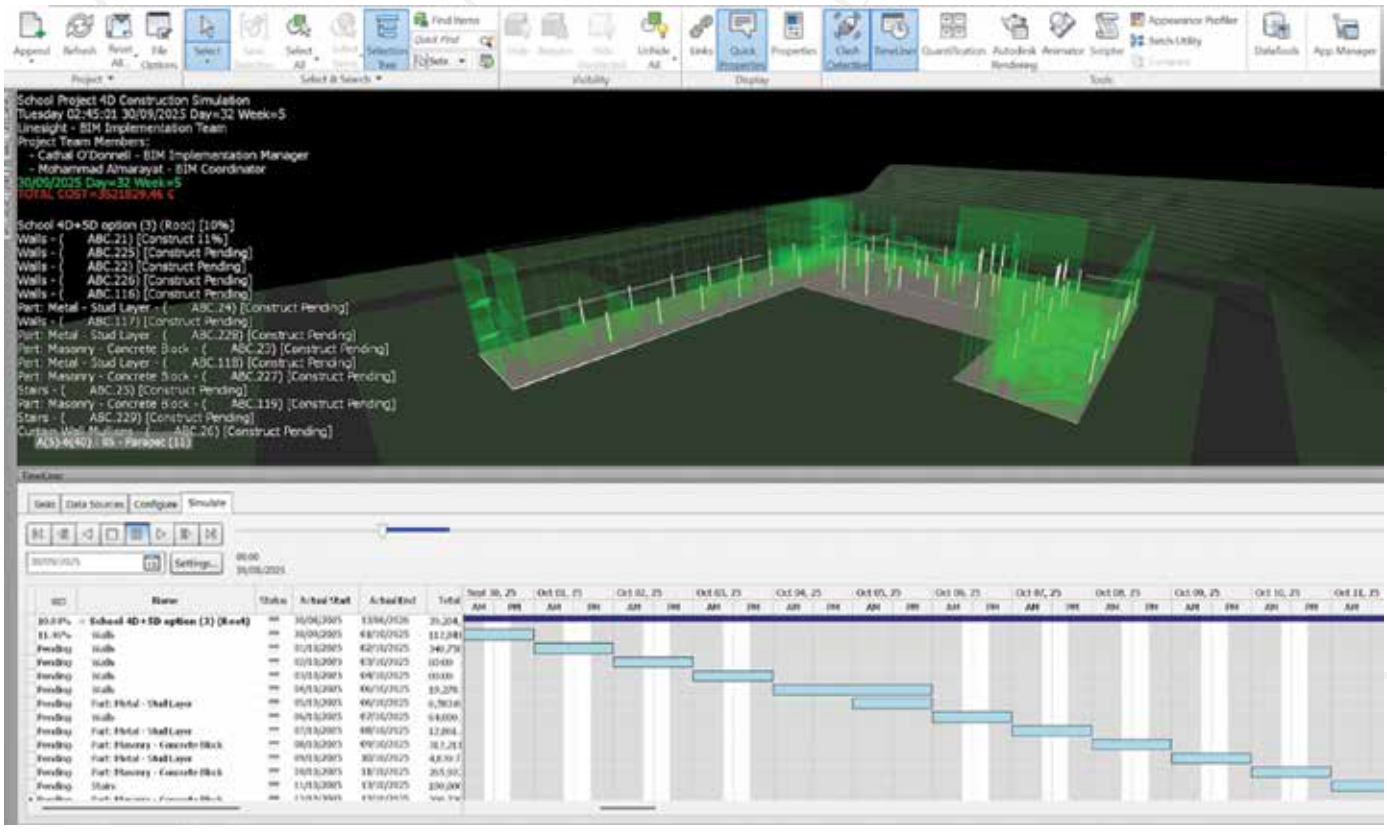

Figure 7: 4D/5D BIM Integration for Clash Detection and Simulation in Navisworks.

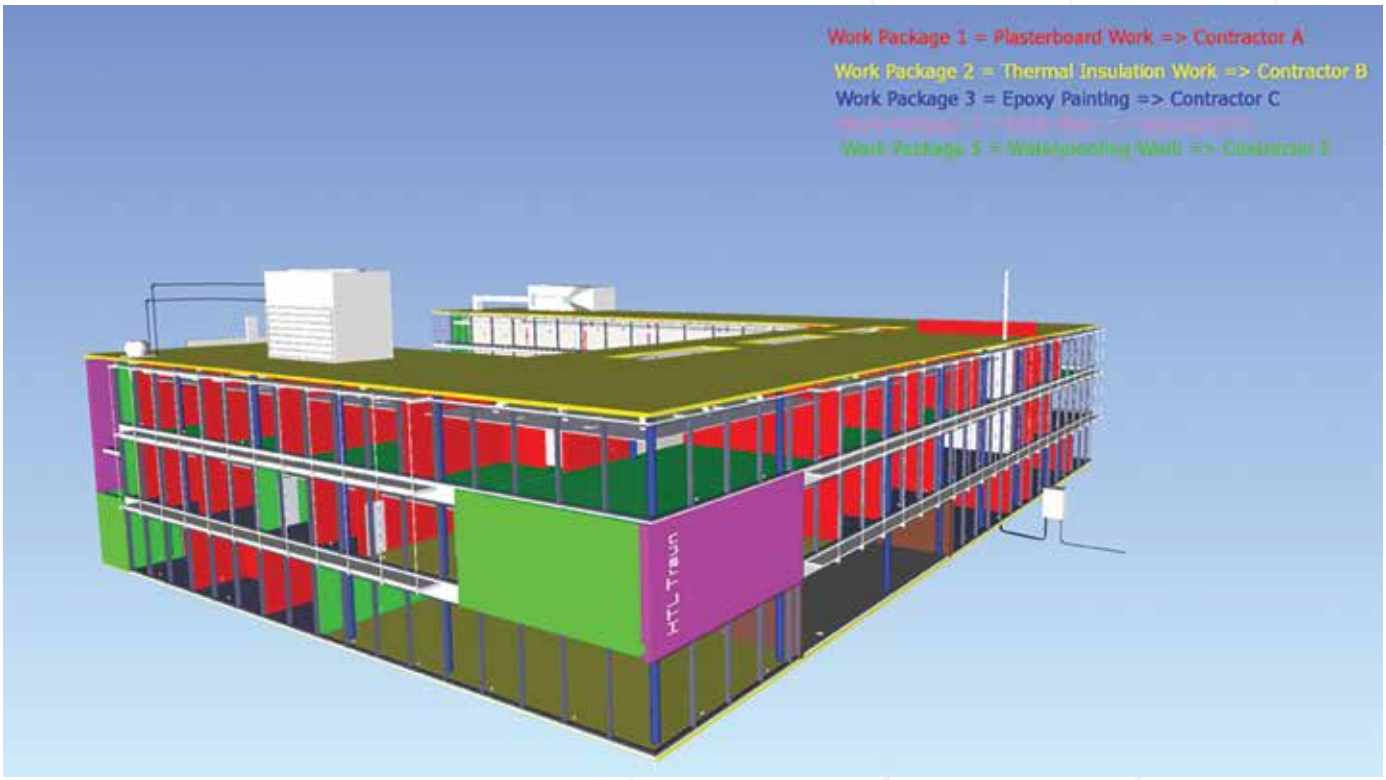

Figure 8: BIM Model Coloured by Work Packages for Contractor Scope Assignment.

Lean Initiative Improvements & Impact

Benefits for Cost Managers: The Power BI dashboard benefits cost managers by offering real-time cost visibility, improving accuracy by reducing errors, enabling faster decision-making, enhancing collaboration through transparency, and allowing proactive cost control with 5D data integration.

Benefits for Project Managers: With a schedule generated directly from a construction-ready model, project managers gain a much clearer understanding of project risks and dependencies. The ability to visualise the construction sequence and cash flow in 4D/5D simulations enables quicker, more informed decisions, especially when assessing the impact of proposed changes.

Proactive Clash Detection and Risk Mitigation: Our

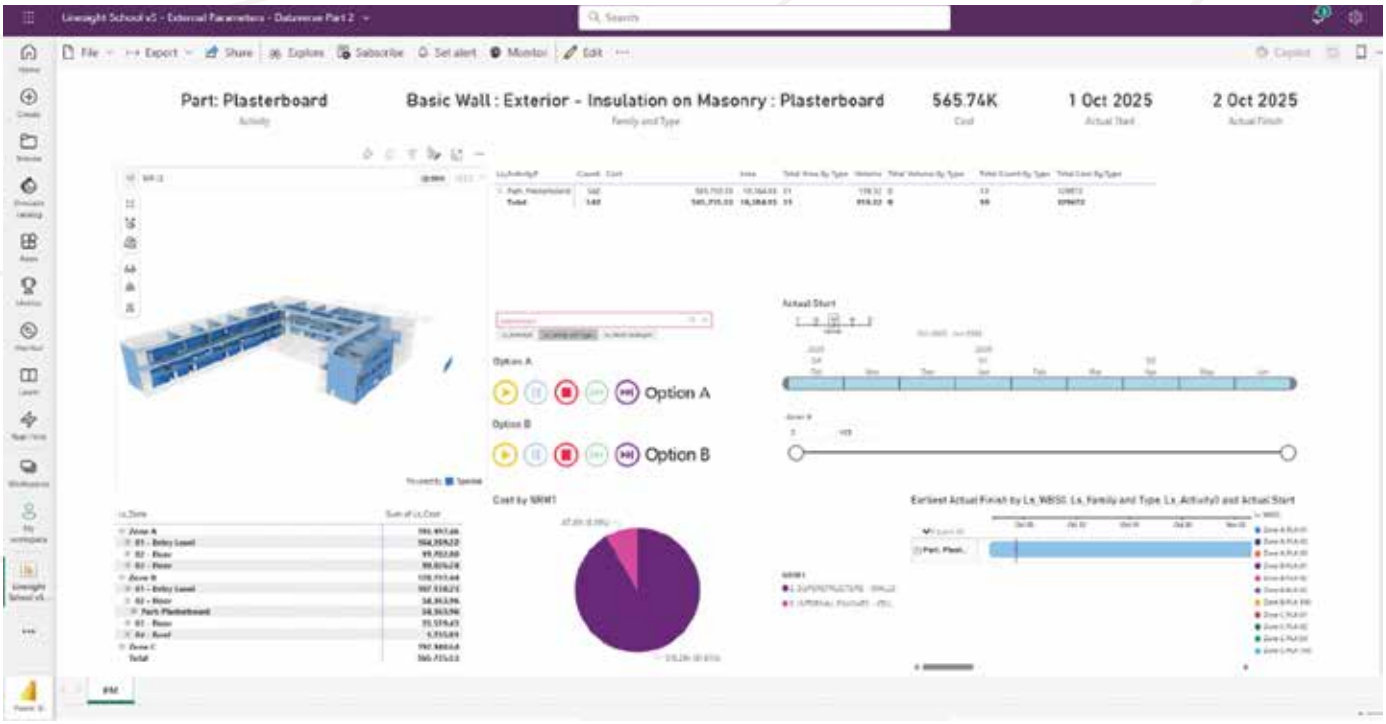

Figure 9: Power BI dashboard showing cost, schedule, and model data in one view.

workflow elevates clash detection from a simple geometric exercise to a strategic risk management tool. By running simulations in Navisworks, we can not only identify clashes but also pinpoint when they will occur in the schedule and what their associated cost impact is. This allows teams to resolve issues virtually before they lead to costly delays and rework on-site.

A True Single Source of Truth: This initiative breaks down the silos between design, scheduling, and cost. By ensuring all data originates from and flows back to a single, reliable BIM model, we create a transparent, collaborative environment. The entire team from BIM specialists to project managers, works from the same information, leading to better alignment, fewer conflicts, and a greater focus on delivering value.

Efficiency Gains: Automation reduced geometry division and data enrichment time by 70% in test models, allowing the team to process complex elements in hours instead of days.

Data Accuracy and Accessibility: Standardised parameters eliminated inconsistencies, enabling quick quantification.

Collaboration Enhancements: Power BI integration created a shared dashboard, fostering team transparency and reducing communication silos. Team reporting has led to faster decision-making and fewer errors.

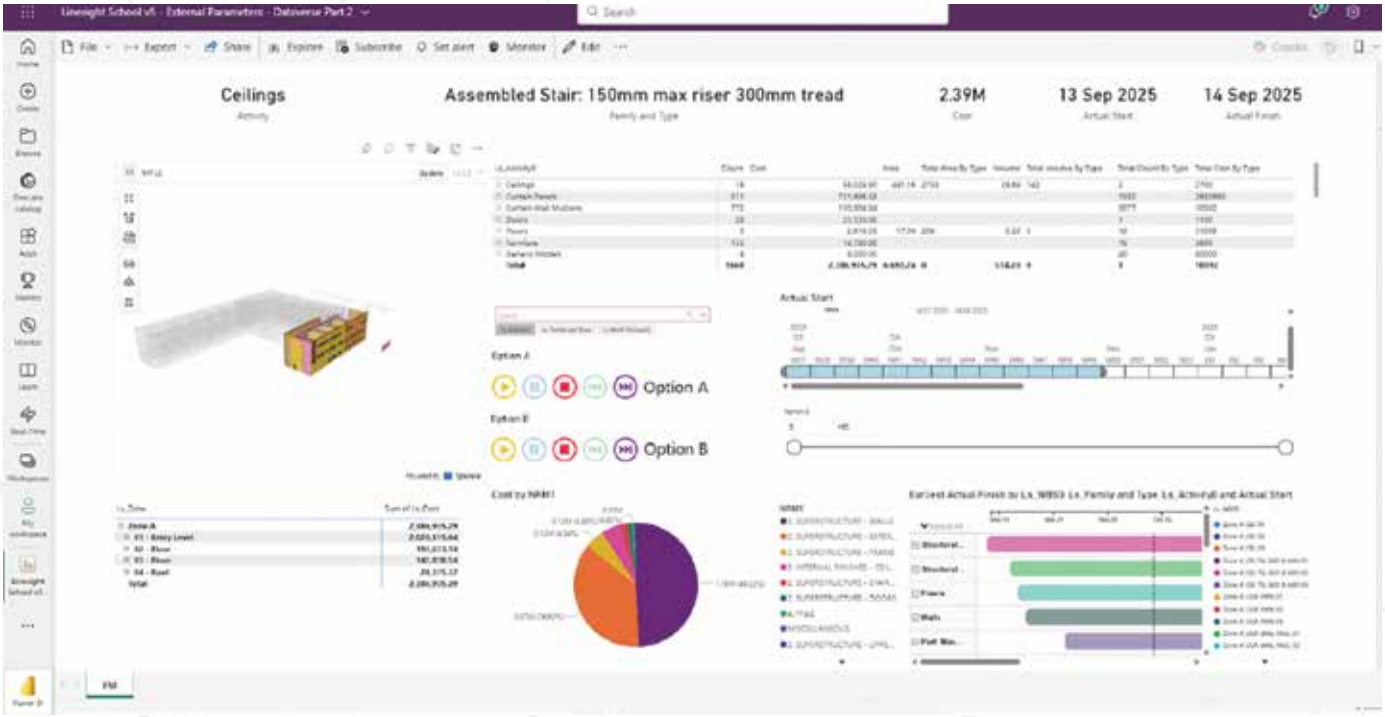

Figure 10: Power BI: Dashboard for Team Transparency and Enhanced Decision-Making

Summary and Lessons Learned

This initiative has created a powerful, automated workflow to systematically correct and enrich BIM models, transforming them into a reliable single source of truth. By leveraging Dynamo, the process of preparing models has been automated for 4D and 5D analysis, driving the generation of schedules and cost plans directly from model data.

The key lessons learned are profound. First, automation is the key to standardisation. Manually enforcing data standards is prone to error; by building our requirements into an automated script, we ensure consistency and quality every time.

Secondly, achieving true integration requires positioning the model at the core of the process. By embedding scheduling and cost data such as WBS, activities, and cost codes directly into model elements, the workflow becomes more logical, data-driven, and seamlessly connected across disciplines.