

IMP's Proactive Workload Leveling Initiative

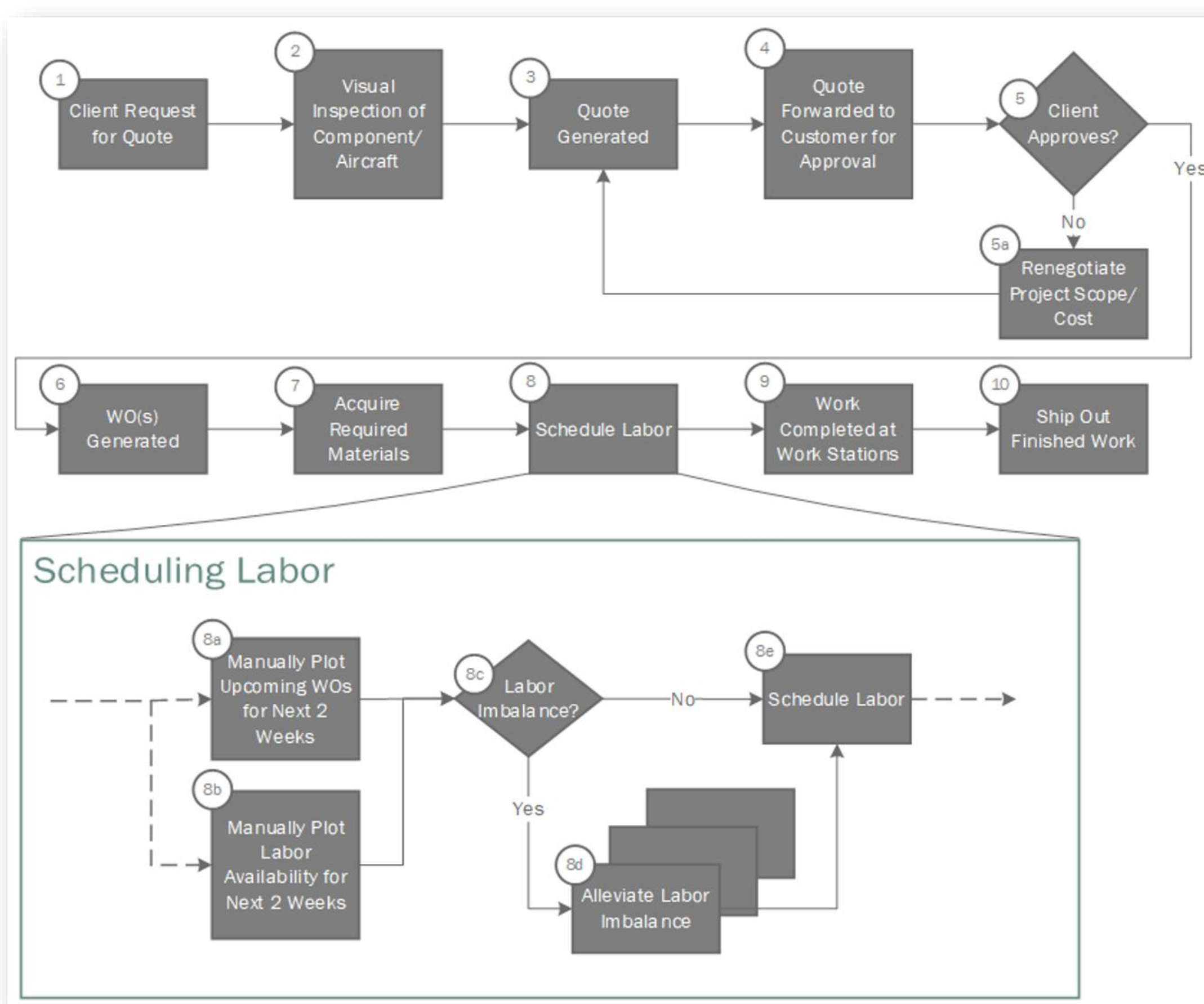
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Client Background

- IMP Aerospace & Defense is headquartered in Enfield, NS.
- They offer services and life cycle support on military, government and civilian platforms in the land, air, naval and space sectors.
- This project focuses on IMP's operations within one of their hangars which primarily deals with component manufacturing, and aircraft restoration and overhaul (R&O). A significant amount of the floor space is dedicated to these operations, with some space being used to house the scheduling department along with other administrative functions.

IMP Manufacturing / R&O Process Map

- Result of discussions with project stakeholders at IMP and internal analysis.
- All steps other than process 8 generally occur once per work order, while process 8 occurs every day.
- Process 8 was the focus of this project as it has internal dependencies that can be controlled to a higher degree than other processes.



Problem Definition

- The narrow time horizon of the current scheduling process causes the scheduling department to be reactive rather than proactive with managing workload imbalances.
- Many of the workload leveling techniques that IMP has at their disposal to fix labor imbalances are not as effective when used last minute.
- Best case this results in more effort for the scheduling department, worst case it results in delays and excess costs.

Problem Statement

IMP's inability to proactively manage upcoming labor imbalances due to the narrow time horizon imposed by the manual nature of the scheduling process.

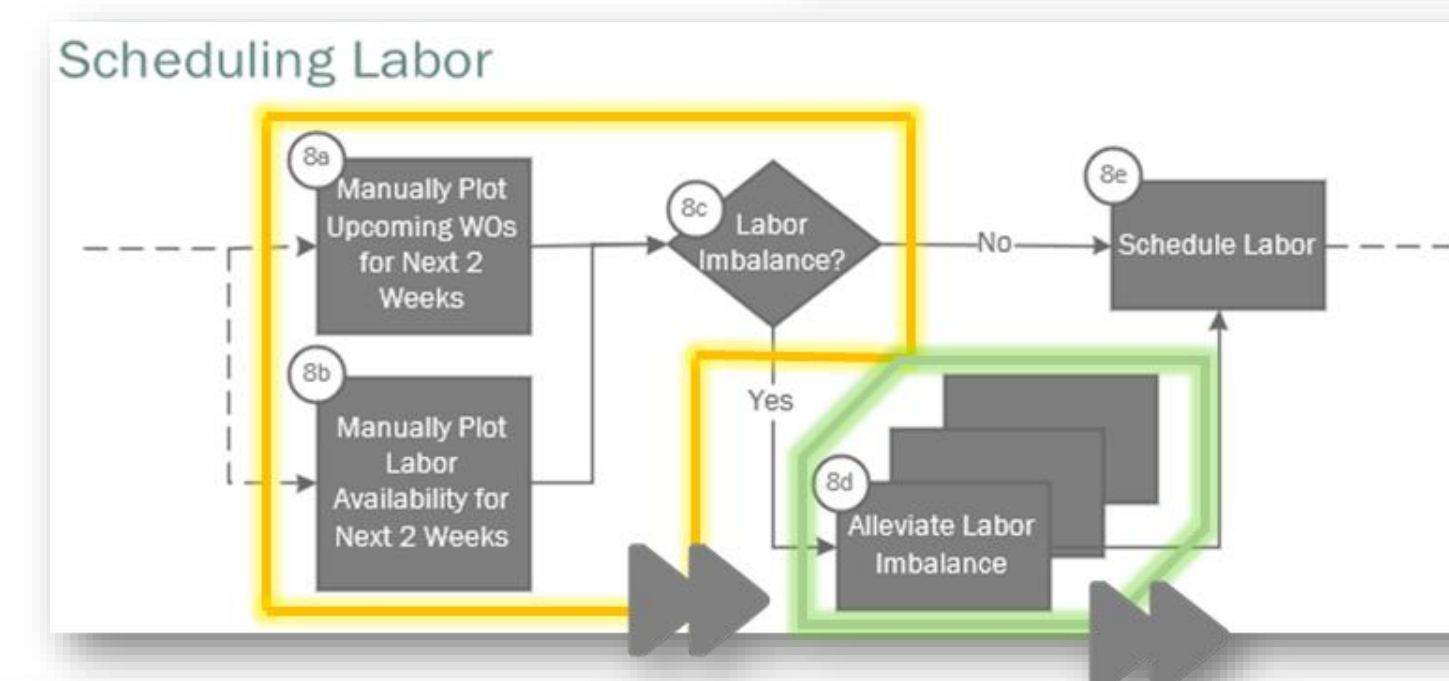
Purpose Statement

Better utilize existing data in IMP's internal databases to expand the scheduling department's planning horizon and allow them to proactively manage labor imbalances before they occur.

Dashboard Functionality

Pages 1 & 2

- First 2 pages aggregates and centralizes all open work order data into several visuals.
- Helps speed up the manual subprocesses (8a & 8b) in the scheduling process.
- Reduction in these manual steps would allow the scheduling department to expand their planning horizon and schedule work orders further in advance.

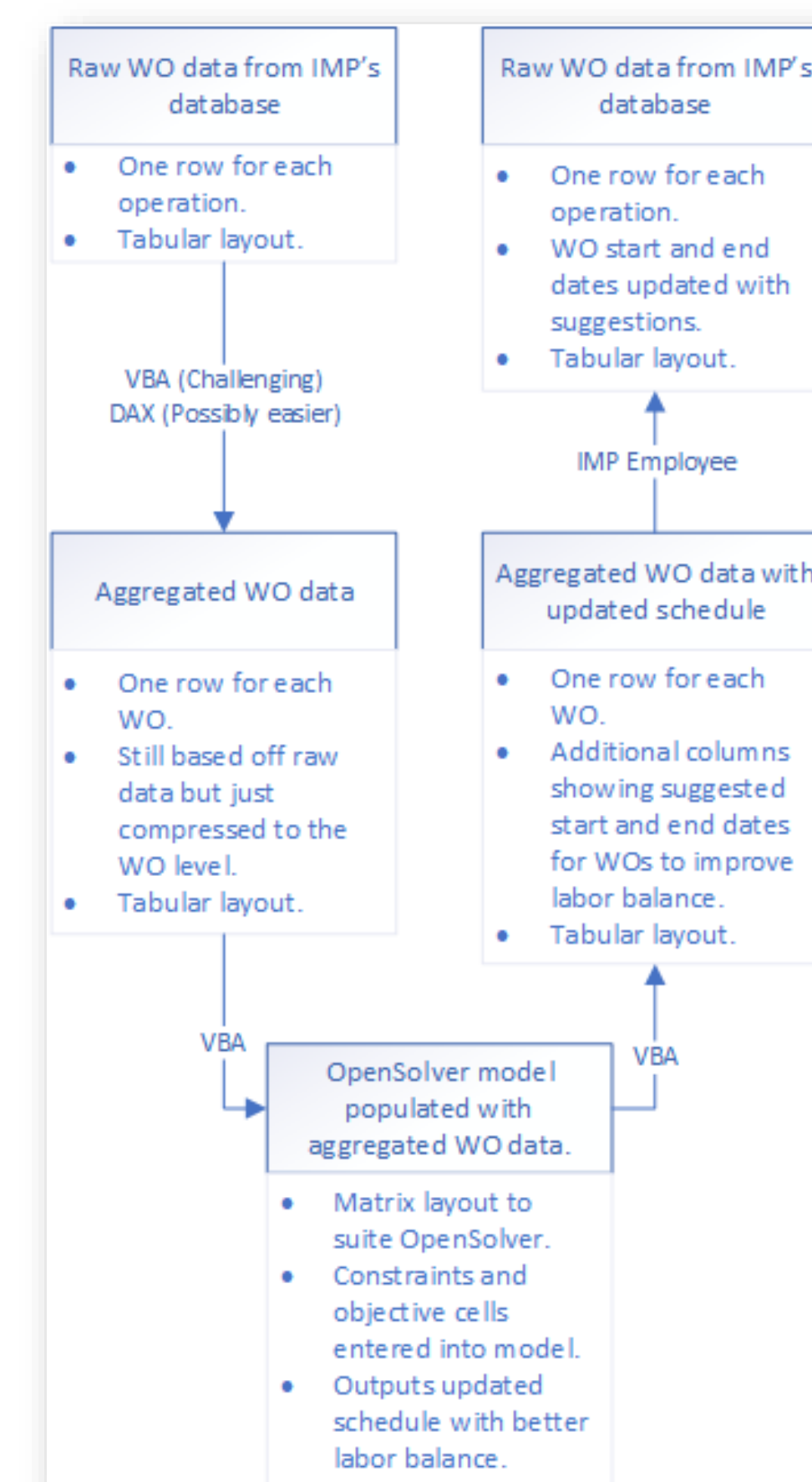


Pages 3 & 4

- Last two pages help the scheduling department act on workloads imbalances that are found.
- This would help speed up subprocess 8d and would better help them be proactive rather than reactive.
- Many of the workload leveling techniques like recruiting temporary labor or suggesting vacations, have higher success rates when done further in advance, so this functionality has tangible value.

*Images blurred due to security reasons

Work Order Schedule Suggestion Model



- The aggregated and centralized work order data within the dashboard could also be leveraged by additional value add features for IMP.
- One such example is the use of linear integer programming techniques to revise the initial work order schedule set by IMP's database.
- By providing the model with key parameters like the initial start date, priority and need by date of each work order, it outputs a revised schedule in which work orders are moved around to get better workload balance, while still ensuring work is complete before it's needed.
- Such a model could provide the scheduling department with a more realistic starting point from which less alterations would be required to reach the final assigned schedule, as compared to the current starting point that's used.
- Scheduling work orders is an important daily process for IMP and as such tools that assist with the workflow can have large benefits.
- Model solves the integer programming problem using the branch and bound technique and uses the open-source CBC solver within OpenSolver in Excel.

Fast Facts

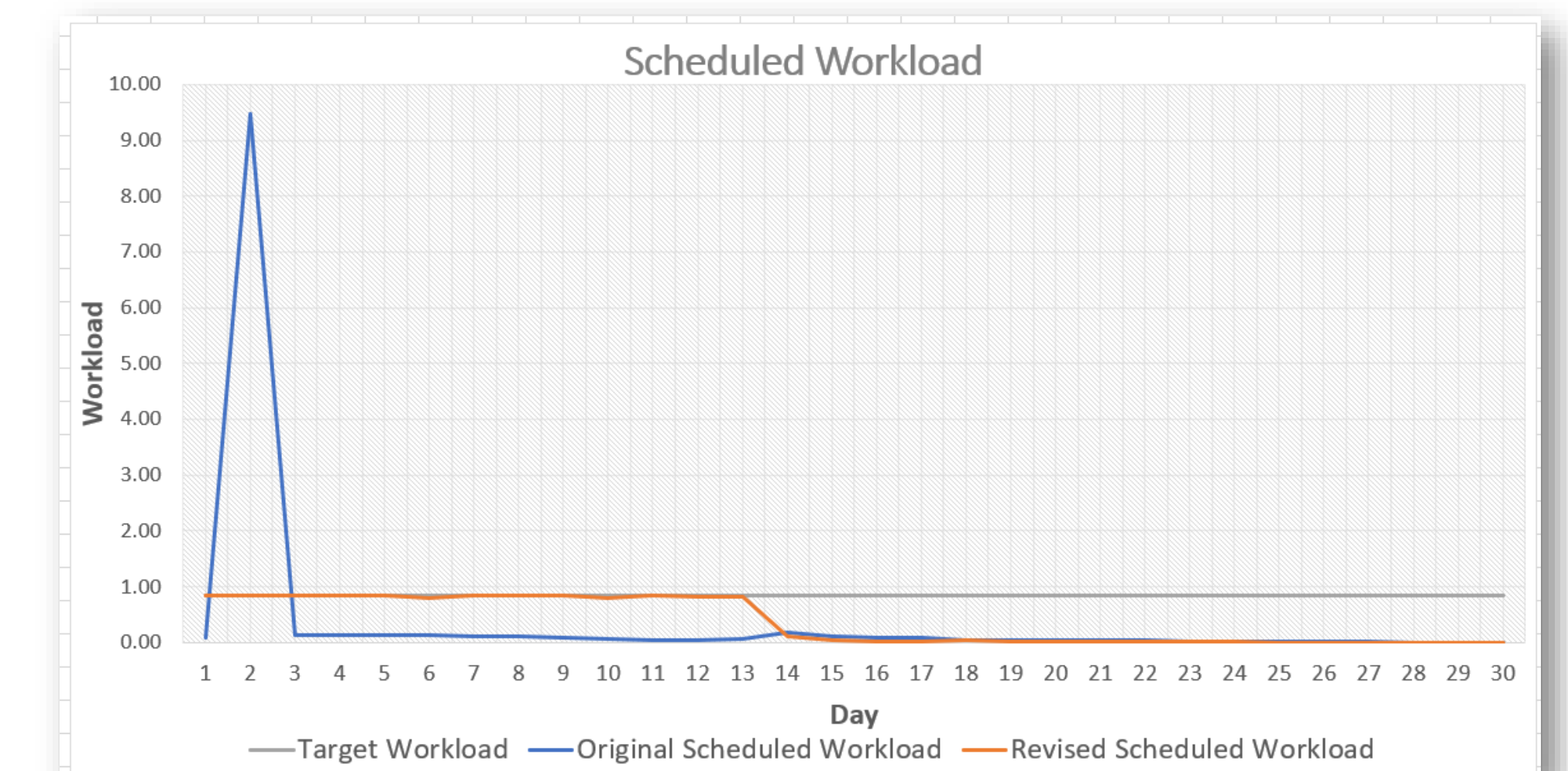
- IMP Aerospace & Defense gives quotes to companies all over the world!
- IMP and DAL worked together before on a capstone in 2018 (also involving scheduling)!
- IMP uses in-house 3D printing for designing dedicated tooling for manufacturing and R&O (repair and overhaul)!
- At any given time, there could be over a thousand open work orders for everything from replenishing safety stock to mission critical maintenance on military equipment.

Dashboard Impact

- A visual, centralized, and real-time platform for IMP to see where current operations are regarding:
 - Work Order reschedules, need by dates, priorities, etc.
 - Upcoming workload imbalances.
 - The forecasted workload for future months that have not been scheduled.
- Aggregates critical workload information for the scheduling department to assist with work order scheduling and workload imbalance alleviation.
 - Expands the scheduling department's planning horizon past 2 weeks better allowing them to proactively manage labor imbalances before they occur.
- Also serves as an illustrative tool to make a case for policy changes to upper management like:
 - Additional cross-training for IMP technicians to make the labor pool more diverse.

Work Order Model Impact

- Once provided with the current schedule, labor availability and target workload, the model automatically provides a revised schedule with improved workload balance.
- In the long run, the model logic could be incorporated into their database to set more viable initial start and end dates requiring fewer adjustments to get to the finalized schedule.



In the above graph, workloads above 1 represent more work assigned on a day than labor available. A user adjustable target of 0.85 is set in the model to avoid queues that could occur when maximally scheduling available labor. Blue line shows the initial assignment's workload as set by the internal database, which exceeds available labor. The orange line shows the model schedule which stays under the target while still ensuring work completed before it's required. These revised WO start, and end dates are shown to IMP to compare with the initial assignments to determine if and how much of the model's suggestions to implement.

Implementation

- Dashboard and model files will be provided to IMP along with a user guide explaining the dashboard's UI and technical documentation outlining the back-end calculations and references.
- The dashboard was built off local data with the same layout as IMP's database to ensure implementation will be seamless.