Balancing Workload by Optimizing the Assignment of Field Sales Proposals to Pricing Engineers

Luke Welch, Project Manager; Harrison West; Andres Luna Orosco Amelunge; Hector Aguilar; Aidan Massanelli
Industry Partners: Erin Hills, Logistics Engineer; Drew Caple, Manager, Pricing and Supply Chain Analytics; Alex Hoge, Senior Manager, Carrier Partnerships
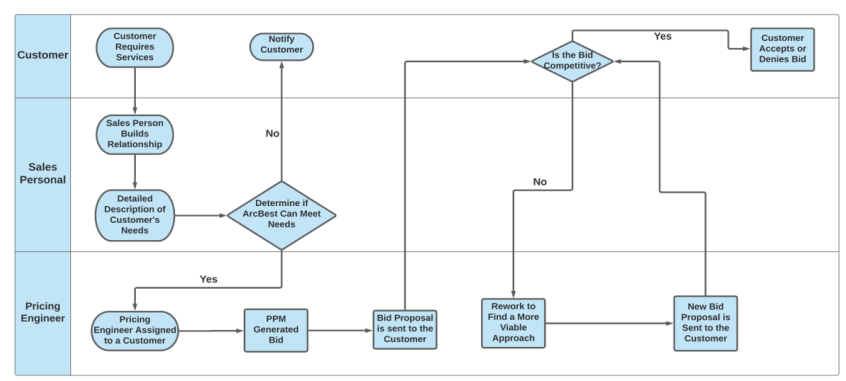
ArcBest

ArcBest is a freight and logistics solutions provider located in Fort Smith, AR, and offers supply chain optimization and moving services. ArcBest encompasses four main segments: Asset-Based Freight, Panther Premium Logistics, U-Pack, and FleetNet.

Our system of interest is the Pricing and Supply Chain Analytics department in the ABF Freight System and Panther Premium Logistics.

Bid Process for Proposals

When a customer needs a service, the customer will contact the sales team. The sales team will begin building a relationship and gather information from the customer. The sales team will then determine if ArcBest can meet the customer's needs. If so, the sales team will assign a pricing engineer. The engineer completes the analytics required and sends the bid to the customer. The customer first decides if the bid proposal needs to be reworked, then either accepts or denies the bid.

Analysis of PPM Completion Time

ArcBest is currently working with four main types of PPMs: standard, contracts, bids against other carriers, and contracts with bids. The completion time of the four types of PPMs are shown below.
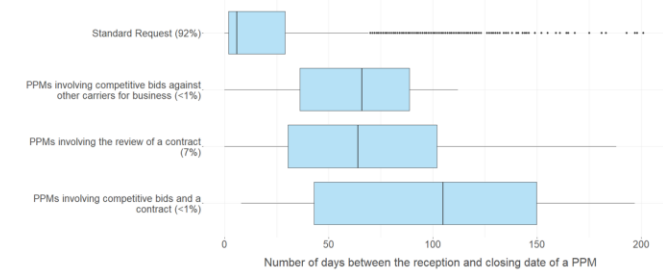
Our team utilized regression methodology to transform PPM completion time into expected service time. The image below illustrates the usefulness of the regression methodology to predict service times.
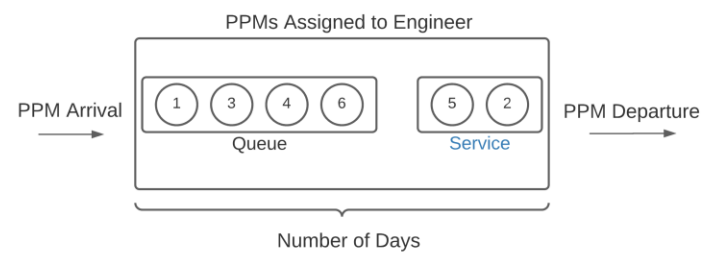
Balancing Workload Using Optimization

We created an optimization model in Java to assign PPMs. The parameters, decision variables, objective function, and constraints of the model are shown below.

Parameters:
$param\ i$: number of engineers
$param\ j$: number of PPMs

$param\ T_{ij}$: amount of time it takes engineer[i] to service PPM[j]
$param\ D_i$: the initial workload of engineer[i] before assignment

Decision Variables:
$X_{ij} \geq 0\ binary,$: decision variable if PPM[j] is assigned to engineer[i]
$w \geq 0$: maximum workload of assigned PPMs for all engineers
$v \geq 0$: minimum workload of assigned PPMs for all engineers

Objective:
minimize $w - v$: minimize the maximum − minimum engineer workloads

Constraints:

For every engineer i
$w \geq \sum_{j=0}^{n} T_{ij} * X_{ij} + D_i$ — For every engineer[j], the maximum workload is greater than or equal to the sum of the service time of assigned PPMs plus the current workload

For every engineer i
$v \leq \sum_{j=0}^{n} T_{ij} * X_{ij} + D_i$ — For every engineer[i], the minimum workload is less than or equal to the sum of service time of assigned PPMs plus the current workload

PPM Assignment Tool

Our team created an assignment tool using a JavaFx user interface. The interface provides a simple method for loading a CSV file, analyzing the assignment of PPMs, and viewing engineer workloads, shown below.
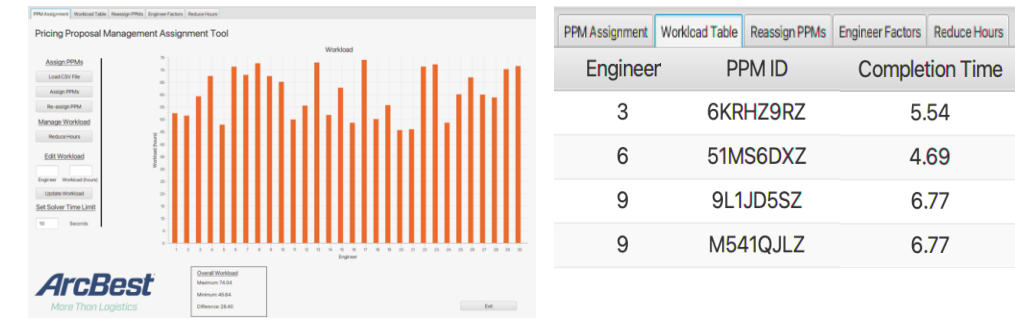
The application has the functionality to reduce workload hours, reassign a PPM, edit the workload of an engineer, set engineer availability, and set engineer factors for calculating service times.

Results and Impact

With PPM data given to us by ArcBest, our team compared the workload balance between several batches of PPMs that ArcBest assigned and the same batches of PPMs that our tool assigned, shown below.
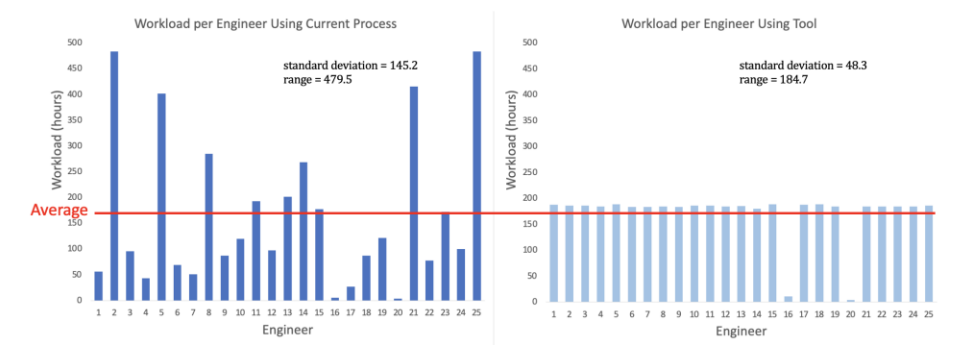
Our tool reduced the difference between the maximum and minimum workload of engineers by 61.5% and reduced the Standard Deviation of workload among engineers by 66.7%. By providing a tool that balances the workload, we hope to decrease PPM completion time and increase job satisfaction among ArcBest engineers.