Production Scheduling Optimization in Marine Propeller Manufacturing

Aditya Agarwal, Anoushka Sanjeev Madavi, Enes Ercikan, Huynh Quang Huy Nguyen, Jakub Sebastian Omylak, Mohammad Hossein Jamshidnejad, Oviya Arulraj, Rishi Rao, Roshan Mani Rao Ram, Savni Maheshwari, Siva Sai Karthikeya Nandagiri, Vishwa Bhushan Patel Bhushan Pa Gaddam

Setting the Context

Yamaha is as a leader in marine propeller manufacturing. Scheduling jobs everyday slows down production and wastes resources if not done right. Our team is working with Yamaha to make their daily job-shop scheduling more efficient. By improving the workflow and balancing equipment, and labor constraints, our goal is to automate the process that ensures products are made and delivered on time.

Central Questions:

- How can we create a scheduling model that is effective, efficient, and not too complicated?
- How can we handle scheduling challenges and unexpected issues to keep production running smoothly?

Marine propeller manufacturing process (Manual):

References & Acknowledgements

Thank you for all the support and assistance:

- Our TA: Jebran Syed
- Our Mentors: William Irwin & Aaron Grinstead
- The Data Mine Staff

Data Understanding

We set out to understand the data by looking first understanding the various data sources we had, constraints owing to the human factor and existing processes

- The Order Sheet, the Master sheet, the PO sheet from Yamaha Marine U.S.
- The number of operators, the manufacturing process order and etc.
- Automating manual scheduling currently accomplished by two people

5 Data Sources

25+ Scheduling Constraints

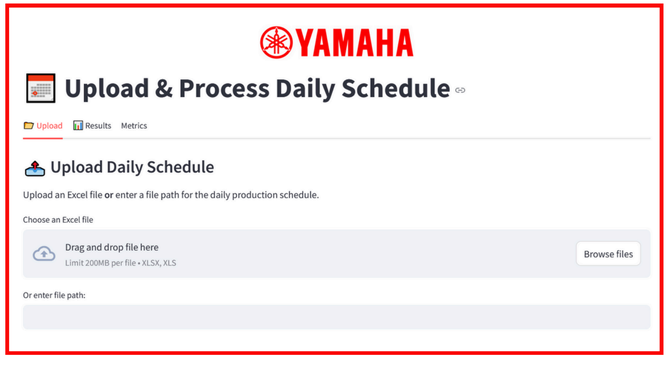
3 Disparate Processes

Data Preparation

1. **Map the propeller IDs to descriptions**:
   - Link the prop IDs to its materials description
   - Makes tracing this prop easier.
2. **Extract blade count**:
   - Pull the blade from item description
3. **Classify by their manufacturing process**:
   - Types: OPD/Manual, High Binder, Small, Large
4. **Split Large parts for Flexible Scheduling**:
   - Break down large batches into smaller ones to ease scheduling

OPD
One-Piece Die

Frontend Interface to view schedules, modify inputs & constraints

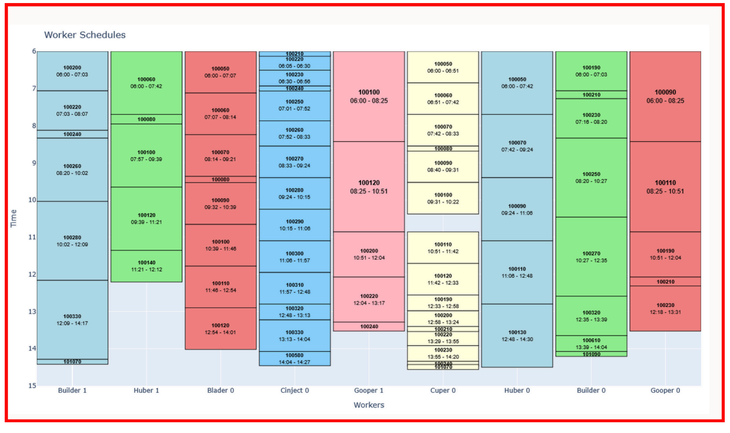


Scheduling Model Insights

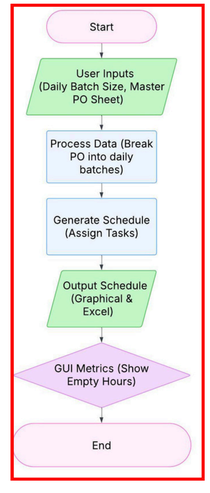
Automates manufacturing job scheduling by optimizing task assignments, managing shift timings within capacity limits, and generating worker-specific schedules while updating the master job list.

1. **Dynamic timing adjustments**: Ensures proper sequencing (e.g., gooping starts only after building ends) by realigning start times as needed.
2. **Progress tracking**: Updates the master job list with scheduled dates (e.g., Cup Date), enabling accurate monitoring and future planning.
3. **Feasibility focus**: Removes jobs exceeding the shift's end to maintain practical schedules, rather than optimizing globally.
4. **Linear time assumption**: Calculates job duration as quantity × procRate, simplifying scheduling but assuming constant efficiency.

Example Model Output



Model Flow



Future Goals

- Adapt the model to handle more complex job dependencies and multi-shift scenarios.
- Expand process coverage to handle foundry tasks and automate complete propeller production.

Business Value

- Unified automation integrates 3 disparate processes, saving 60 hrs/month through an intuitive platform.
- With routine execution and adaptable inputs and constraints, supervisors can focus on tasks that matter.