Reducing the Wing Body Join (In-Tank Systems) Cycle Time

Keysha N. Candelaria Gonzalez
Engineering Management Program
Advisor: Héctor J. Cruzado, PhD, PE

Abstract

Due to increased demand, The Boeing Company decided to reduce the cycle time of the 777/777x Airplane Program from 10-day to 7-day. This project impacts the position of the Wing Body Join (In-Tank Systems). The goal was to have a bar chart with zero conflicts and correct precedence and duration time; these would positively improve bar load and jobs completed on time. The D.M.A.I.C. methodology was used in this project. A workshop was performed as a starting point to build the new bar chart with the personnel related to the process. Time studies were conducted, starts and completes were eliminated, and the job's time duration was adjusted, increasing the bar load by 22% and reducing by 50% jobs with more than two hours. After the time studies, analysts worked on two champion recipes to minimize conflicts between sealers and in-tank mechanics and reduce inspections. These efforts increased the jobs completed on time by 16%, comparing the last airplane used with a 10-day cycle and the third airplane on a 7-day cycle.

About the Company

Figure 1: Boeing's Everett, WA Factory [1]

This project was developed at The Boeing Company (Everett, WA Site), a leading global aerospace industry. It was performed at the 777/777x Wing Body Join Position, specifically in the In-Tank Systems, where the hydraulics are installed.

Define Phase

Problem Statement

Due to an increase in demand, the company decided to change the 777/777x Airplane Program cycle time from 10-day to 7-day.

Goal

The goal was to have zero conflicts in the process to perform the schedule with no delays. Also, they wanted to maximize labor utilization based on the budget given.

Objectives

The objectives of this project were:

- Increase Do What's Due Metric
- Increase bar chart load to 85%
- Reduce the number of conflicts in the process

Workshop

Actions:

- WBJ Team created a precedence network
- Identified jobs with more than two hours duration
- Identified jobs with start and complete
- Identify conflicts inside the tank with sealers and mechanics

Measure Phase

In this phase, analysts performed time studies on eight jobs. These jobs had a 10% difference between the bar chart time and the historical data. Analysts ran the conflict check giving thirteen conflicts at the time. Also, twenty S.A.T.s were created to split twenty jobs to eliminate starts and completes.

10-Day Cycle

In Table 1, the budget time has been identified as 7,680 minutes. Currently, the bar time is 4,860 minutes with a total of three mechanics, giving a bar load percentage of 63% out of 85%, which is the goal. The In-Tank Systems Bar charts had twenty jobs identified with starts and completes. On the other hand, analysts identified ten jobs with more than two hours of duration. In Figure 1, jobs marked as peach were the jobs identified with more than two hours of duration.

Table 1: In-Tank Systems 10-Day Cycle Time

Total Jobs	7-day budget (min)	Bar time (min)	Bar load (%)	# Starts / Completes	# Jobs >2hrs
20	7680	4860	63%	20	10

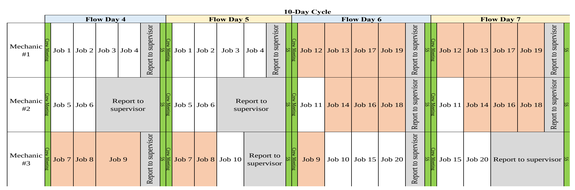

Figure 2: In-Tank Systems 10-day Bar Chart

7-Day Cycle

After the workshop, twenty jobs were split, eliminating starts and completes and reducing the number of jobs with more than two hours to five. Also, the bar time for the 7-day cycle is 6,500 minutes, with a bar load of 85%, as shown in Table 2. In Figure 2, the workdays for the In-Tank Systems bar chart remained at four days. However, the number of mechanics increased by one, with four in the In-Tank Systems area.

Table 2: In-Tank Systems 7-Day Cycle Time

Total Jobs	7-day budget (min)	Bar time (min)	Bar load (%)	# Starts / Completes	# Jobs with >2hrs
40	7680	6500	85%	0	5

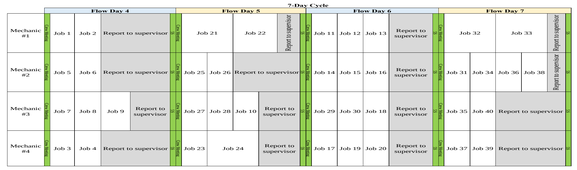

Figure 3: In-Tank Systems 10-day Bar Chart

Analyze Phase

Analysts discussed findings with the personnel involved in the workshop. Analysts shared the champion recipes for the eight-time studies, comparing the bar chart time, historical data, and new duration. Analysts and managers could adjust the time for the jobs without impacting the bar chart load and the budget. Industrial Engineering Managers prioritized the Champion Recipes; two worked, and managers will re-evaluate the rest for the 4-day cycle time starts.

Champion Recipes

After performing time studies, areas of improvement were identified. The analysts created champion recipes to capture the problems they observed during the studies. Here are the two champion recipes:

- **Conflicts reduction between Seal and In-Tank Systems bar chart due to limited space in the tank:** Sealers were able to identify the jobs performed inside the tank and the jobs that have direct precedence with the in-tank systems jobs. This helped reduce the conflicts and manage the number of mechanics working per day in the tank without impacting space requirements.
- **QA Process Inspection:** The analysts worked with the Quality Assurance team to identify when the process inspections were required.

Present to Leadership

To use the new bar chart when the 7-Day cycle starts, team leads, managers, and senior managers needed to sign the bar chart. Analysts presented to the leaders the before and after, sharing data to validate what they did during this process.

Improve Phase

Pilot

The company selected three specific airplanes as pilots of the project. The first airplane was the one starting the new bar chart. The analysts observed the building of the airplane, identifying any conflicts or areas of improvement. On the first airplane, analysts identified four conflicts in the schedule. These conflicts were about space constraints with mechanics and sealers in the tank. Analysts solved those conflicts and captured them on the next airplane. The same happened with airplanes two and three.

Do What's Due (D.W.D)

On airplane LN1700, D.W.D. was 63.2%, and on airplane LN1701, 71.7%. This represents an increase of 8.5% between the last airplane using a 10-day cycle and the first airplane using a 7-day cycle, refer to table 3. On the other hand, airplane LN1702 had a D.W.D. of 74.3%, and airplane LN1703 had 79.3%. The DWD between airplane LN1701 and airplane LN1703 increased by 7.6%.

Table 3: Do What's Due Progress

Cycle	Airplane/Line Number	D.W.D.
10-Day Cycle	LN1700	63.2%
7-Day Cycle	LN1701	71.7%
	LN1702	74.3%
	LN1703	79.3%

Control Phase

In this phase, the analyst will only keep track of the D.W.D because of the projected changes in the demand. Analysts are currently attending Tier 2 meetings with manufacturing managers to discuss D.W.D. In the case of the D.W.D. being less than 80%, managers need to explain why that happened and perform a root cause analysis if required.

Conclusion

The project was completed following the D.M.A.I.C. methodology. The new bar chart met the objectives by increasing the bar load to 85% and D.W.D. to 79.3% on the LN1703 airplane. Jobs with starts and completes were eliminated, and 50% of the jobs with more than two hours duration were eliminated. The future expectations are to keep track of the DWD considering the learning curve and be able to meet at least 95% D.W.D. Also, this project should work as a precedence baseline for future cycle time changes.

Acknowledgments

Special thanks to the 777/777x Wing Body Join team for their engagement and efforts in this project and my manager Ms. Knight for giving me the opportunity to lead the team during this process. Also, my professor Dr. Cruzado for being detailed and clear on what he expected from us.

References

[1] Gates, D., Long, K. A., & Roberts, P. (2020, October 1). Everett, Region Brace for economic impact of Boeing's decision on 787 line. The Seattle Times. Retrieved October 22, 2022, from https://www.seattletimes.com/business/boeing-aerospace/boeing-leaders-meet-thursday-to-decide-fate-of-everetts-787-line/