Agile Manufacturing and Customer-Supplier Relations in the Auto and Aircraft Industries

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Objectives

- Understand how to improve complex customer-supplier relationships, using assemblies as an example

- Compare methods and performance of auto and aircraft industries

- Develop new methods and tools

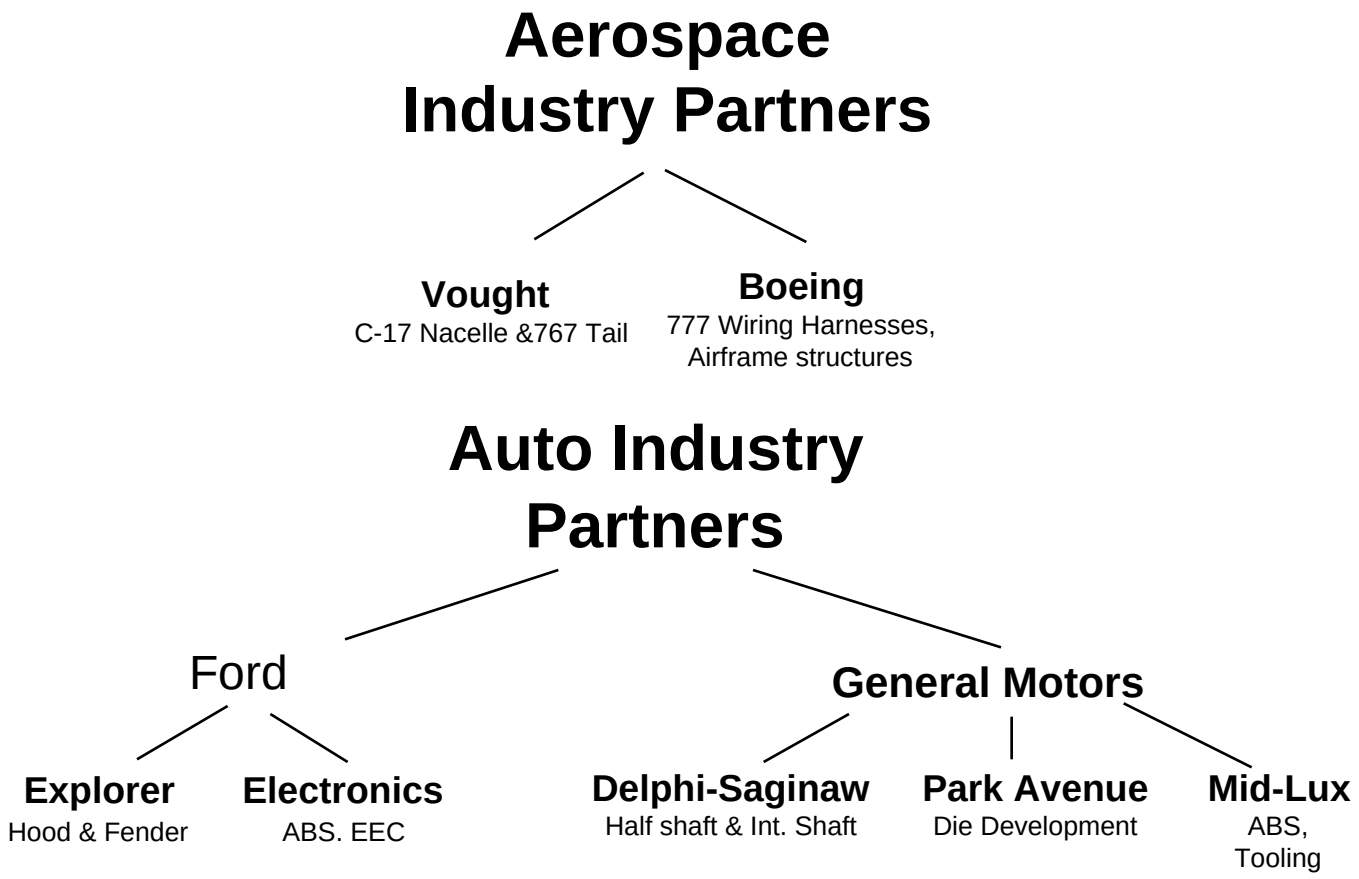
- Develop metrics

- Test tools and metrics in partner companies

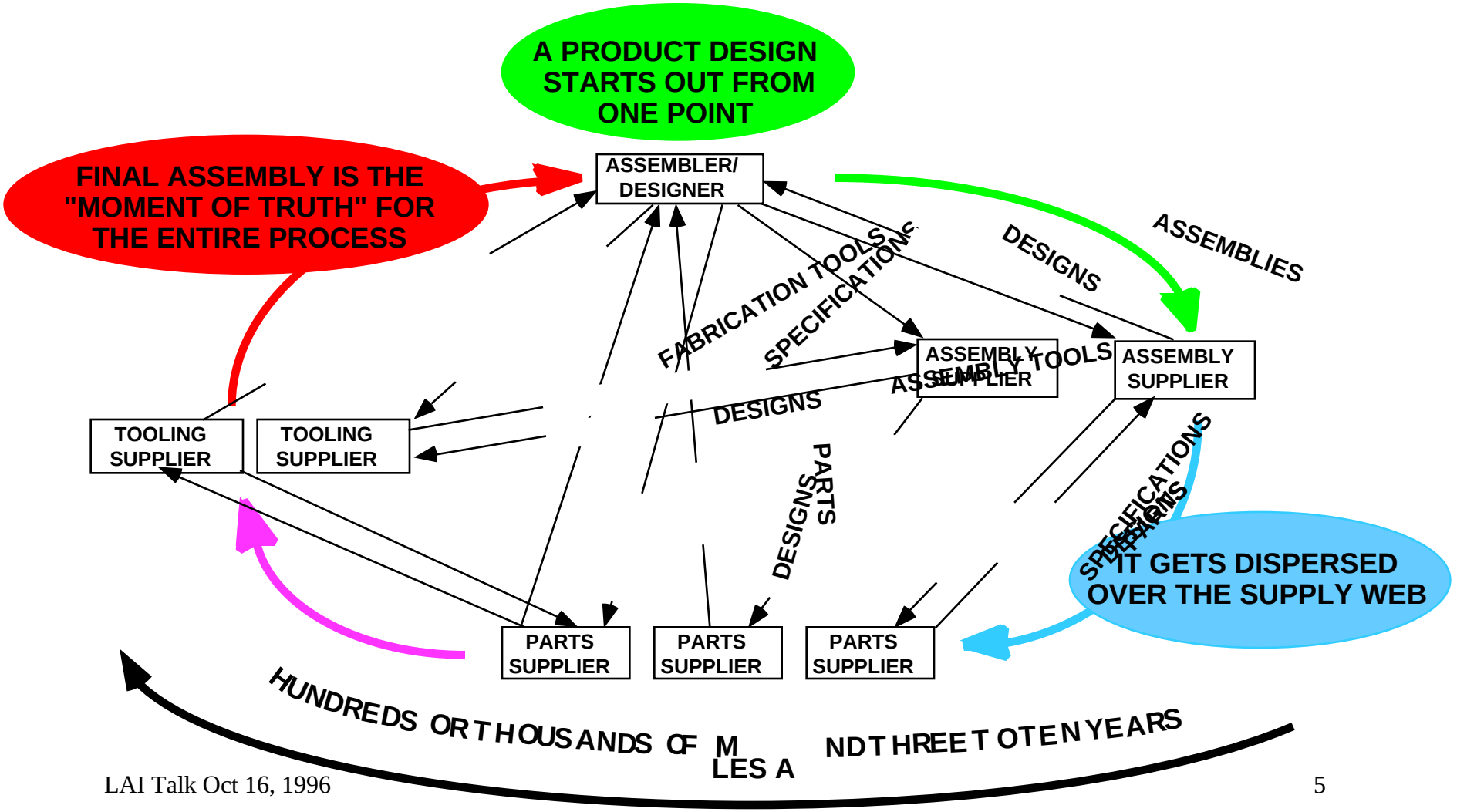
Methods

- Use a set of lenses to draw out different issues
- Combine technical and organizational solutions
- Develop tools that improve communication
- Perform case studies at partner companies to test tools
- Emphasize full cycle from product design to organizational learning for next product

Research Partners



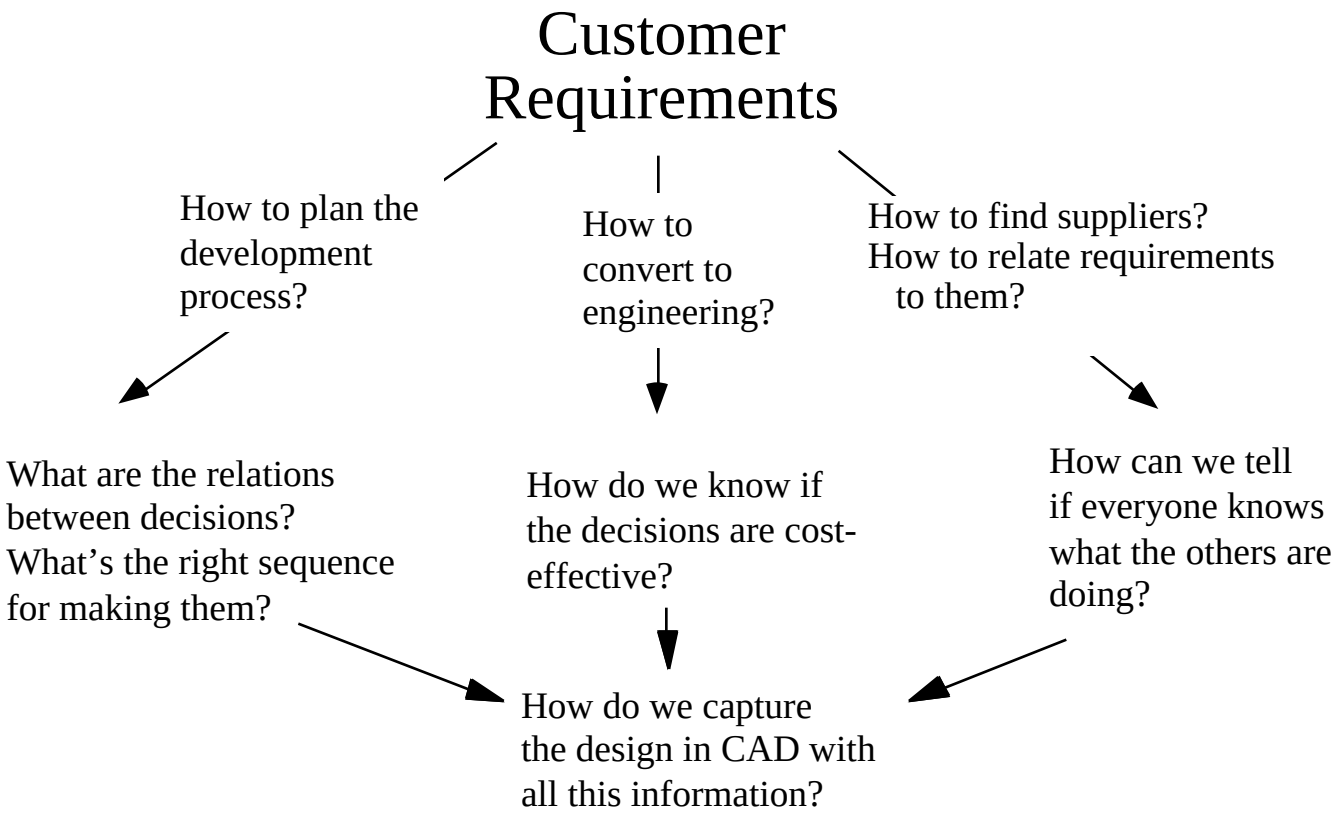
Make-Buy Complexity: Product Development on a Web



PDP Complexity:
Focus on Assemblies

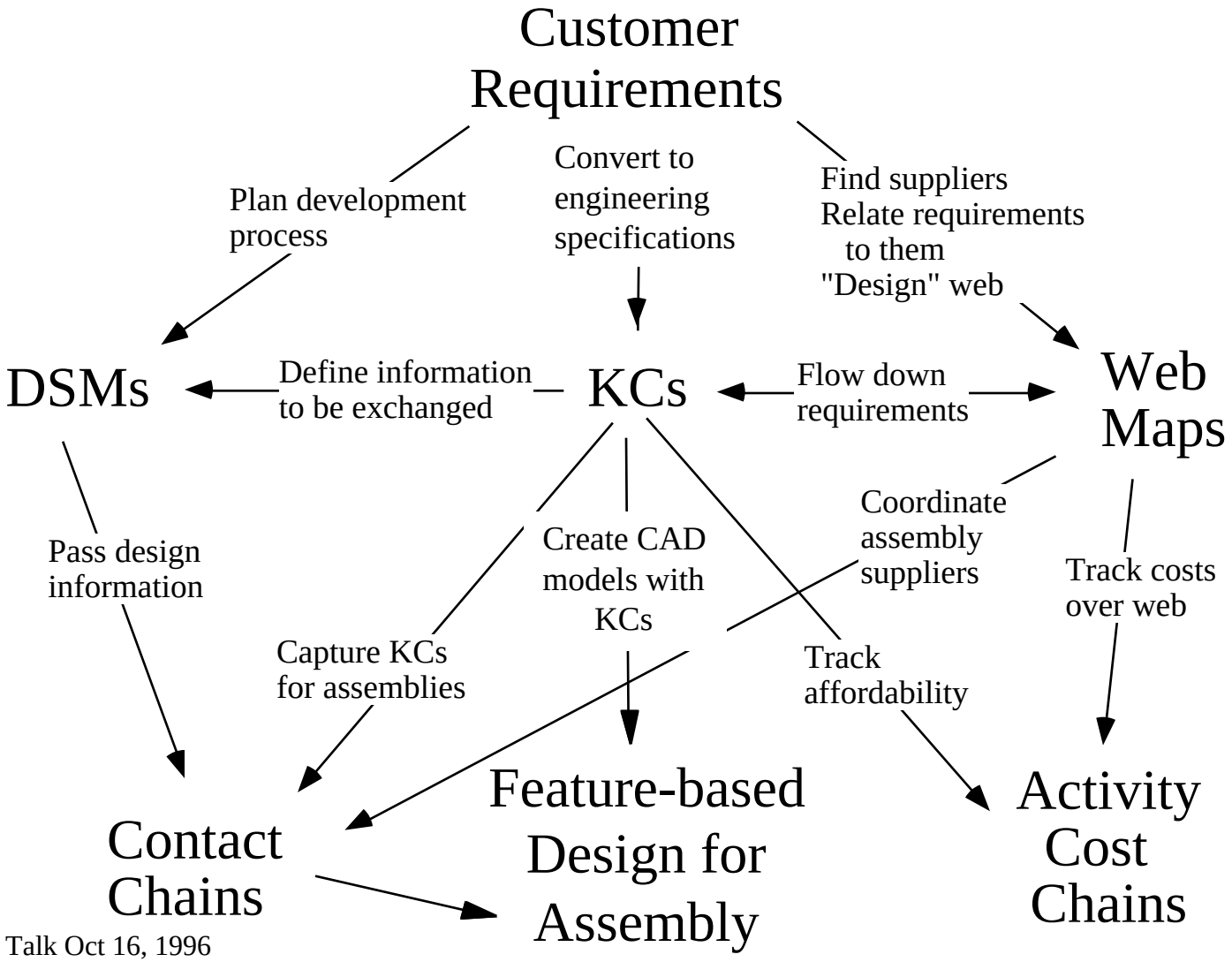
- Product development for complex assembled products involves many participants in a web
- Defining and managing the interfaces among parts and tools and the corresponding web participants is a key element in fast/flexible product development
- The assembly process is inherently integrative and reveals web problems vividly

Planning and Coordinating Shared Distributed Product Development



Are these questions related?
Are there tools to help answer them?

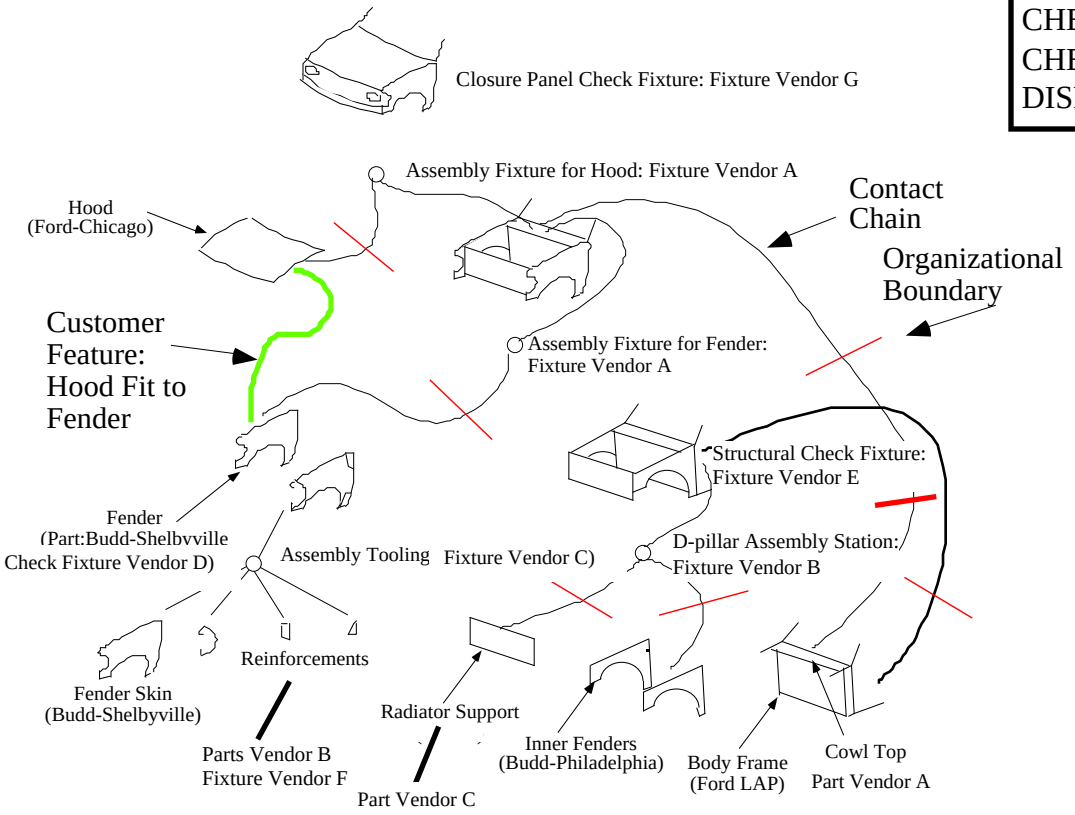
Tools and Their Relationships



Manufacturing Example: Supplier Web Superimposed on Contact Chain

Shows clearly who delivers what and how long the chains of delivery are

PART COUNT: 9
PART SOURCES: 7
TOOL COUNT: 5
TOOL SOURCES: 4
CHECK FIXTURE COUNT: 2
CHECK FIXTURE SOURCES: 2
DISPERSAL INDEX: 81%



N. Soman, M. Chang

Key Characteristics

Product Key Characteristics (PKC)

What is important ?

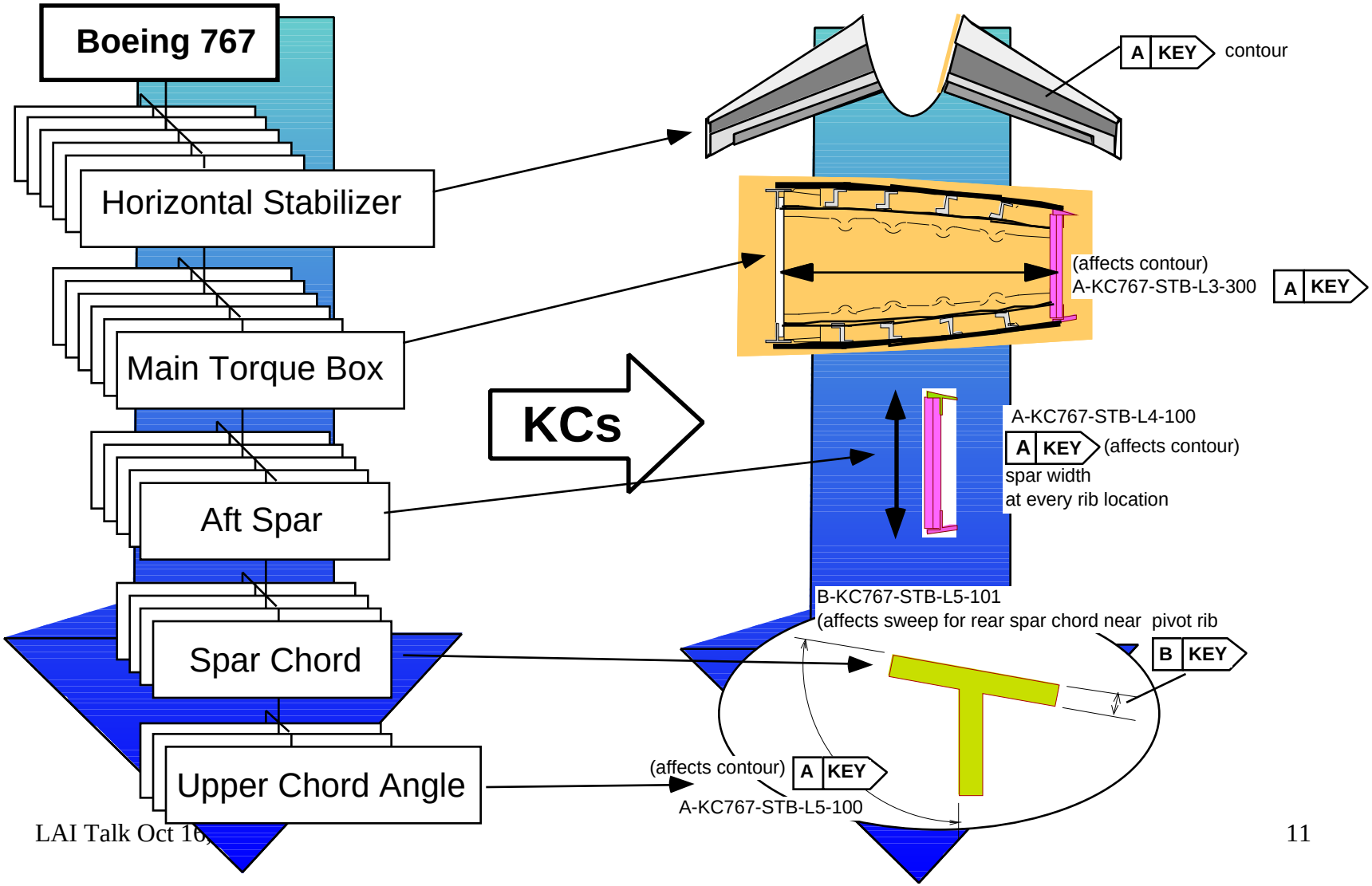
Assembly Key Characteristics (AKC)

How is it delivered ?

Manufacturing Key Characteristic (MKC)

How is it realized ?

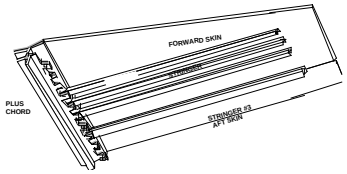
Boeing 767 KC Flowdown:
A Snapshot

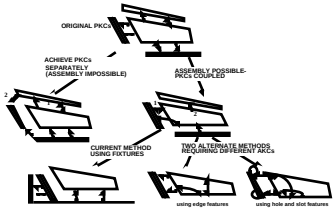


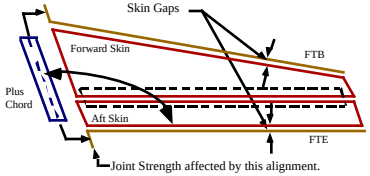
Projects with Companies

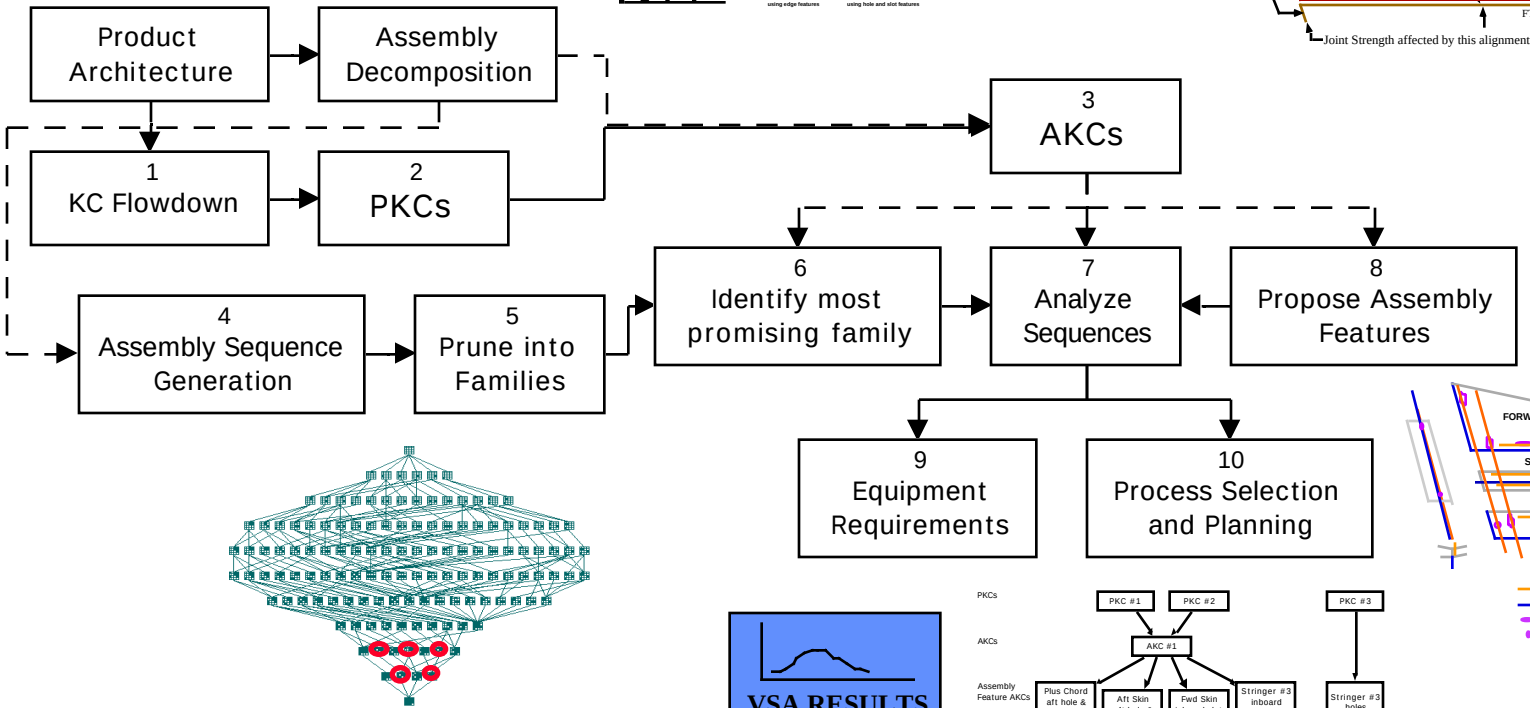
- Corrective Action at Ford and Vought N-G (2)
- Precision Assembly of 767 Horiz Stab Skin (2)
- KC - process capability formulation at GM (1)
- Org learning for precision assembly (1)
- Modeling of assembly layouts for top-down design and process planning (2)
- Strategies for long term outsourcing, supply chain design, and product module definition (2)

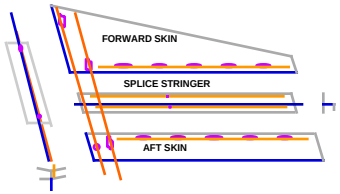
Precision Assembly Project











ASSEMBLY LEVEL DATUMS
PART LEVEL DATUMS
MATING FEATURE (SLOT)
MATING FEATURE (HOLE)

Findings

- Auto and aircraft industries have similar problems
- Supply chains are large and complex
- Products are outsourced down to the last part and tool
- There is too much rework and too little up-front work
  - This is much less a problem for cars
- People and companies have trouble thinking about complete systems like assemblies

Findings, continued

- Product design repeats past thinking
  - same subassemblies, module breaks, priorities
- Corrective action focuses on parts
  - little knoweldge of “other” areas or why they are important
- The procurement process still delays consideration of basic producibility issues

“Connectivity” is Missing

- People think of assembly as fastening
- Assembly is really chaining
- Assembly is in fact a classic systems problem:
  - problems show up “here”
  - causes are “over there”
  - “over there” means another part, another work area, another department, another company

Complex Problems Require New Solutions and Communication Tools

- Relationships between design, manufacturing, and supply chain design are extremely complex
- Consequently they are hard to explain
- Few people are accustomed to thinking in multi-dimensional ways about organizations or geometry
- Solutions to these problems involve a combination of technical and organizational changes
- *3D CAD will not do it alone*

New Design Tools Must Have a New Level of Communicative Power

- Design teams are multi-functional and multi-cultural
- Getting everyone to understand the other person's problem may be more important than getting every detail right the first time
- Communicative power may have to be gained at the temporary expense of technical accuracy

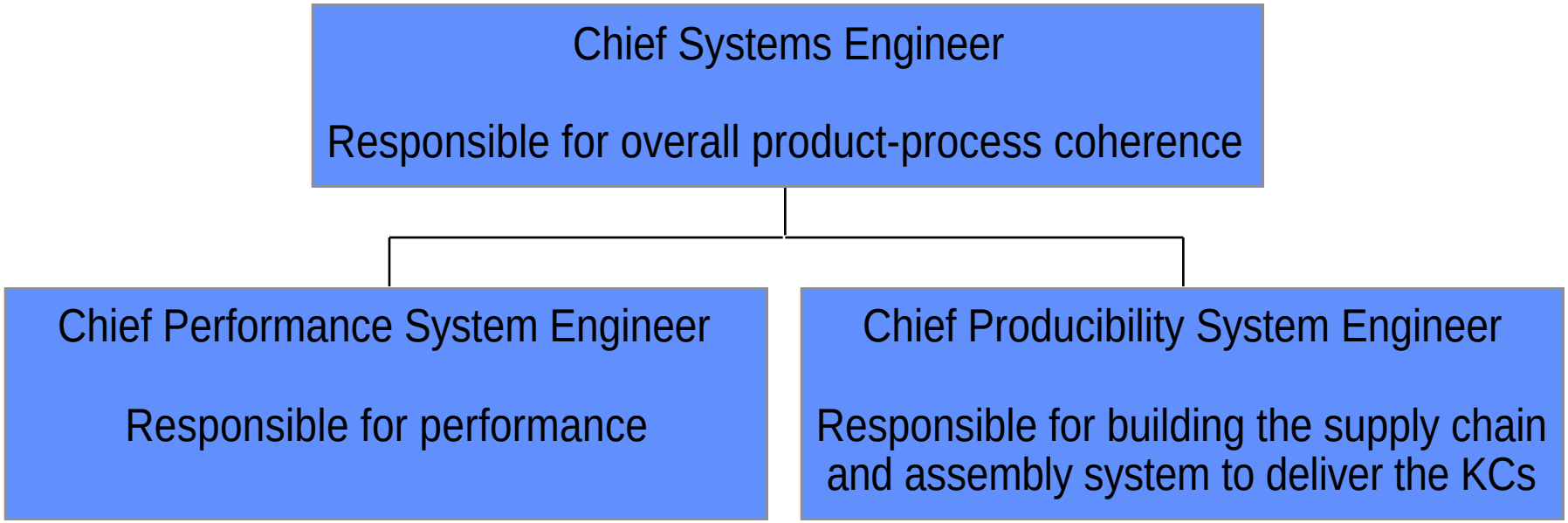
We Need to Focus on Chains

- Product quality increasingly is delivered by systems
- Key characteristics are delivered by chains of parts that are designed and produced by chains of companies
- We need better design methods, data models, and customer-supplier practices that encourage product development that focuses on these chains

A Vision for Chain-driven Product Development

- Top-down design defines KCs and relates them to modules and parts
  - KC deliverability and cost criteria applied
- Product design and producibility system design have equal status
- Vendor system is designed to deliver these KCs
- Everyone in the chain knows their contribution
- CAD/CAM/CAE/PIM capable of supporting integrative data, queries, calculations

A Vision for Chain-Driven Product Development



Information on the Web

Fast and Flexible Communication Projects at MIT

http://web.mit.edu/ctpid/www/agile/index.html

follow the links to other related MIT pages

look for papers about flexible assembly, make/buy decisions, descriptions of the fast/flexible project, supply chain dynamics, and assembly modeling