# 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

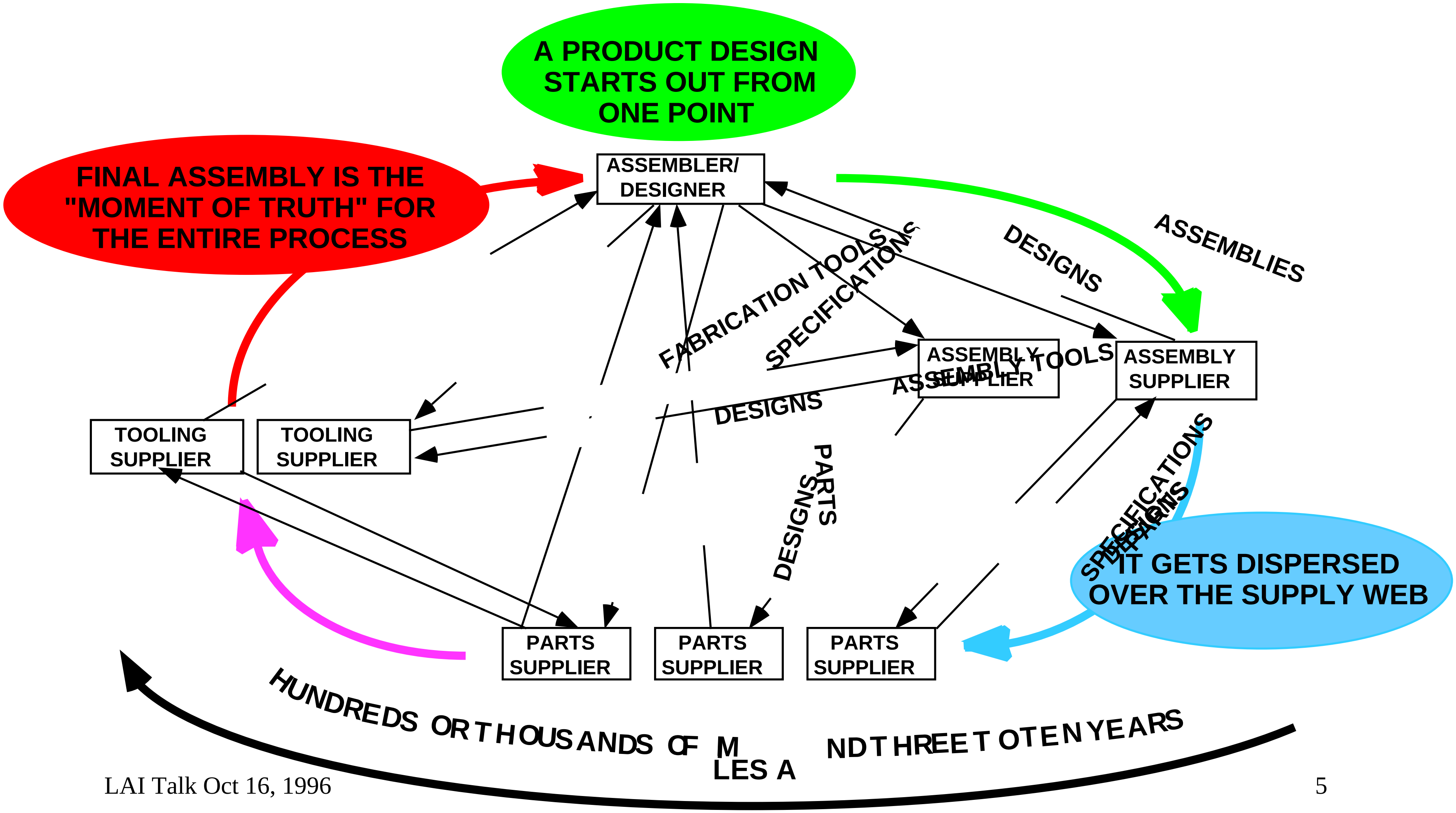
## Aerospace Industry Partners

- **Vought**
  C-17 Nacelle &767 Tail
- **Boeing**
  777 Wiring Harnesses, Airframe structures

## Auto Industry Partners

- Ford
  - **Explorer**
    Hood & Fender
  - **Electronics**
    ABS. EEC
- **General Motors**
  - **Delphi-Saginaw**
    Half shaft & Int. Shaft
  - **Park Avenue**
    Die Development
  - **Mid-Lux**
    ABS, Tooling

# 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

Customer Requirements

How to plan the development process?

How to convert to engineering?

How to find suppliers?
How to relate requirements to them?

What are the relations between decisions?
What's the right sequence for making them?

How do we know if the decisions are cost-effective?

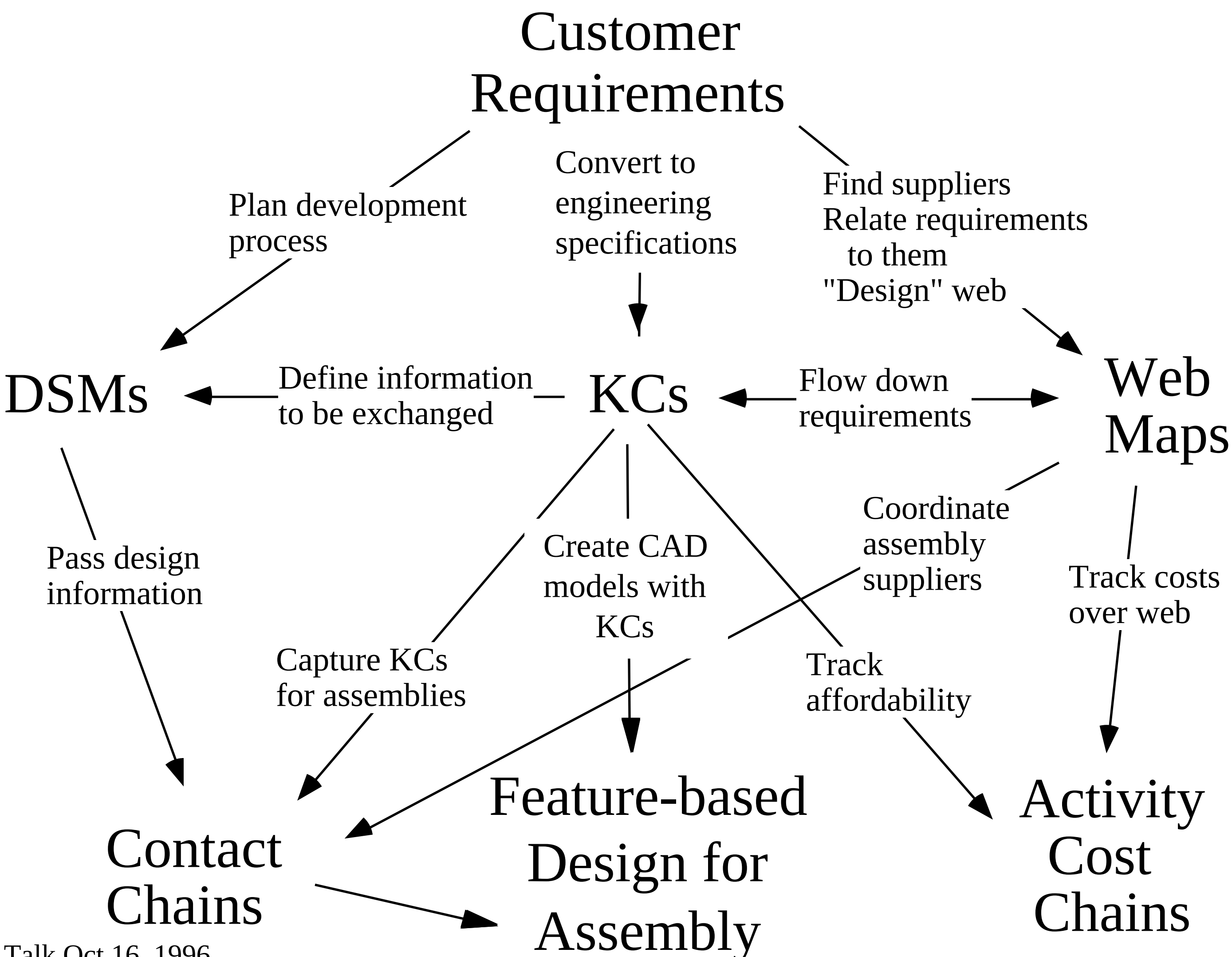
How can we tell if everyone knows what the others are doing?

How do we capture the design in CAD with all this information?

Are these questions related?

Are there tools to help answer them?

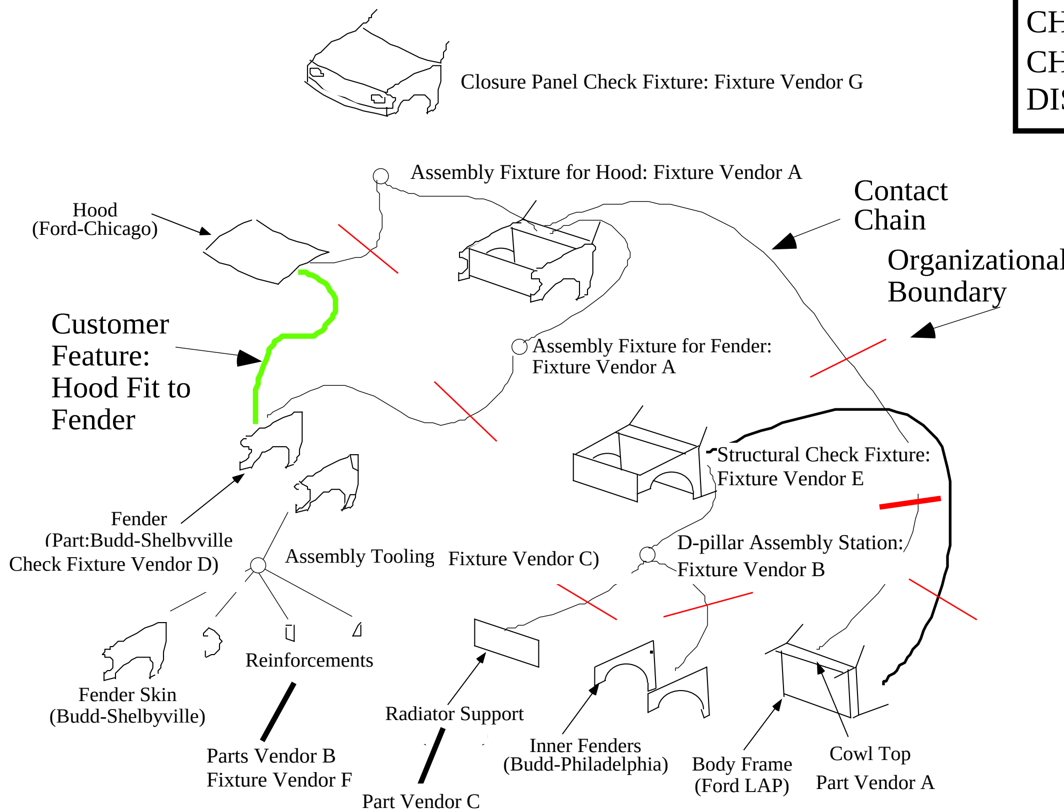
# Tools and Their Relationships



# 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 ?

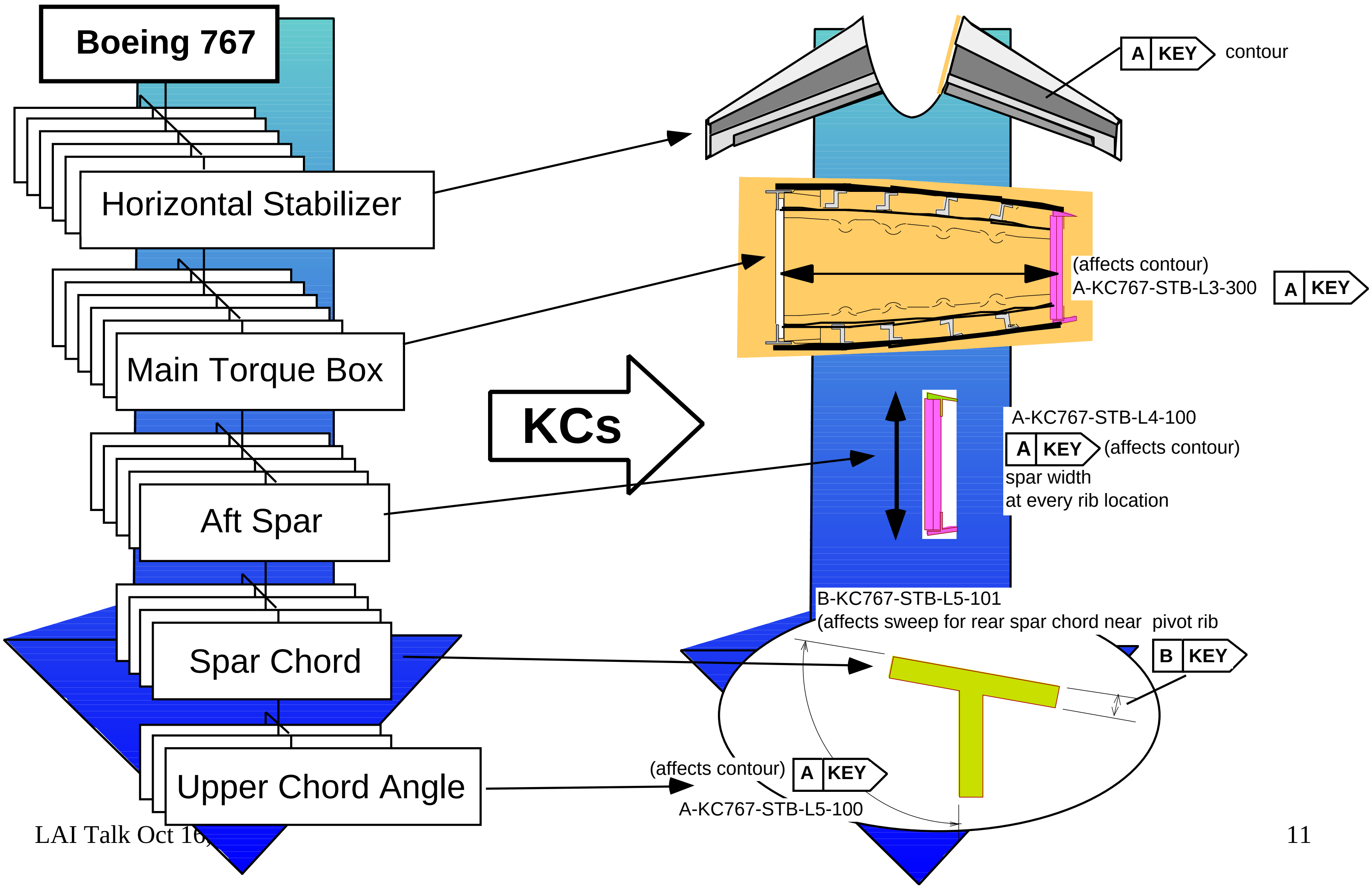
Assembly Key Characteristics (AKC)

How is it delivered ?

Manufacturing Key Characteristic (MKC)

How is it realized ?

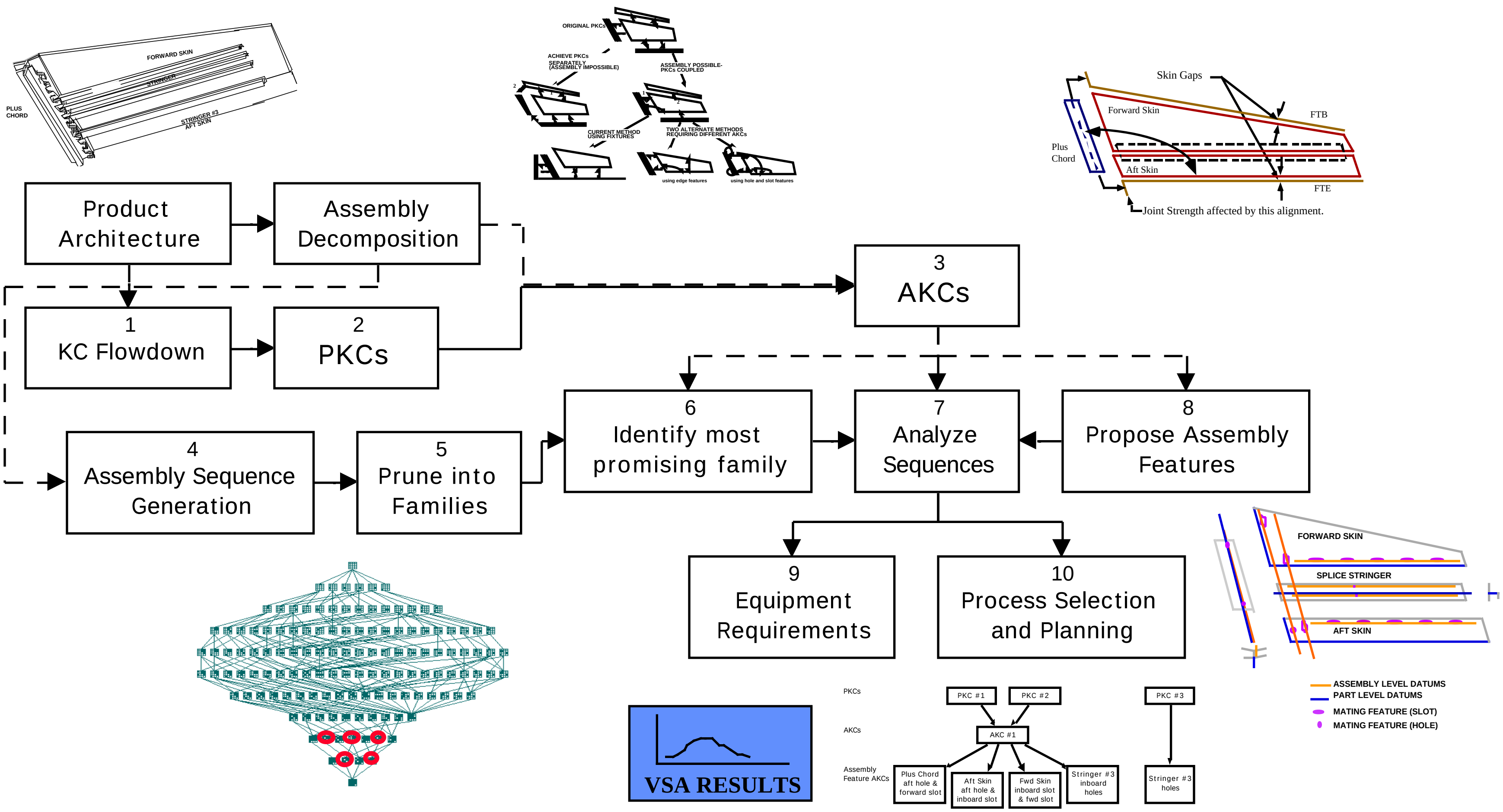
# Boeing 767 KC Flowdown:
## *A Snapshot*



# 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



# 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 <u>fastening</u>
- Assembly is really <u>chaining</u>
- 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

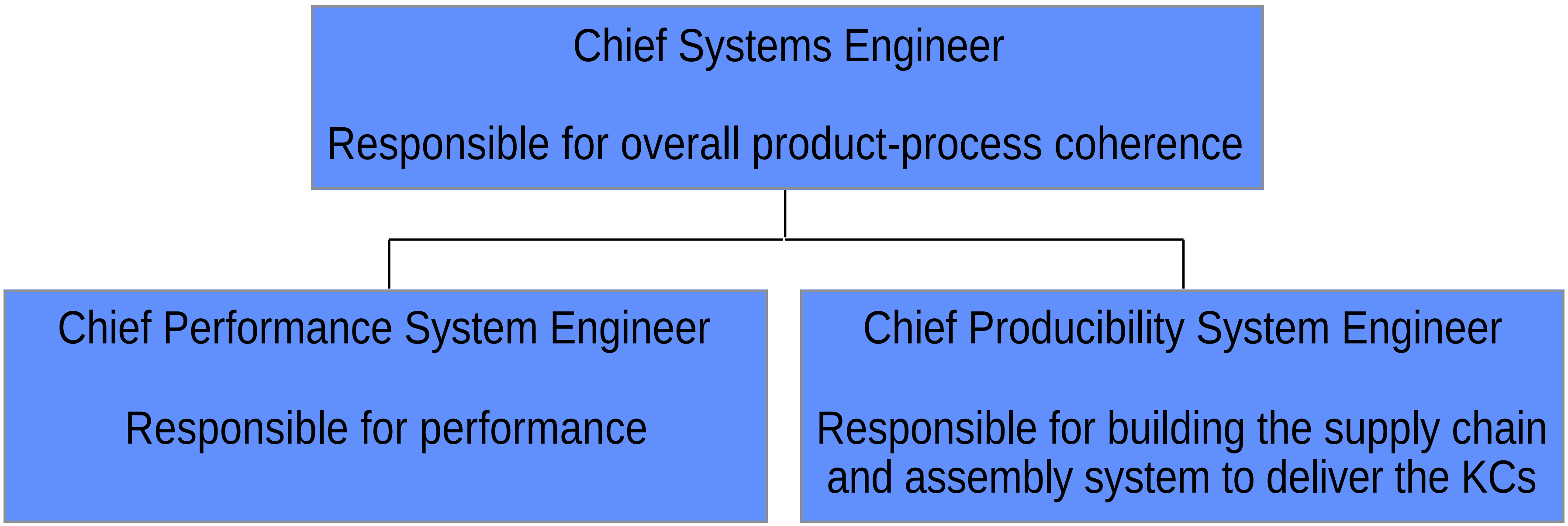
# We Need to Focus on Chains

- 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