Bottleneck-focused

Production Planning and Control

based on Goldratt`s „Theory of Constraints“

good to know it's

Lufthansa Technik
AERO Alzey

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Company Overview

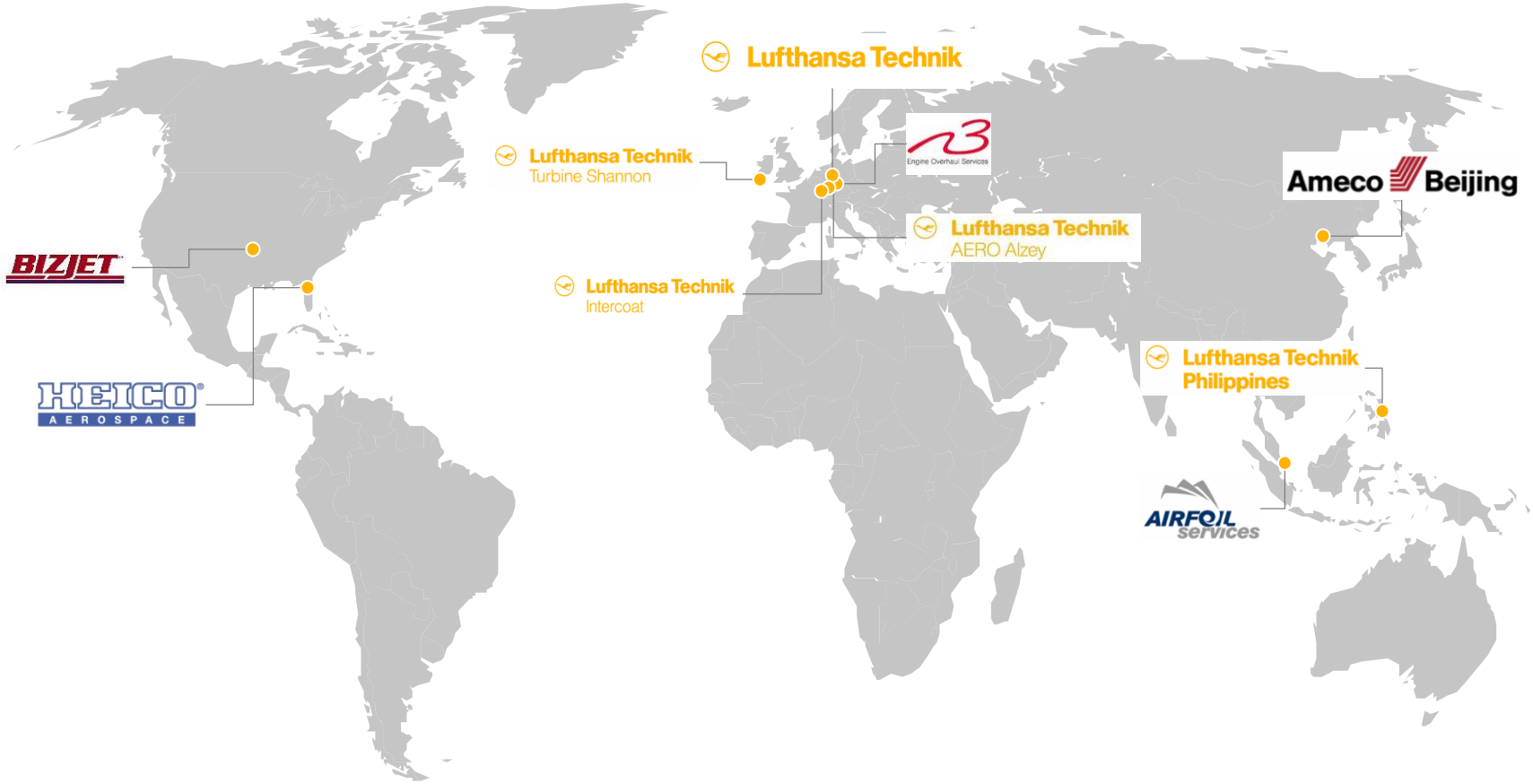
Key Facts for 2013



- Specialized in Turboprop and small Turbofan Engines
- 100% subsidiary of Lufthansa Technik AG
- 490 employees
- More than 220 Mio. € Revenue
- More than 100 Customers
- 480 Engines repaired and overhauled (per year)
- Service Center in Tulsa, Melbourne, Bejing and Buenos Aires
- Lease engine portfolio of more than 50 engines
- On-site services (300 events per year worldwide)
- 24/7 AOG hotline

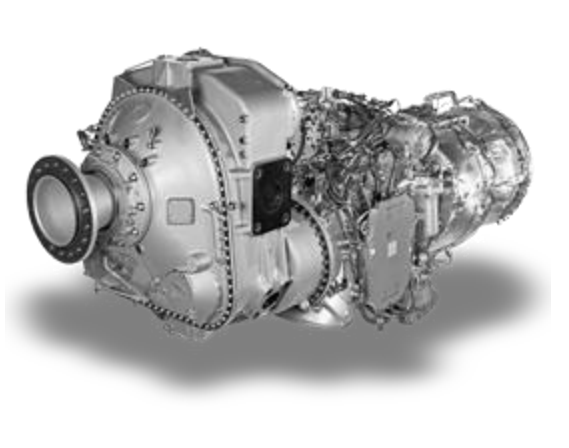
Company Overview

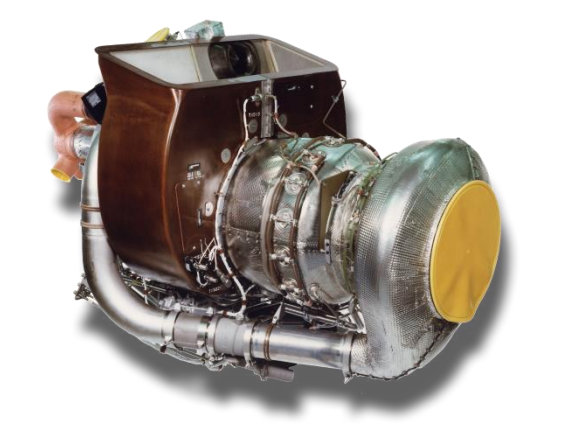
Lufthansa Technik Product Division „Engine Services“



Company Overview

Competence Center for regional aircraft engines

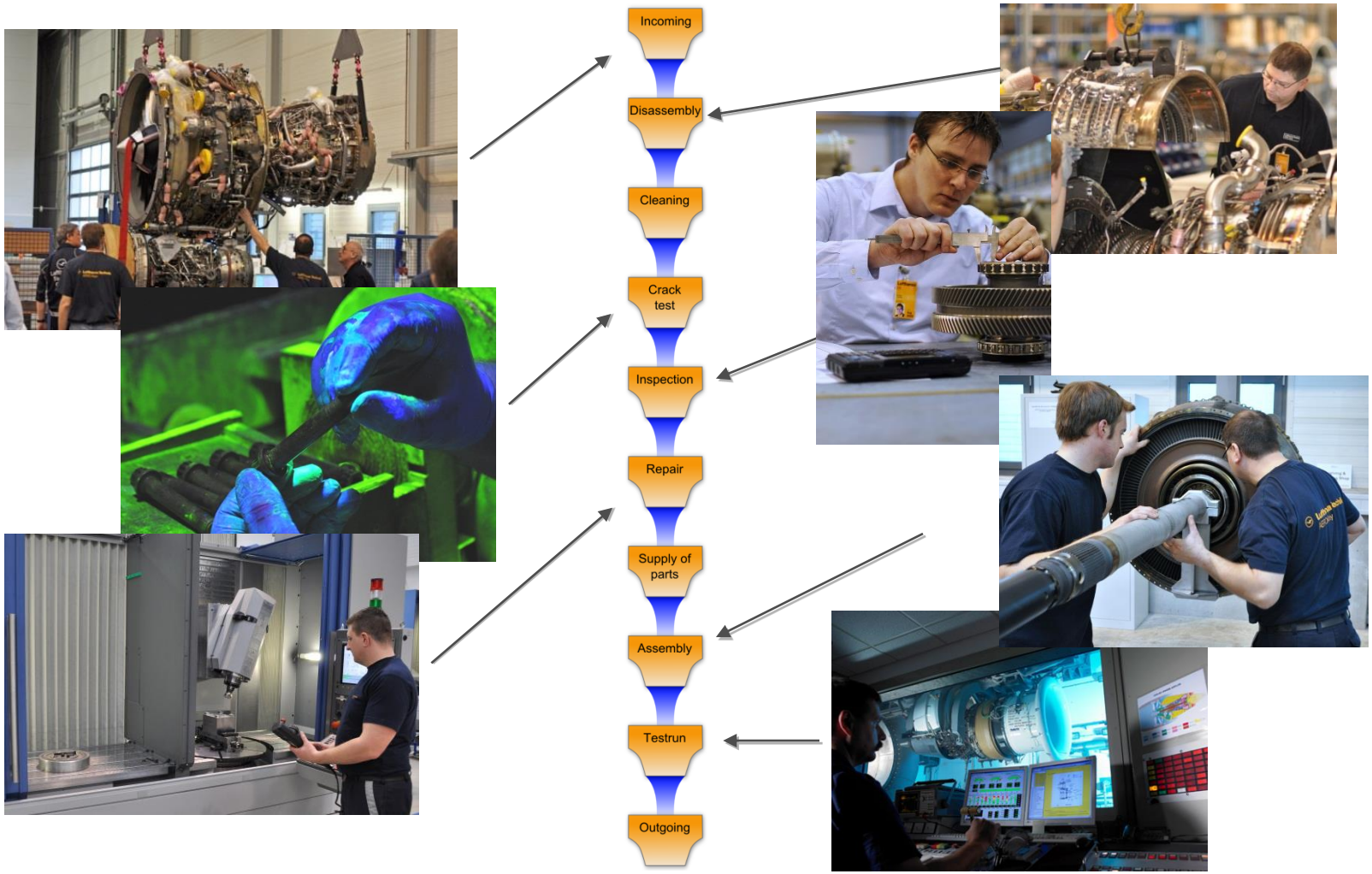




GE CF34 Turbofan Engine	PW100 & PW150 Turboprop Engine	PW 901A/C Auxiliary Power Unit

Company Overview

Typical workflow at LTAA



Production System

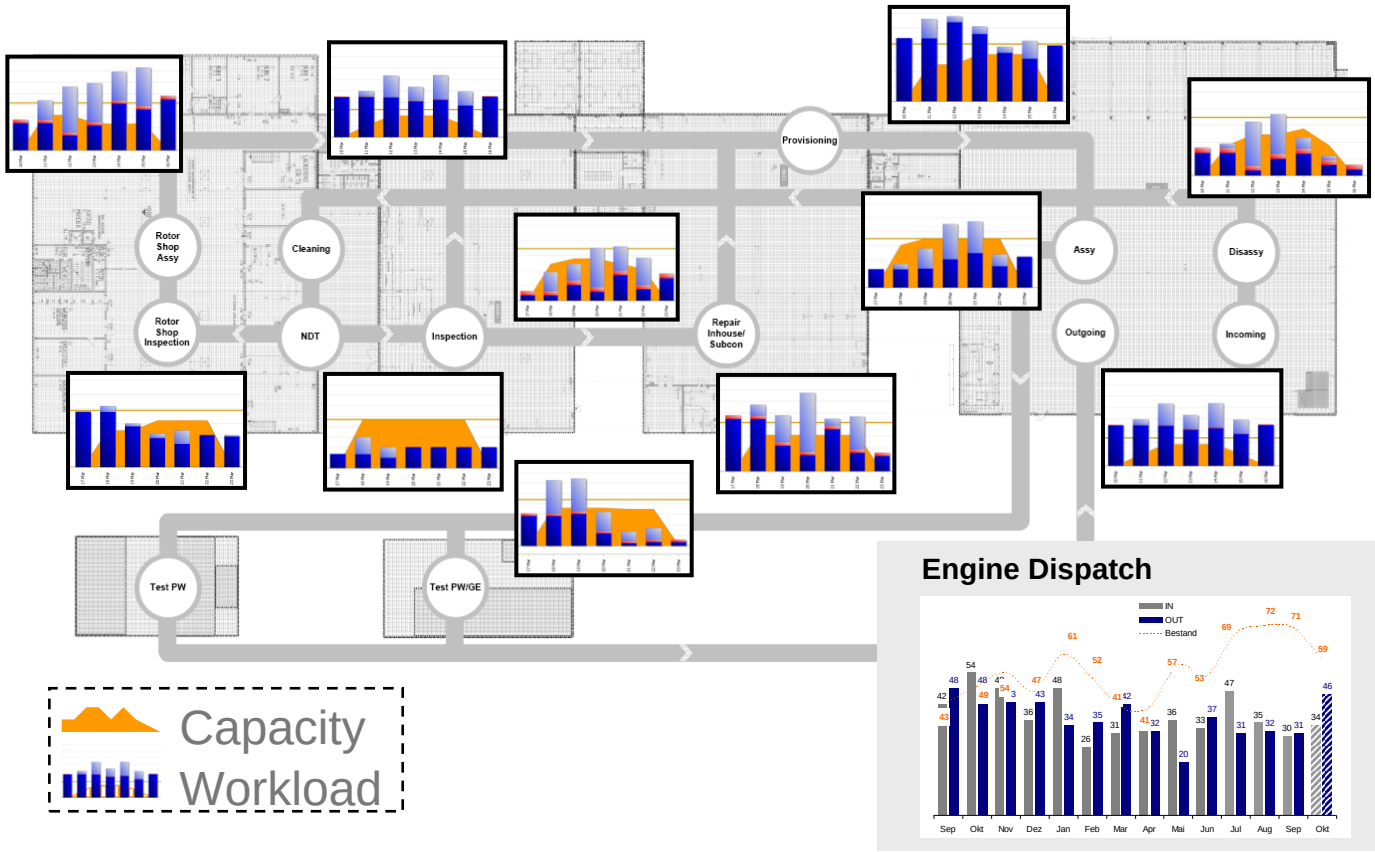
Major Production Challenges

- **Engine removals from aircraft mostly driven by unforeseen issues**
  - Shop load forecast difficult
- **Workscope mostly based on findings**
  - Repair can require 100MH or 1500MH
- **Many material sources**
  - Repair of original part, new material, used material
- **Many Customer decisions during shop visit**
  - Mainly cost driven
- **OEM requirements to consider**
  - Deviations from manuals all to be accepted by aviation authority, OEM and customer

Production System

Major Production Challenges

- **Engine removals from aircraft mostly driven by unforeseen issues**
  - Shop load forecast difficult due to strong capacity fluctuation



Production System

Former Production Monitoring & Control at LTAA

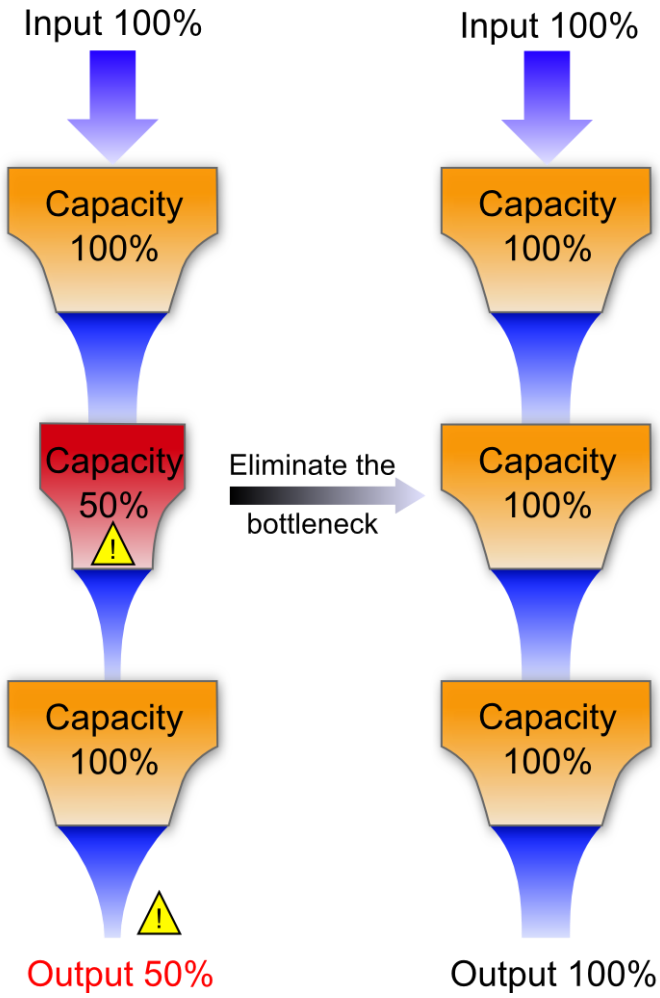
- **Daily production meetings**
  - Up to 90 engines to be discussed
  - 25 Participants, 2 hours
  - Data collection on the shop floor to fill individual spread sheets (1 hour preparation)
  - Afterwards information needs to be distributed (1 hour)
  - Not all issues were addressed
  - No documentation of decisions

- **KPIs were only available looking backwards**
  - Already too late for corrective actions
  - Justification discussions instead of pro-active solutions

Production System

New LTAA Production System is based on Goldratt's Theory

- LTAA's production system is based on Goldratt's Theory[1]
- The throughput of any linear production is always limited by a single „bottleneck“
- In a series of funnels, the „bottleneck“ is the funnel with the smallest outflow surface
- The task is to IDENTIFY and RESOLVE bottlenecks continuously

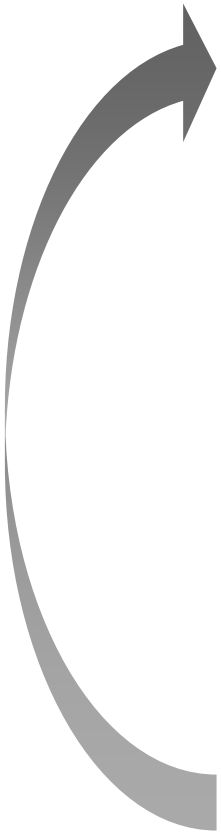


[1] [„The Goal” by Eliyahu M. Goldratt and Jeff Cox]

Production System

New LTAA Production System is based on Goldratt's Theory

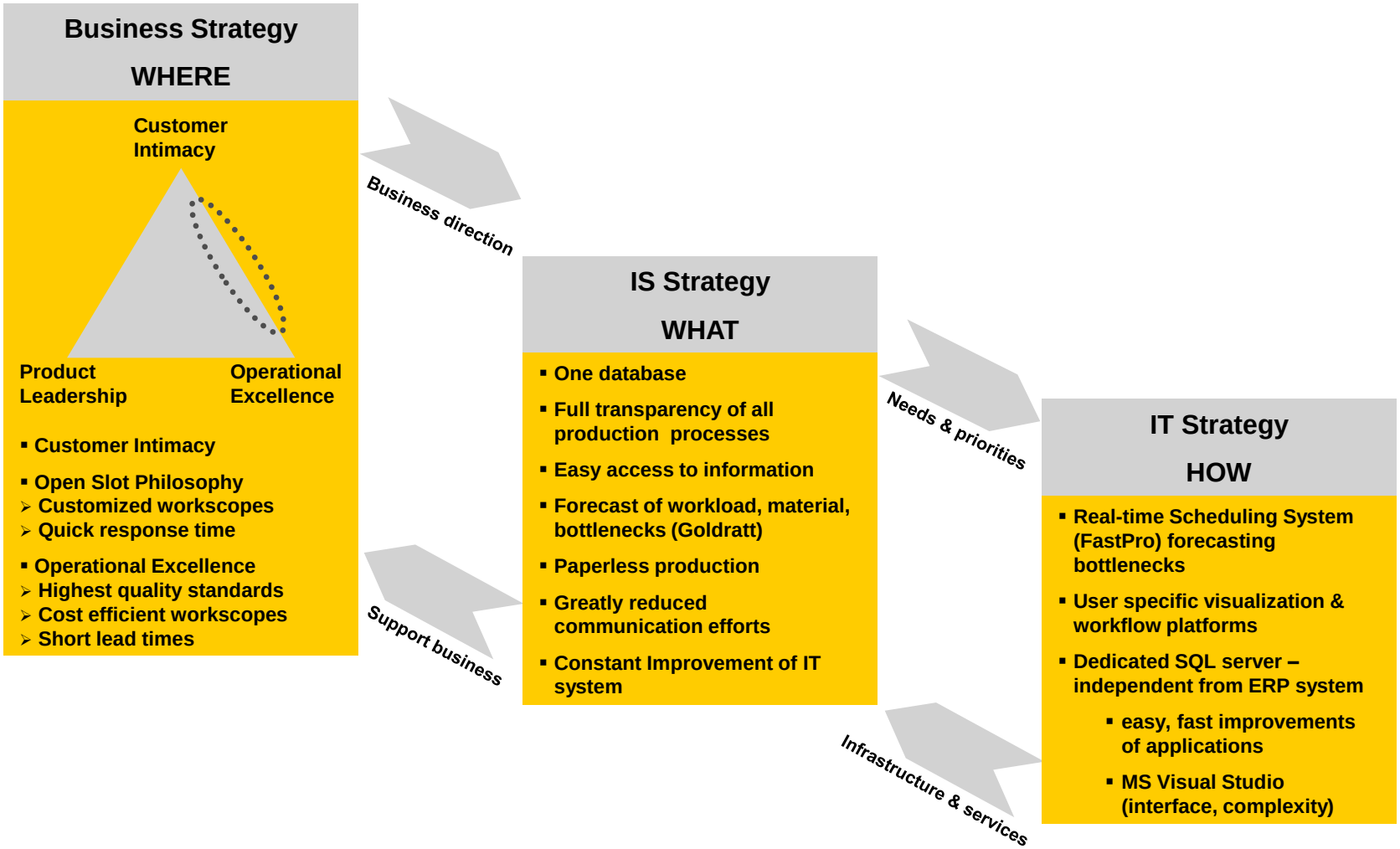
- **Goldratt suggests in his „Theory of Constraints“ five steps to eliminate constraints:**



1) Identify the constraint(s).
2) Exploit the constraints by keeping it running.
   - Protect it with a buffer.
   - Aim for alternative routings.
   - Avoid defects by improving the quality.
   - Ensure it is properly maintained.
3) Subordinate all other resources to the constraint, as the constraint affects the bottleneck capacity and therefore determines the output of the entire production.
4) Elevate the constraint by increasing the capacity, e.g. by buying an additional machine or working overtime.
5) If the constraint has been resolved, revolve to step one.

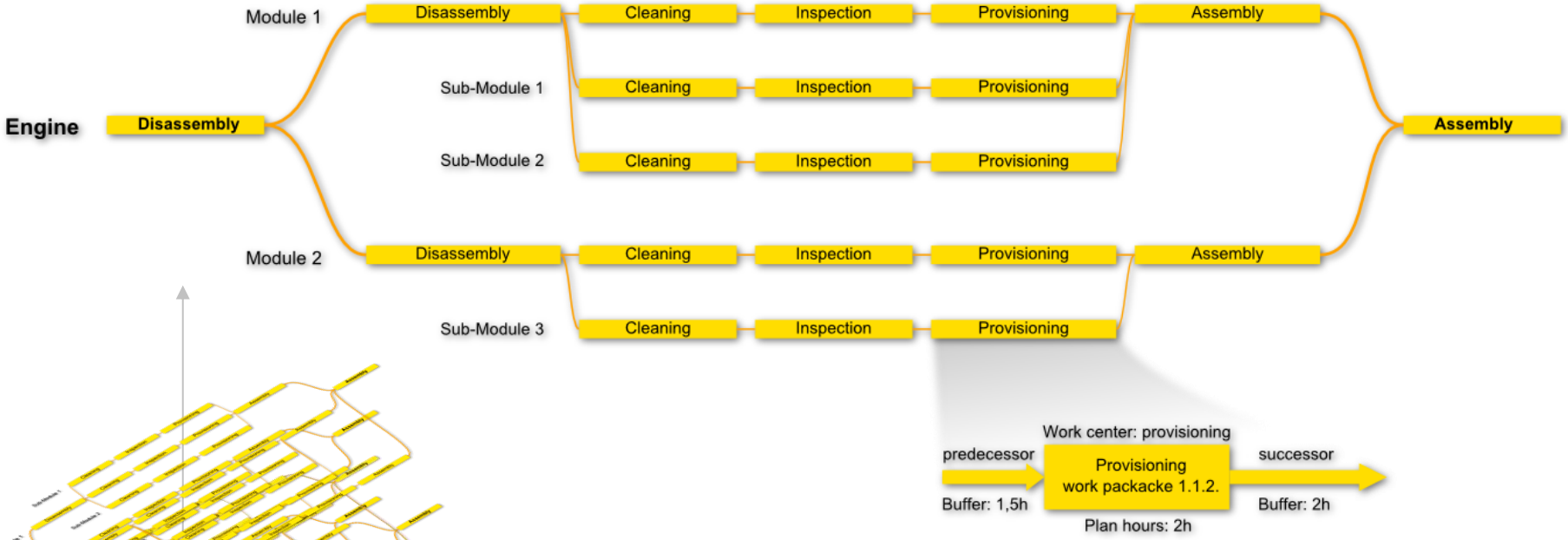
Production System

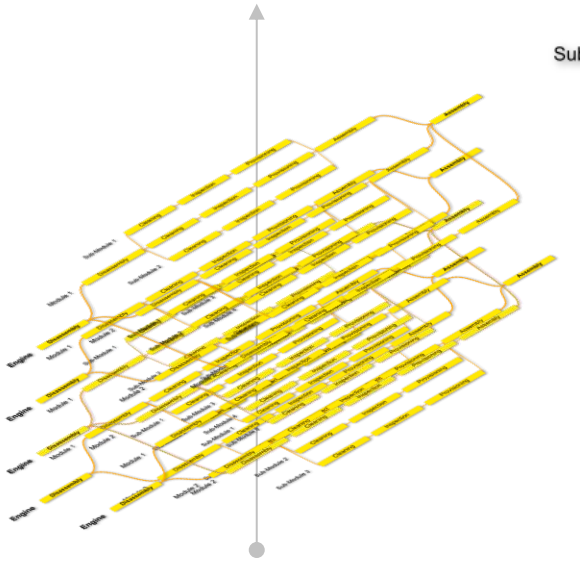
Business Strategy governs Information System



Production System

Typical workflow at LTAA – Network plan





today

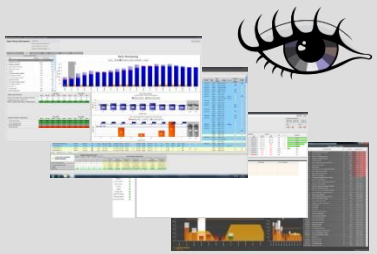
Production System

Goldratt's theory assigned to LTAA's Production System

- **Main Production bottlenecks at LTAA are:**
  - Capacity (man power)
  - Material availability
  - Tooling
  - Deviations from OEM technical documentation
  - Production line stops

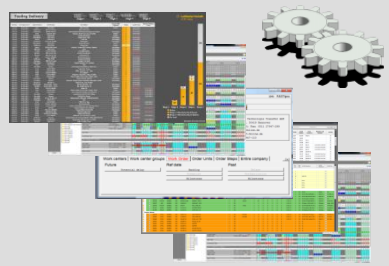
Identify Bottlenecks

In order to identify a bottleneck, all workflows are visualized to everyone involved in the process – from mechanic to manager



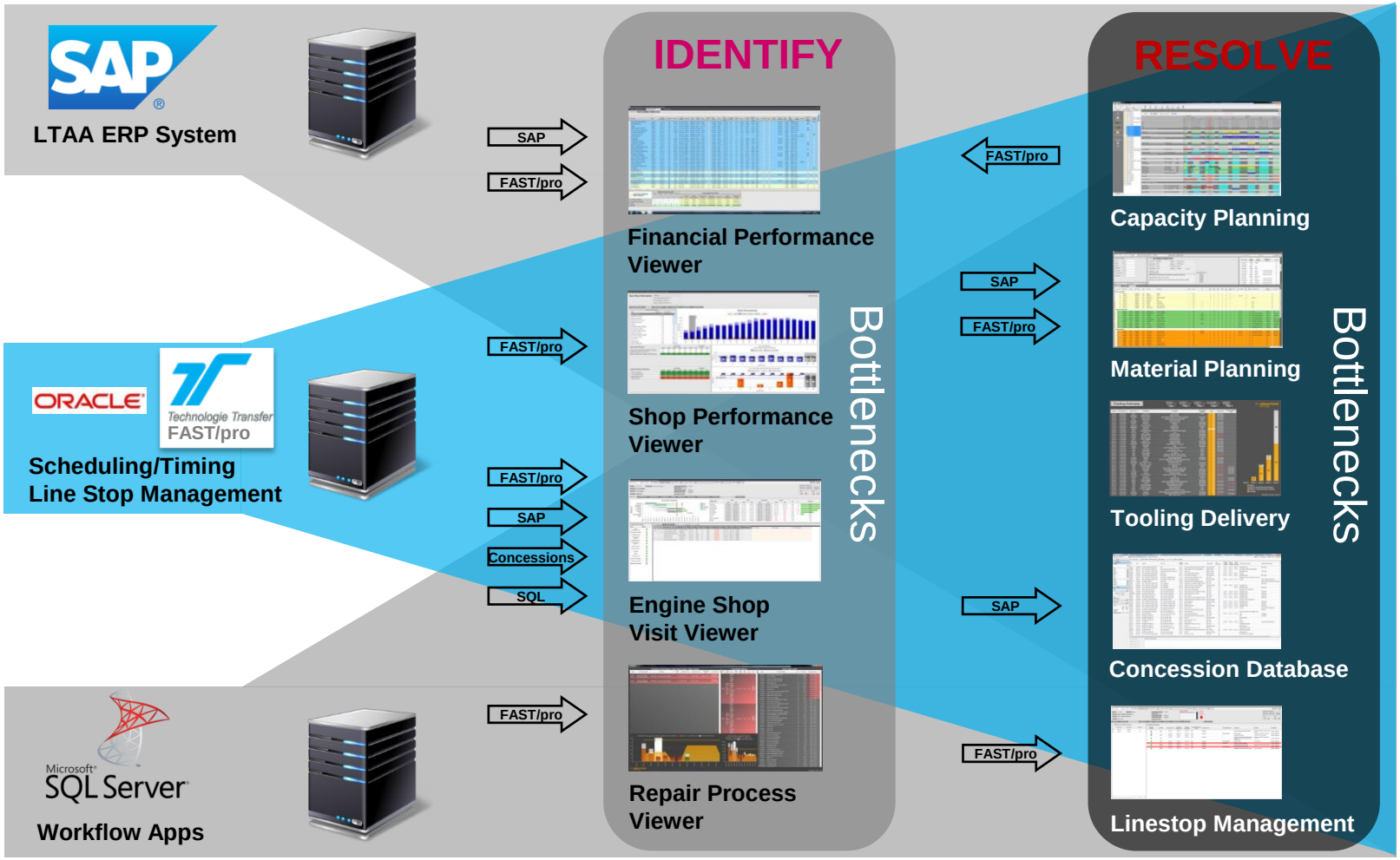
Resolve Bottlenecks

In order to resolve a bottleneck, all critical workflows are addressed in dedicated workflow databases



Production System

IT architecture at LTAA



Production System

Practical implementation

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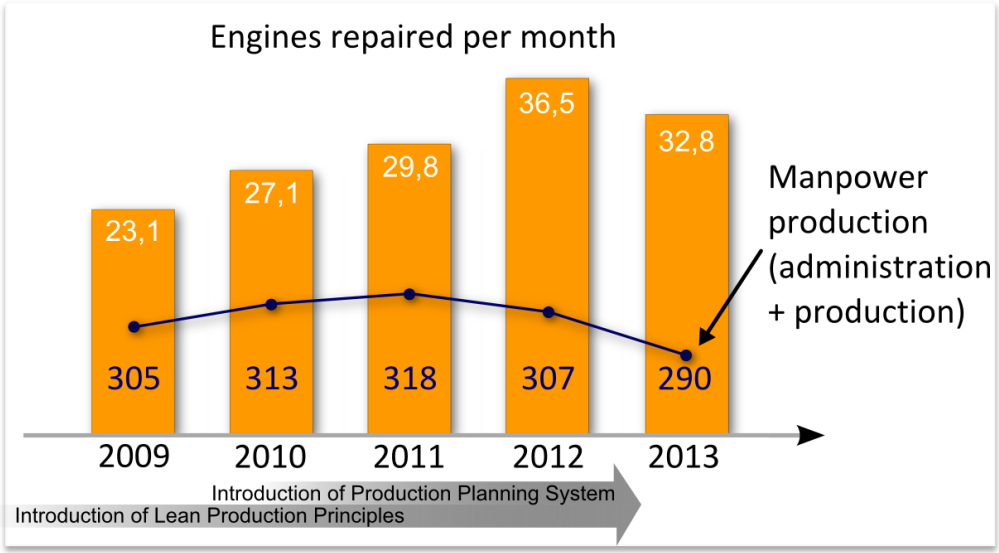
Production Planning

Success so far…

- Fully transparent production system → all information is available for everybody
- Real-time monitoring and control of all production processes → less communication/meetings necessary
- Each LTAA bottleneck addressed in dedicated workflow databases
- Simulation of the future using FAST/pro Scheduling technology to identify and resolve FUTURE bottlenecks

- Increased work-center efficiency
- All production KPIs enhanced (TAT, CDP, Efficiency, TCRR)[1]
- Significantly higher engine output per month @ same workforce size



[1] [TAT=Turn Around Time, CDP=Customer Delivery Performance, TCRR=Test Cell Rejection Rate]

Vielen Dank für Ihre Aufmerksamkeit.

Thank you for your attention.

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