



Engineering, Operations & Technology
Boeing Research & Technology

Research & Technology

Assembly and Automation Technology



Agenda

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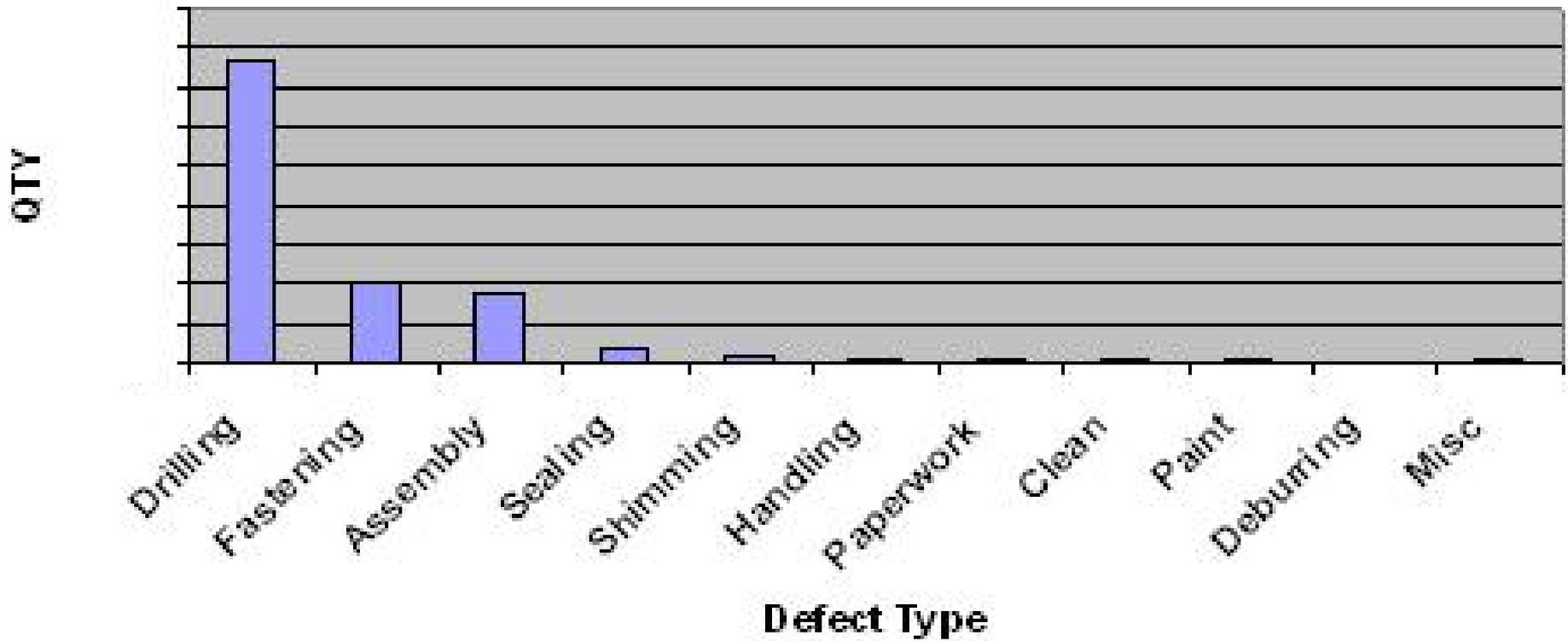
- Background information
- State of the art
- Future development and technology needs

Background information

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- Quality/Defects
- Cost
- Flow/Rates/Flexibility
- Safety/Ergonomics
- Capital Investment Costs

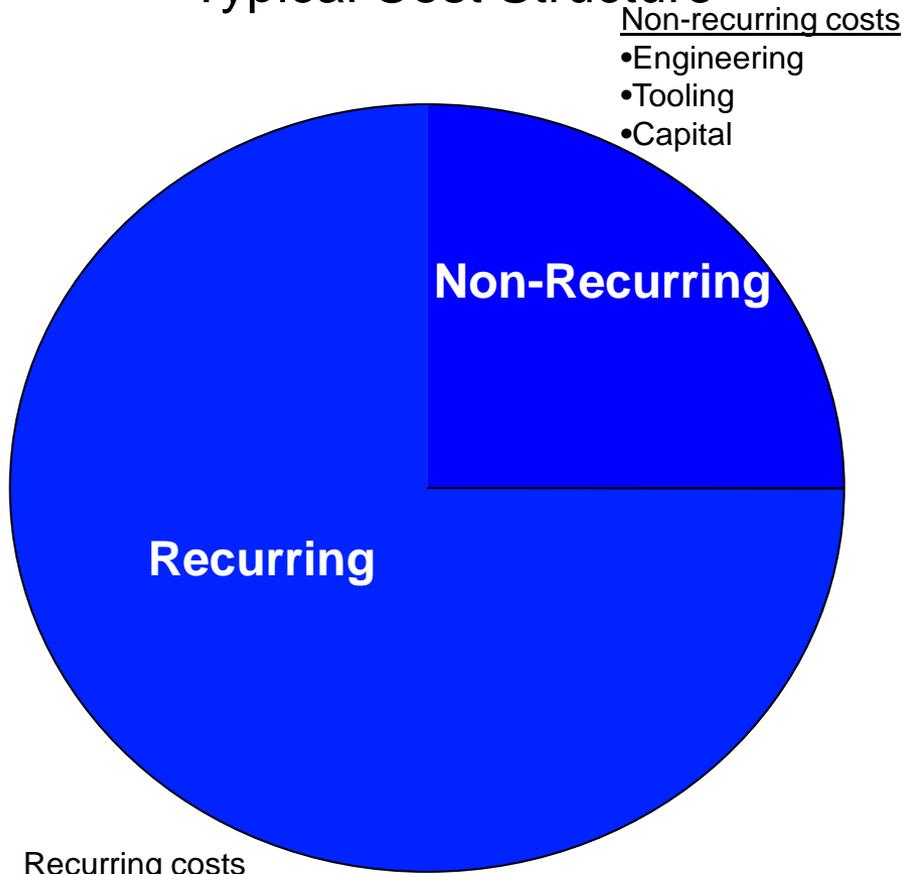
Quality



Program and Assembly Costs

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Typical Cost Structure

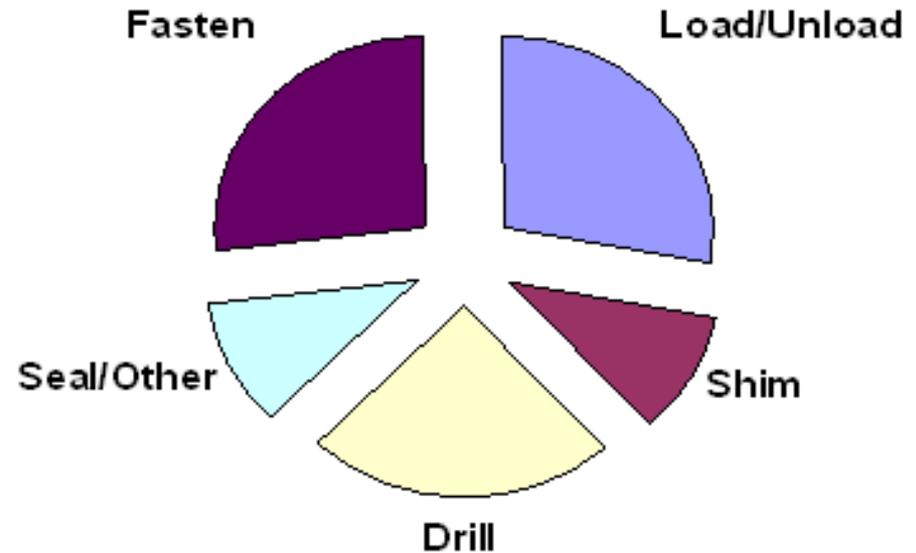


Recurring costs

- Materials
- Direct Factory Labor
- Support Labor
- Rework

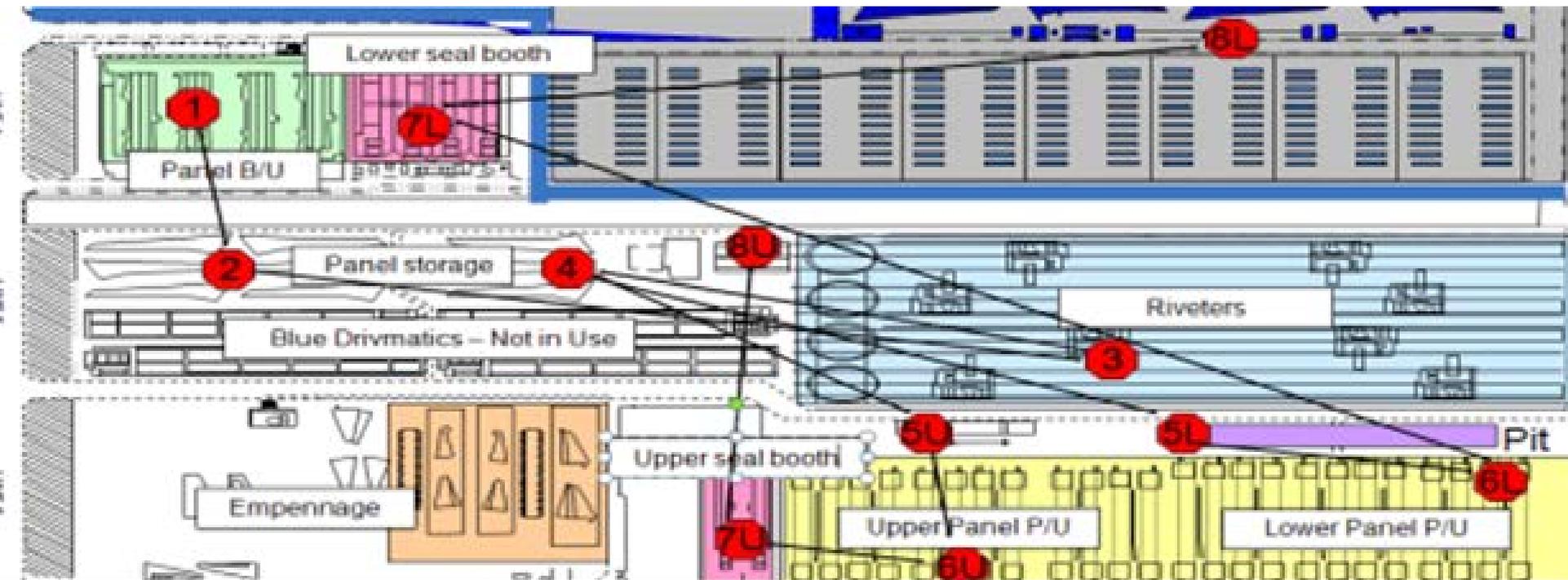
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Typical Assembly Tasks



Flow

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State of the Art Assembly and Automation Technology

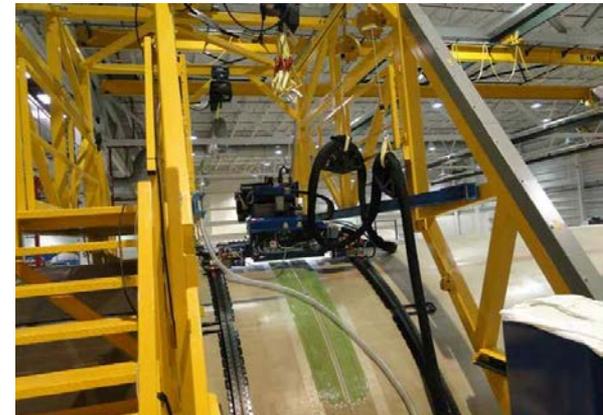
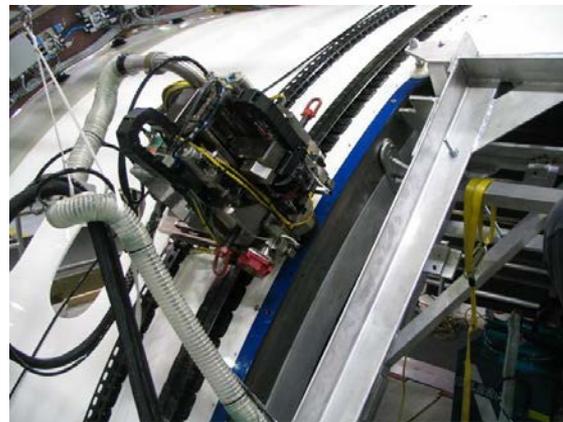
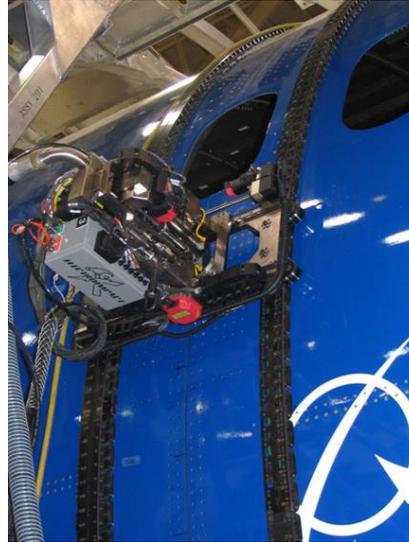
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- Portable Automated Systems
- Robotic Drilling/Fastening
- Confined Space
- Robotic Sealing
- Tool-less Assembly
- Flexible Fixturing

State of the Art Assembly and Automation Technology

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- **Portable automated systems**



State of the Art Assembly and Automation Technology

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- Robotic drilling and fastening



State of the art Assembly and Automation Technology

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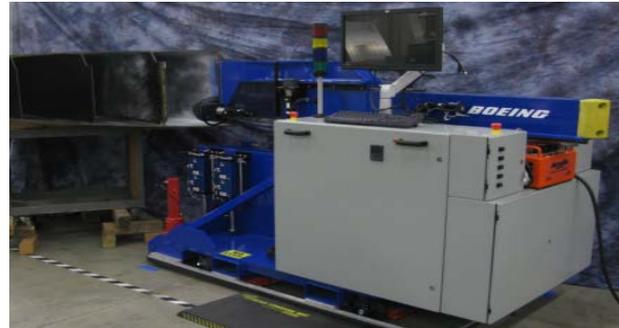
- **Robotic cleaning and sealing**



State of the Art Assembly and Automation Technology

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- **Confined Space Automation**



State of the Art Assembly and Automation Technology

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- **Horizontal build pulse lines and toolless assembly**



State of the Art Assembly and Automation Technology

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• Mobile platforms and flexible fixtures





Wing Build Technologies

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Manufacturing / Assembly

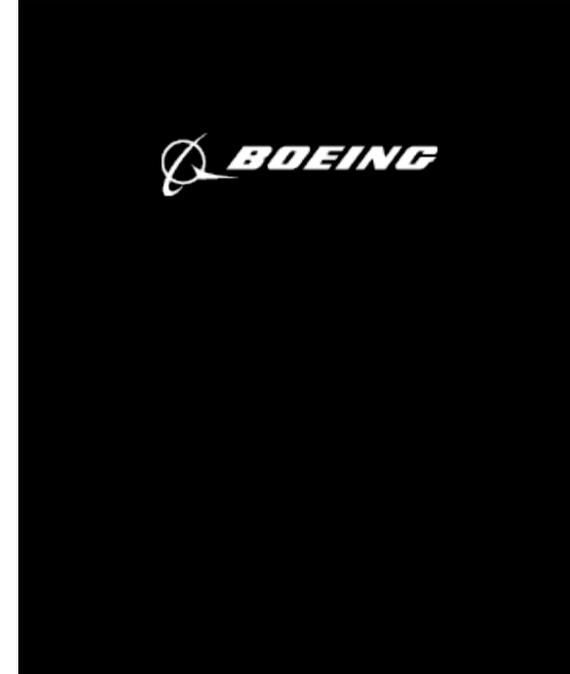
Yesterday



Today



Tomorrow



Future Development and Technology Needs

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- **Localized positioning/sensing**
- **Synchronous/coordinated robotics**
- **Swarm robotic navigation/control**
- **Adaptive control**
- **Common end effector interface**
- **Automated Clean/Seal/Paint Systems**
- **1 sided portable&robotic fastening**
- **Crawlers**
- **Reconfigurable mobile tooling**
- **Safe man/machine interface**
- **In process inspection**
- **Automation mistake proofing**

Questions?