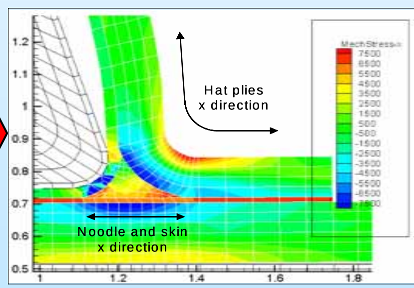
Use of AIM-C

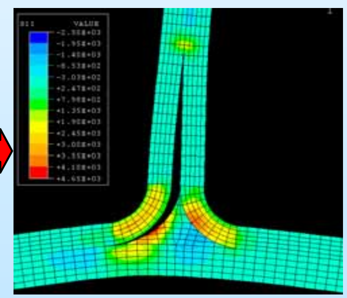
Web-Based System Delivery

Process Guidance and Risk Reduction Status

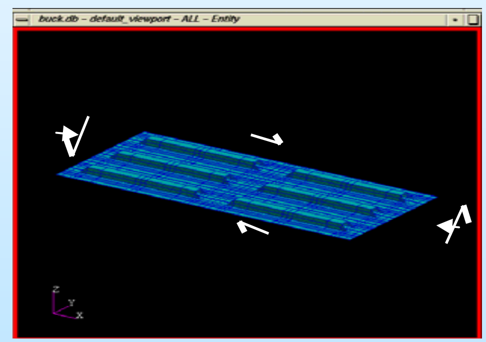
AIM-C Contains Analytical Models From Constituents



To Processing



To Effects of Defects



To Structural Reqs.

To Provide Analysis Supported by Test To Technology Readiness

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Handling Uncertainty – The AIM-C Approach

- The First Step is Identifying and Understanding potential error sources
  - Maintains Visibility of potential errors
  - Forces step-by-step breakdown of the analysis/test process
  - Forces agreement on responses of interest

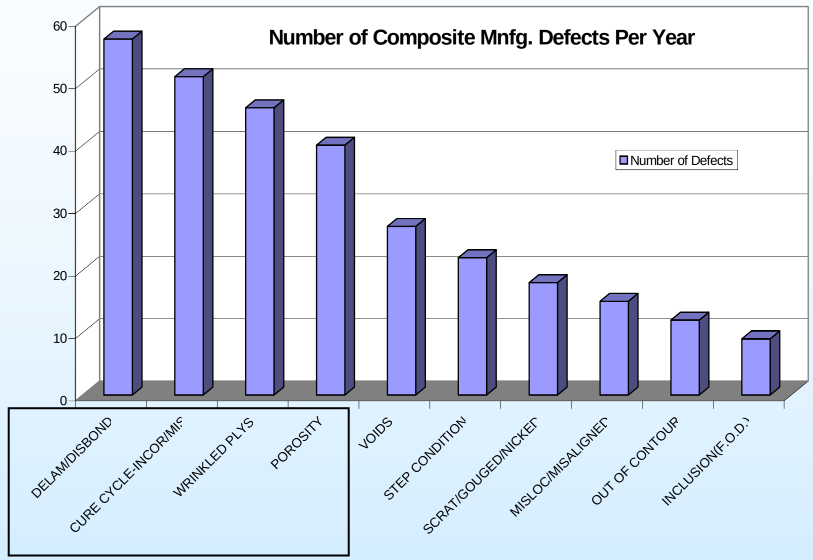
- Classifying them allows the team to determine appropriate strategies for addressing them.

- Types:
  - Aleatory Uncertainty (Variability, Stochastic Uncertainty)
  - Epistemic Uncertainty (Lack of Knowledge, e.g., unknown geometry)
  - Known Errors (e.g., mesh convergence, round-off error)
  - Unknown Errors (Mistakes, e.g. wrong material inputs used)

Handling Uncertainty – The AIM-C Approach

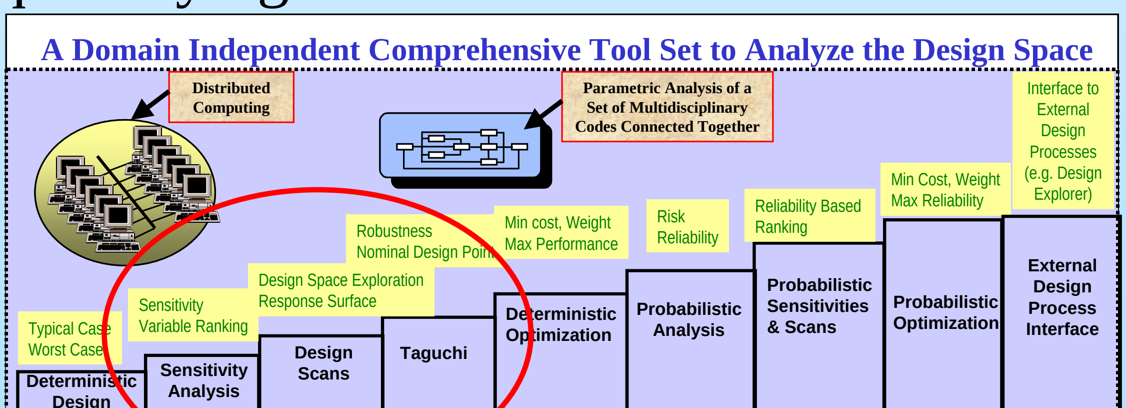
- Prior knowledge is useful in determining likelihood of occurrence.

Example: Past experience with Similar designs suggest that 3/4 of Stiffened panel defects are:
- Delaminations
- Cure Cycle Inconformities
- Ply wrinkles, or
- Voids/Porosity



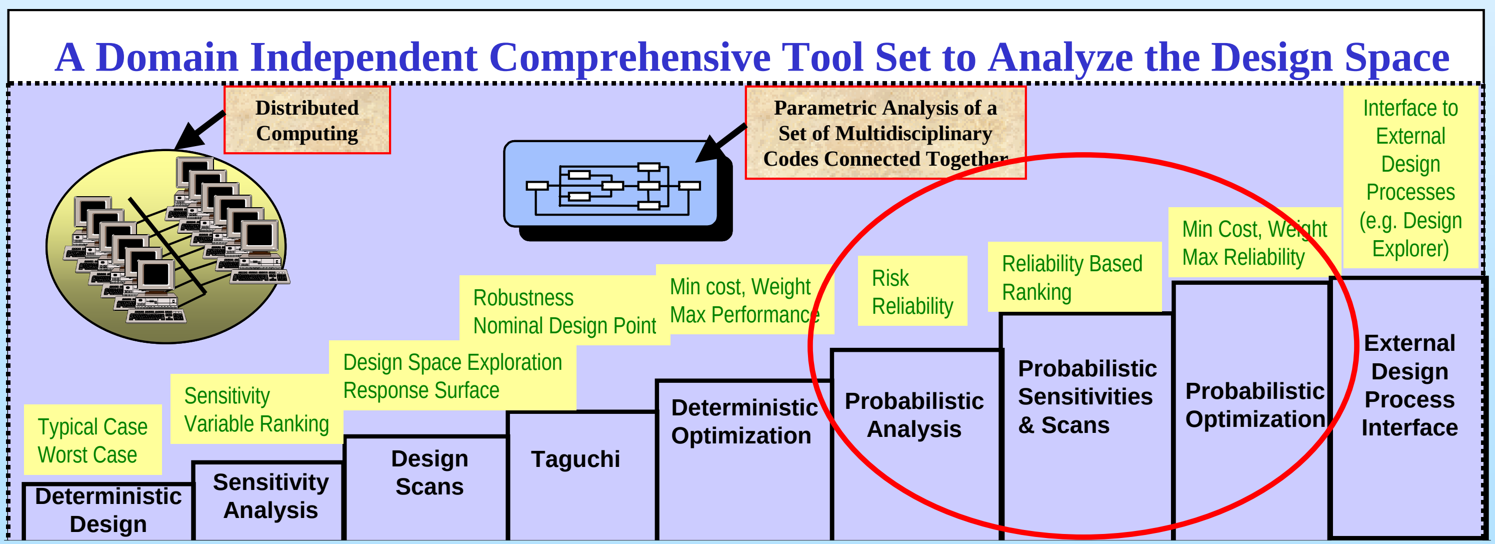
- Tools such as DOE/ANOVA and Sensitivity Analysis are useful in quantifying a variable's influence on the result.

Robust Design Computational System (RDCS)



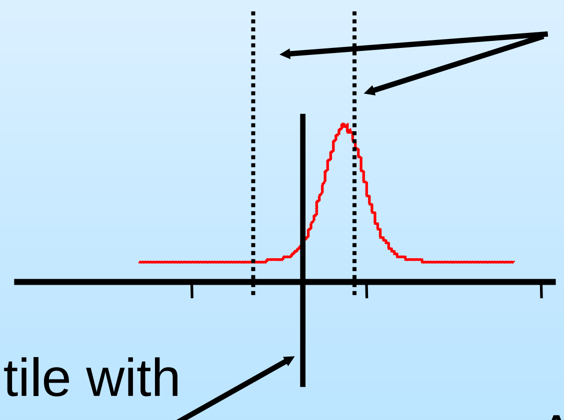
Handling Uncertainty – The AIM-C Approach
Quantifying Uncertainty

- If its important, and you can't remove it by design, quantify it.
- Testing or Probabilistic Analysis Tools are applied.



Data from Knowledge, Analysis, and Test
Combined Data – Allowables with Uncertainty

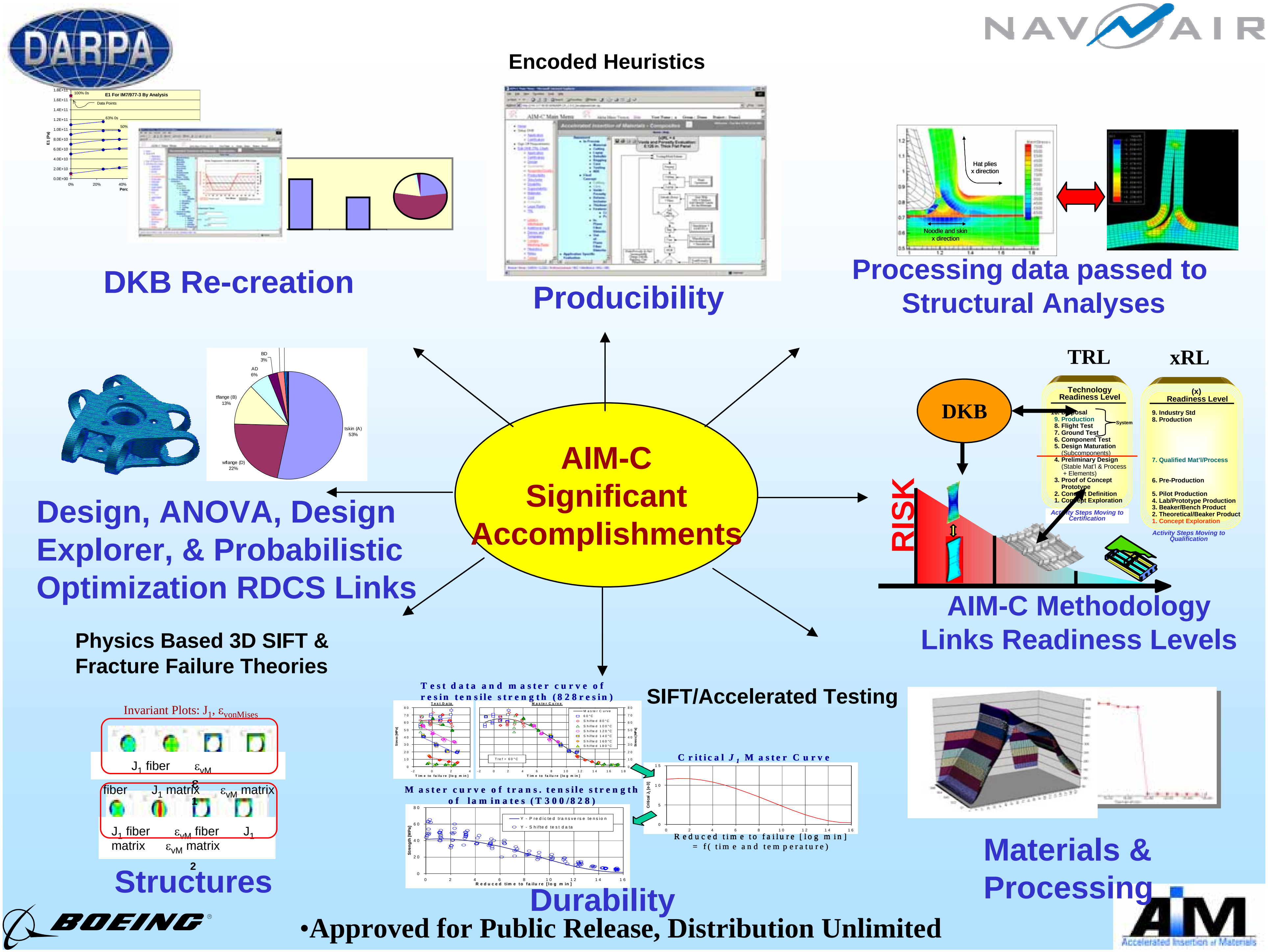
- Data contain replicates => can estimate stress allowables (quantiles with confidence bands)
- RDCS allows simulation of physical data with sources of randomness including batch effects (aleatory or random uncertainty) => can simulate allowables.
- Combined data: allowables with uncertainty bands



Bayesian uncertainty band on allowable

Allowable estimate = quantile with confidence band. This is the "aleatory" content

Aleatory and Bayesian are kept separate


DARPA
NAVAIR
Encoded Heuristics
DKB Re-creation
Producibility
Processing data passed to Structural Analyses
Hat plies x direction
Noodle and skin x direction
AIM-C Significant Accomplishments
Design, ANOVA, Design Explorer, & Probabilistic Optimization RDCS Links
tskin (A) 53%
wflange (D) 22%
tflange (B) 13%
AD 6%
BD 3%
TRL
xRL
DKB
RISK
Technology Readiness Level
9. Production
8. Flight Test
7. Ground Test
6. Component Test
5. Design Maturation (Subcomponents)
4. Preliminary Design (Stable Mat'l & Process + Elements)
3. Proof of Concept Prototype
2. Concept Definition
1. Concept Exploration
Activity Steps Moving to Certification
(x) Readiness Level
9. Industry Std
8. Production
7. Qualified Mat'l/Process
6. Pre-Production
5. Pilot Production
4. Lab/Prototype Production
3. Beaker/Bench Product
2. Theoretical/Beaker Product
1. Concept Exploration
Activity Steps Moving to Qualification
AIM-C Methodology Links Readiness Levels
Physics Based 3D SIFT & Fracture Failure Theories
Invariant Plots: J1, εvonMises
Structures
Test data and master curve of resin tensile strength (828resin)
Master curve of trans. tensile strength of laminates (T300/828)
SIFT/Accelerated Testing
Critical J1 Master Curve
Reduced time to failure [log min] = f(time and temperature)
Durability
Materials & Processing
BOEING
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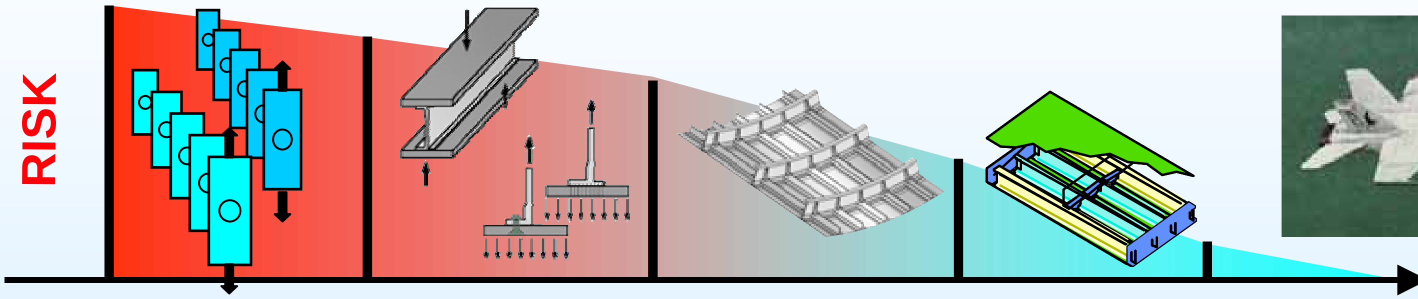
AIM Accelerated Insertion of Materials

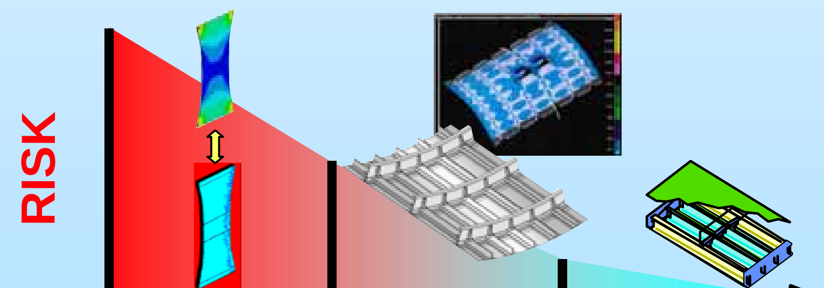
What's the Benefit of AIM-C?

Traditional Test Supported by Analysis Approach



Time to Insertion Readiness

AIM Provides an Analysis Approach Supported by Experience, Test and Demonstration



Time to Insertion Readiness Reduced by 55%

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