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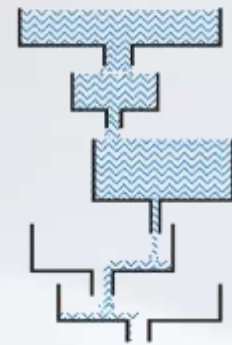
Fixing airplanes twice as fast using Critical Chain

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Marris
Consulting



Brief bio

- IPSA, Expert in aeronautics and space engineering
- Airworthiness Responsible at Air Tahiti
- Quality Manager, Security and Human Factors Manager at CAP Sud Tahiti
- **Maintenance Engineering & Planning Manager at Embraer Executive Jets**



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Activity of Embraer Executive Jets at Le Bourget (#1/2)

- Le Bourget airport is just outside Paris. It is the largest and busiest business jet facility in Europe.

Phenom
100/300



Legacy
450/500
/600/650



Lineage
1000



Activity of Embraer Executive Jets at Le Bourget (#2/2)

- Maintenance support for Embraer Executive Jet fleet for the Europe Middle-East Africa (EMEA) zone.
- Maintenance teams:
 - 2 shifts, 5 days/week,
 - A 4 on / 4 off maintenance team dedicated to Line (scheduled maintenance) and AOG (Aircraft On the Ground) to ensure a 24h/7 service.
- The Hangar is fully booked for the whole year.
- Customer Service is mandatory.



Initially very little visibility and reliability...

- Planning before and during the check is not efficient especially for the Check-C (major maintenance operation after 8 years of use).
- Only 40 % of parts are delivered on time to the hangar.
- Customer validations for additional work arrive late.
- Technicians don't know their daily priority.
- Very poor visibility on the work progress.
- Management of the hangar's "slots" is not robust nor reliable.

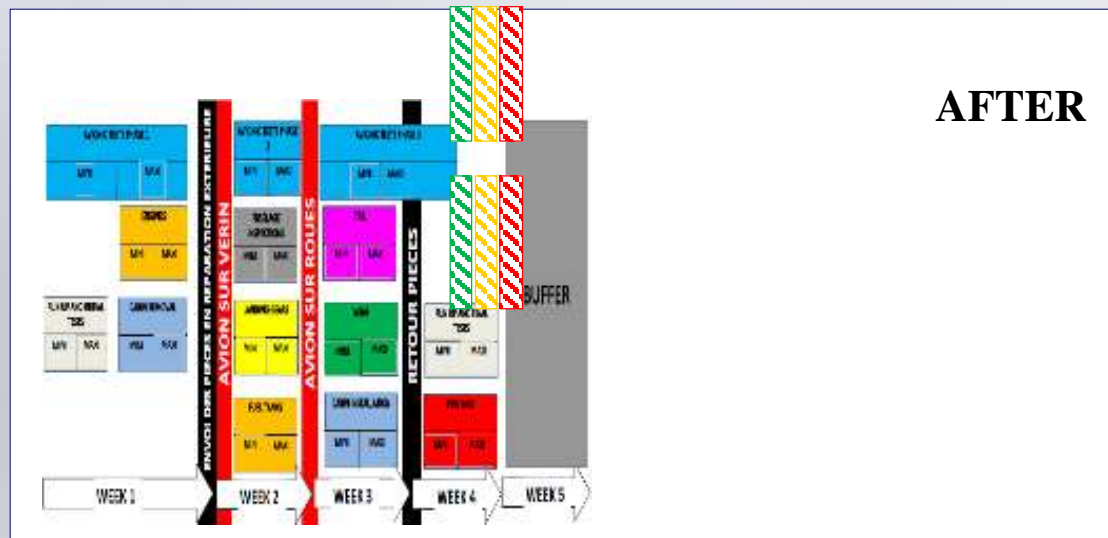
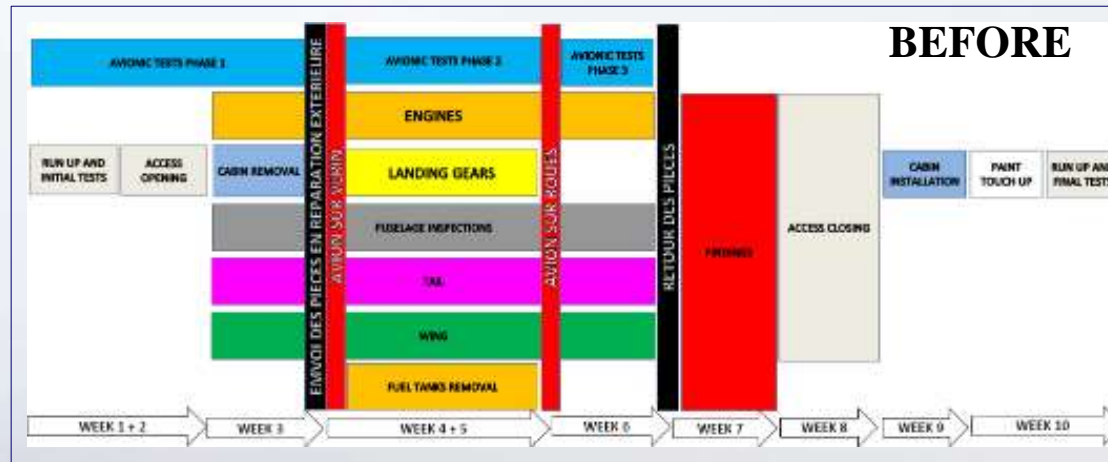


The first step was to build a macro-schedule

- Creation of a macro-schedule with short-term objectives, example: Jacking – Day 5.
 - Analysis of previous Check-C:
 - Priority is given to aircraft areas that generate the most "findings".
 - Supply of the most recurring parts.
 - Definition of a mini/maxi number of resources per area.
 - Training of all employees on Critical Chain.
- *Findings = Unexpected problems found while inspecting the airplane and it's equipment.



Macro-schedule for achieving a check in 5 weeks

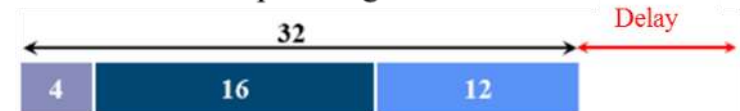


The Critical Chain approach was applied #1/2

- Schedule for the aircraft is created in MS-Project (with an add-on for Critical Chain) in line with the macro-schedule.
- Reduction of the number of work cards thanks to work "packages" (from 1,200 cards to 170 packages).
- Schedule adjustment with aggressive durations and a protection for the whole project through a final buffer.
- (../..)



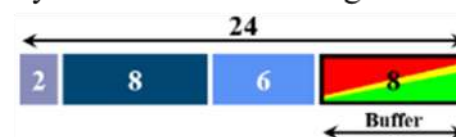
With traditional planning...



... each task has its own margin



With Critical Chain, margins are mutualized and cycle times are challenged



The Critical Chain approach was applied #2/2

- Establishment of a “Findings Buffer” to model the load due to the discovery of defects during the check.
- Ensure that the schedule respects the basic principles of Critical Chain.
- Analyze and optimize the Critical Chain to ensure a 5-week check.

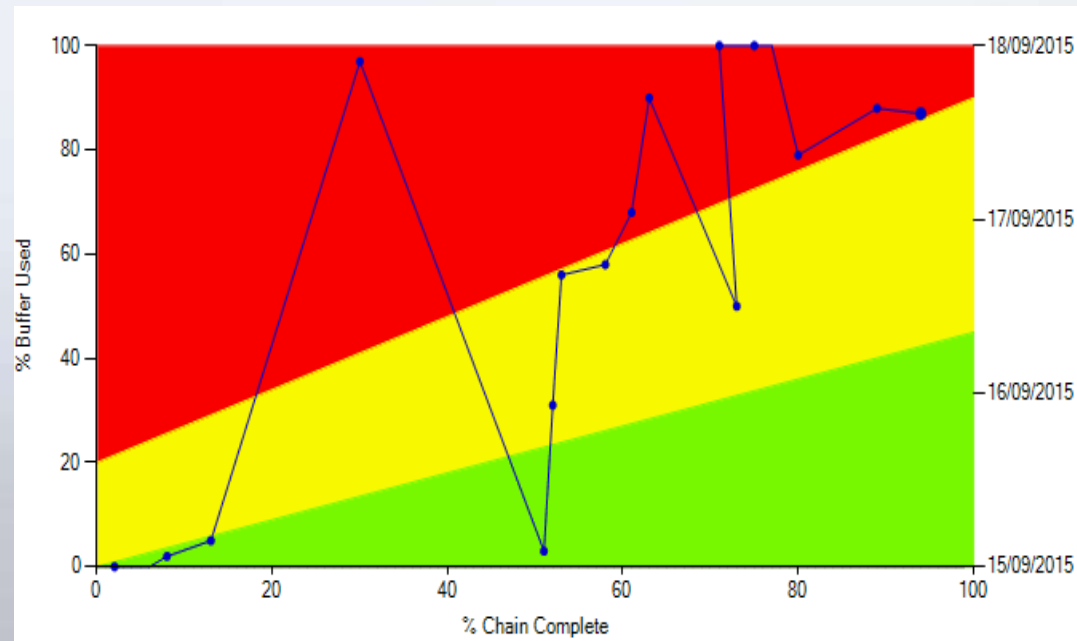


During project execution, new behaviours were implemented

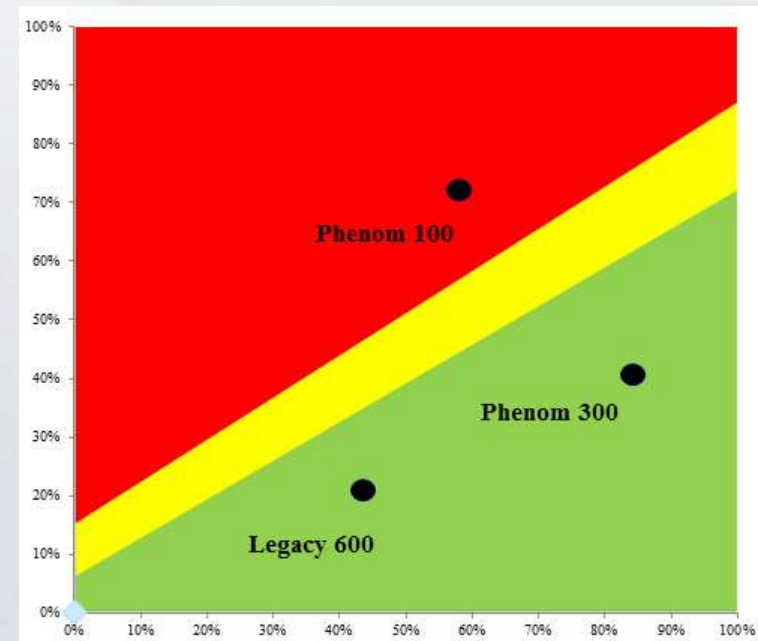
- At the end of each shift, the planner and the team leader prepare the work cards for the following team.
- Independently from their status, at the end of the shift, all the work cards are handed over to the team leader, so they can be rescheduled.
- In order to keep a low work-in-progress, the planner only gives new work cards when he gets a closed work cards.
- (.../...)



The Fever Chart was used to manage execution



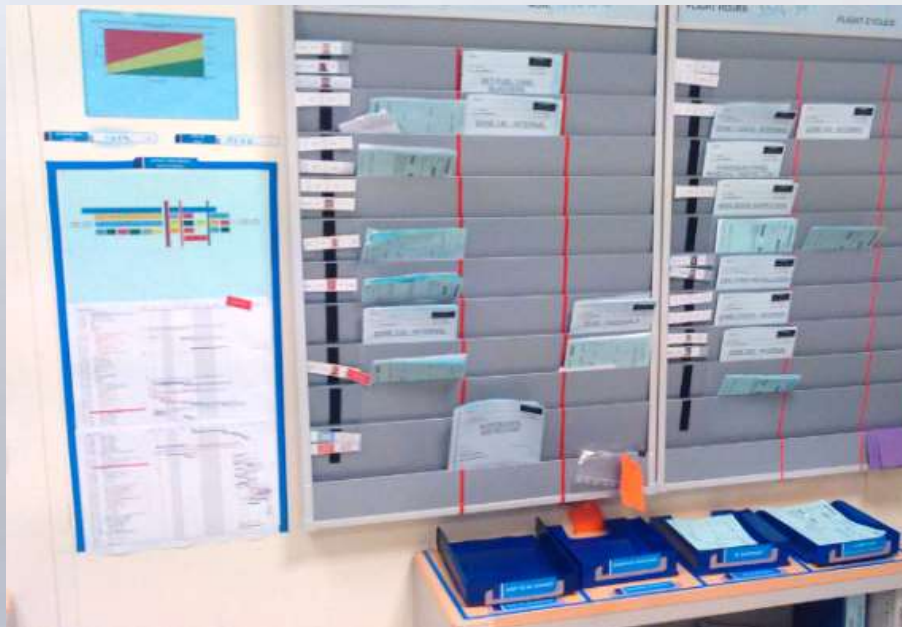
Exemple of an Aircraft Fever Chart



Exemple of Hangar Fever Chart

Deployment of Visual Management to facilitate the monitoring of daily activities

- Modification of the “control room” to optimize the monitoring of the check as well as the monitoring of couple of checks simultaneously.



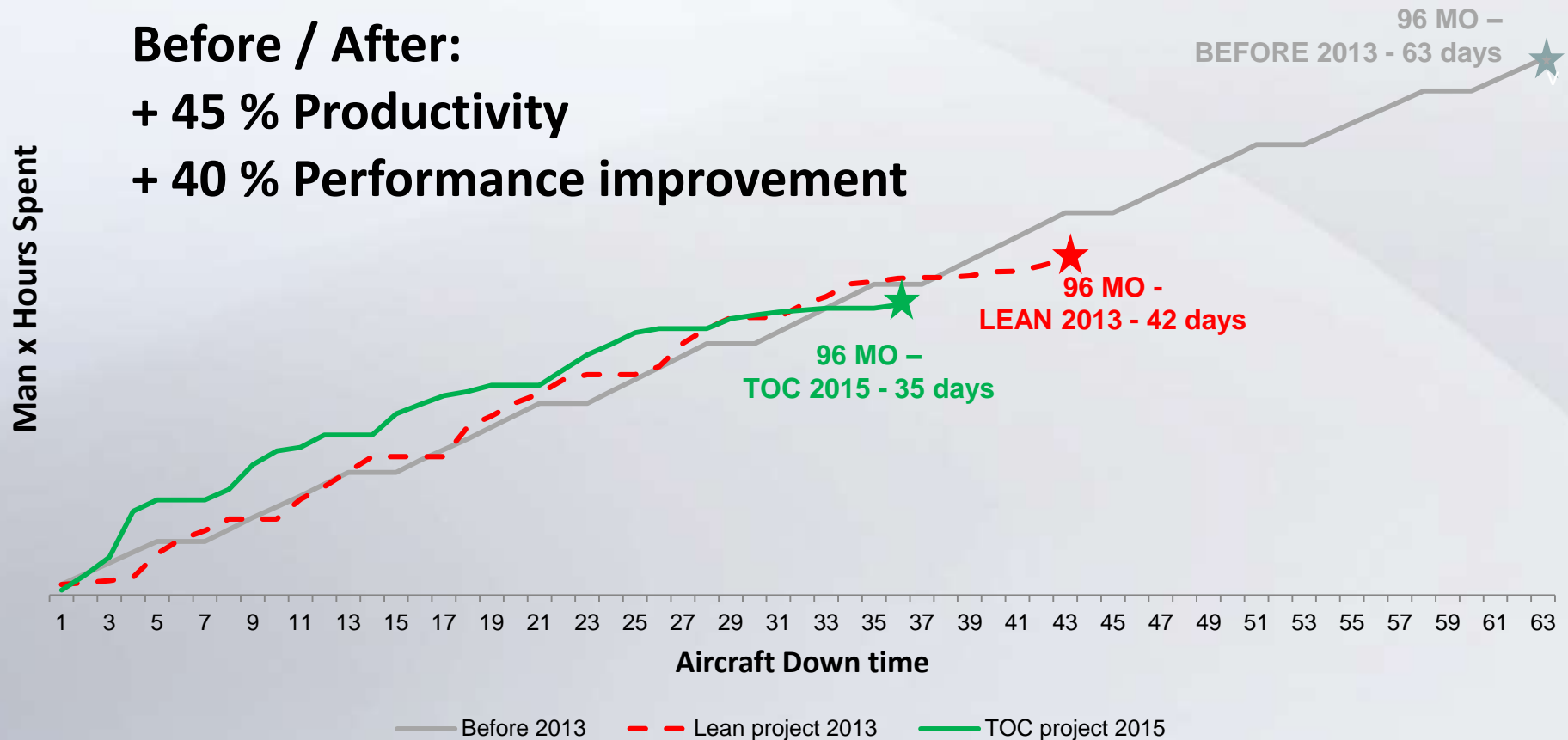
Managing execution becomes much easier

- The impact of problems (late parts delivery, internal or external intervention,...) is easily visible on the Fever Chart.
 - Indeed, Critical Chain allows simulation of the corrective actions and the effects on the aircrafts' delivery date.
- Managers don't need to have details for all activities. Only aircrafts in the Fever Chart's Red Zone should be considered.
- During the check, the progress and remaining work is much clearer and shared with everyone.



Now we fix airplanes twice as fast...

Before / After:
+ 45 % Productivity
+ 40 % Performance improvement



...and many undesirable effects have disappeared

- Late deliveries
- Lack of visibility on aircraft release dates
- Important workload for planners
- Constantly changing priorities
- Forced multitasking
- Stress caused by work environment



Any questions?