Capacity Planning and Production Scheduling for Aircraft Painting Operations

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Boeing
Boeing painting operations

- New aircraft assigned to hangars for painting based on expert knowledge and heuristic scheduling
- Painting can occur in house or be outsourced
Research questions

- Does Boeing have sufficient painting capacity to meet future demand?
- What is the future demand for airplanes?
- What is the optimal schedule for painting aircraft to minimize costs given demand?
- How does uncertainty (in painting times, future demand) impact the optimal schedule and decision about capacity?
Optimal schedule to minimize cost

- Time frame: 1 month increments (20 years total)
- Minimize cost
  - Cost of painting airplanes in house
  - Cost of outsourcing airplanes to be painted
  - Cost of being late
- Decision variables: assign each plane to a hangar for painting at each time (assignment problem)
Constraints

- 5 different models of planes; each model has a different painting time
- Hangars can only paint certain models of planes
- Setup times can vary with hangar
- Job cannot be assigned until plane is released for painting
- Per-day tardiness penalty for planes that are finished late
- All jobs must be assigned to a hangar
- Each hangar can only paint one plane at a time
Input data

- Monthly demand data from demand forecasting model
- 22 hangars: 12 in house and 10 outsource
- Cost as a function of painting time
  - $6,000 per day (material and labor)
  - $50,000 daily penalty cost for being late

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<th>Model</th>
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Optimal Solution for Month 1

37 total airplanes

Table 2. Schedule Gantt Chart for month 1

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Painting assignment

- Out-Sourcing
- On-Site
- Dummy

Month

Demand
Cost per month
Simulation with random release dates and painting times
Key conclusions

- Planes can be painted in house for years 0-2
- Delays start occurring in year 5
- Capacity exceeded in year 6
- Significant delays beginning in year 7

Due to demand uncertainty, capacity could be exceeded much earlier or later!

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