Closing the Gaps On Data Interoperability
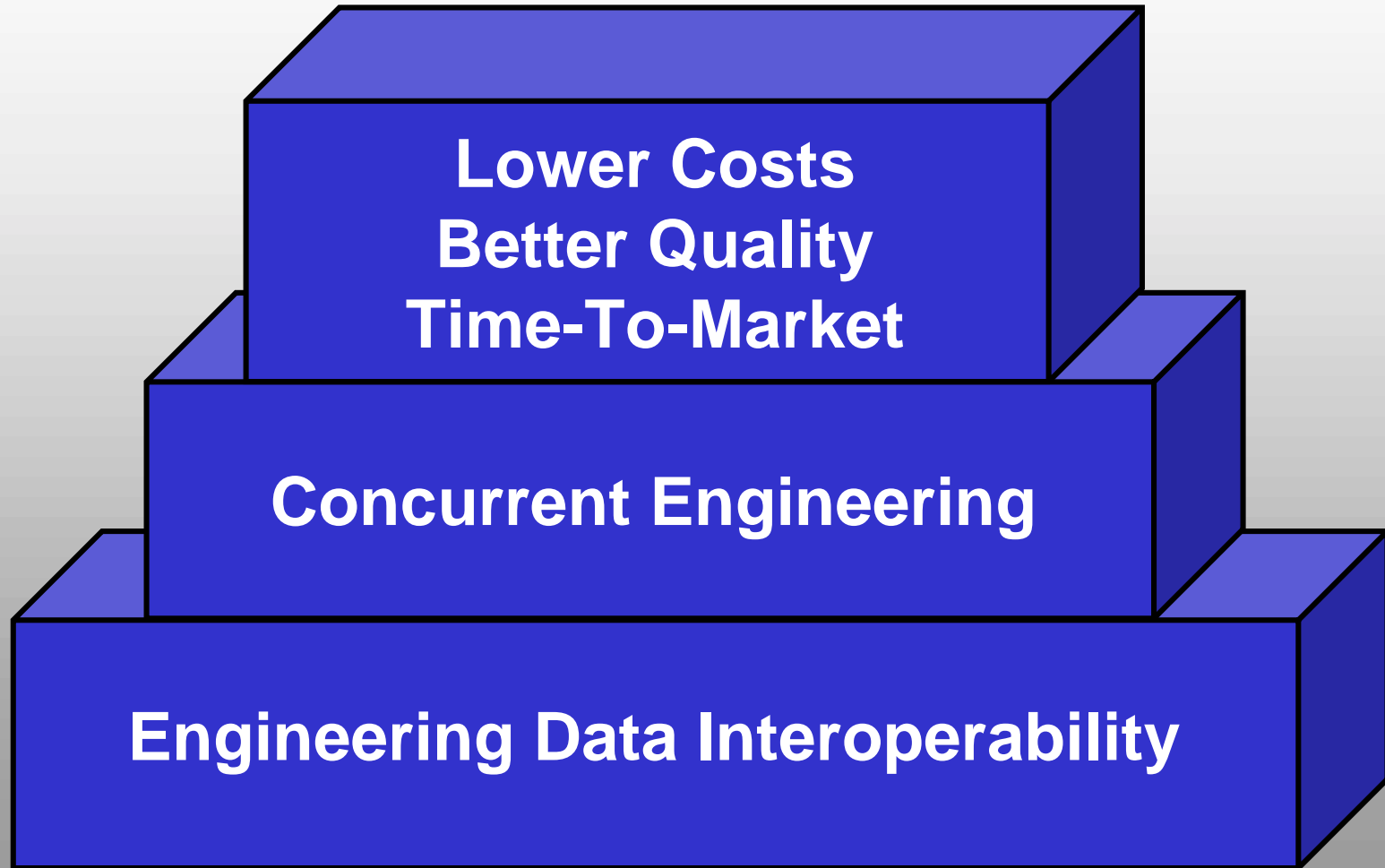
ANSYS User Conference

August 29, 2000

Don Hemmelgarn
International TechneGroup Incorporated

The Need for Data Interoperability

**Lower Costs
Better Quality
Time-To-Market**

Concurrent Engineering

Engineering Data Interoperability

Web based Collaboration

e-Business

B2B Exchanges

Collaborative Product Development

Supply Chain Management

Web based Product Management

24x7 Engineering Teams

Supplier Collaboration

eCommerce

THEY ALL NEED
DATA INTEROPERABILITY!!

What We're Seeing…

➢ Major product programs stopped or delayed due to interoperability problems between teaming partners

➢ Global companies struggling with Multi-CAD vs. Single CAD strategies

➢ Companies discovering over 70% of their complex CAD models have quality problems impacting downstream applications

Why Now?

- ➢ 3D CAD becoming the Master data representation

- ➢ Rapid growth in global product development partnerships requiring 3D model sharing

- ➢ The Internet – enabling almost instantaneous transfers of large models

- ➢ Result - an explosion in downstream use of 3D CAD models
  - ✓ Collaboration tools
  - ✓ Visualization
  - ✓ Multi-discipline analysis tools
  - ✓ Manufacturing
  - ✓ Rapid prototyping

The Goal of Data Interoperability

- ➢ Seamless flow of data to all applications using CAD data

- ➢ Create the data once - use it many times

- ➢ Avoid reworking, re-entering, and re-creating data

- ➢ Allow users to concentrate on their engineering tasks
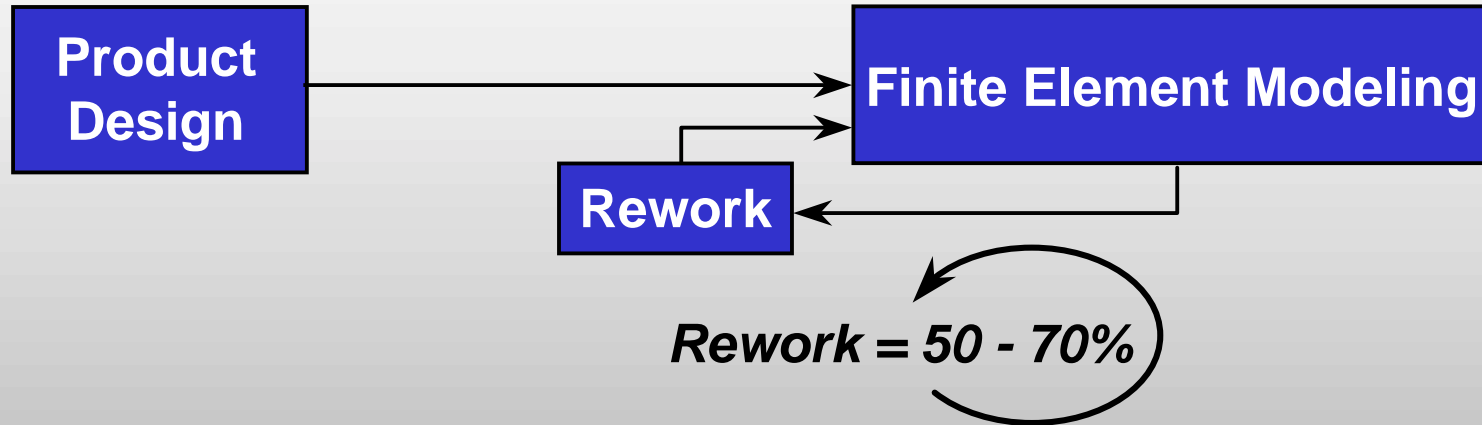
The Interoperability Problem

➢ Direct, non interactive automatic data exchange

➢ Most CAD models built today cannot be used "as-is" by downstream applications

Upstream System

Automatic Exchange

CAD CAM CAE
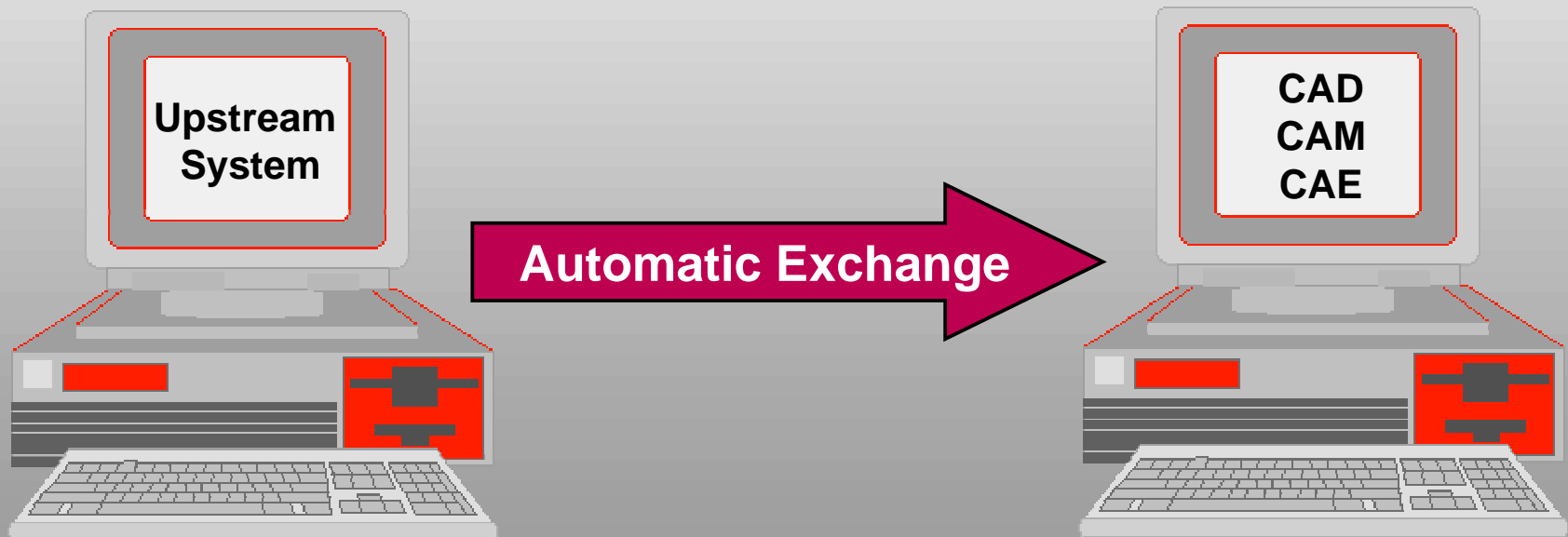
The Process Without Interoperability
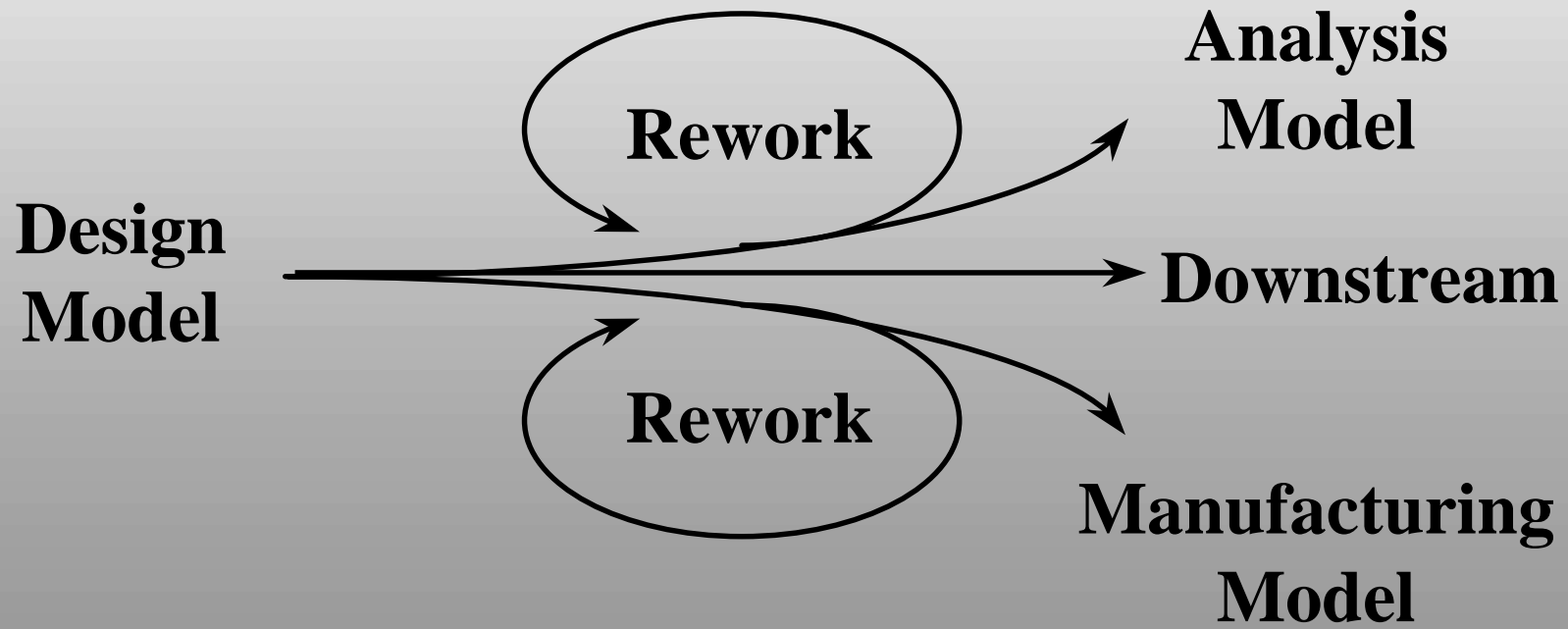
CAD System **Downstream Application**

- Design releases model for analysis with no known problem

- Analysis reveals problems potentially by application failure

- Analysis re-works then reruns or returns model to Design

- Designer's CAD system still highlights no problems !
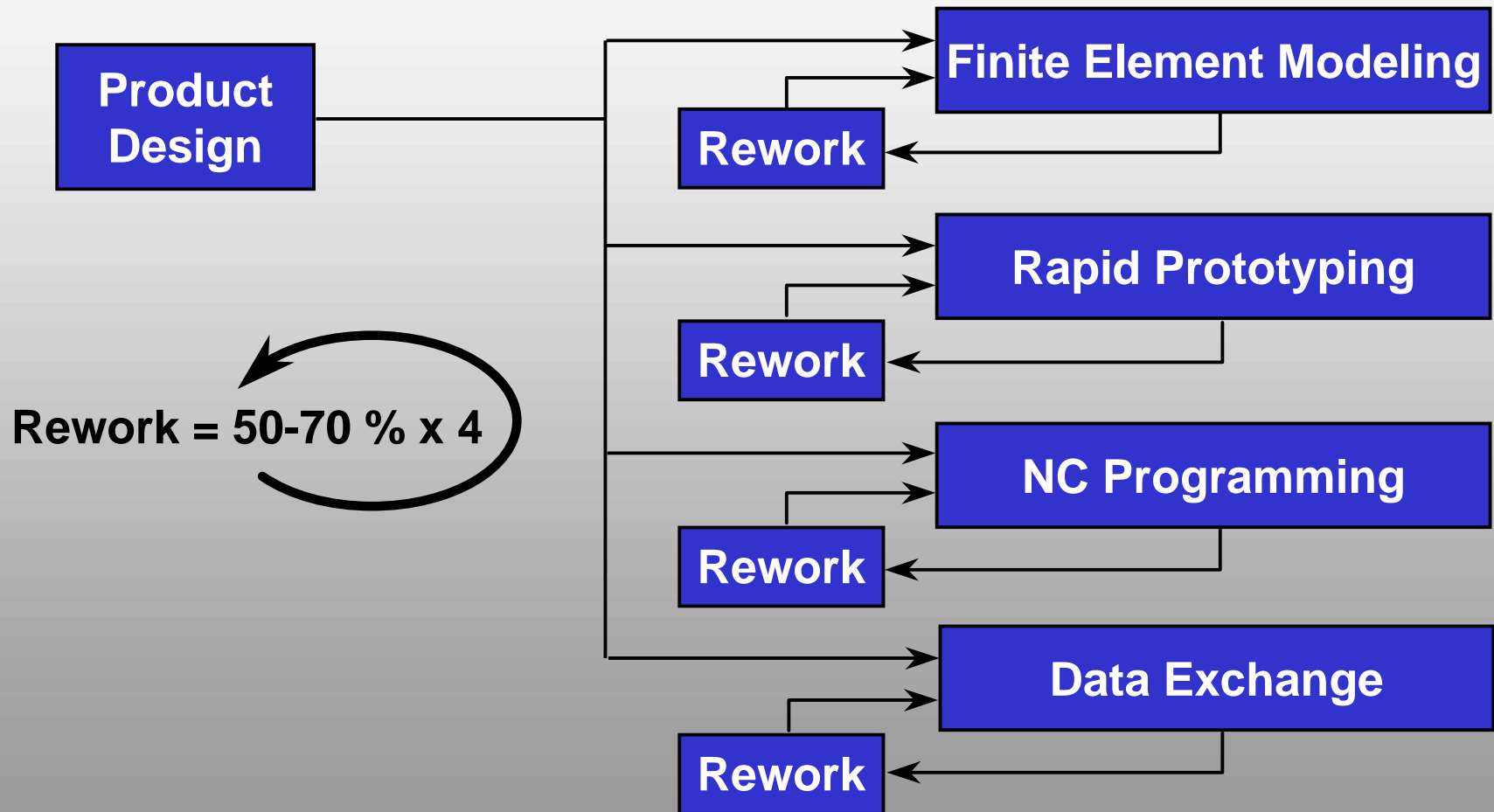
Serious Consequence of Downstream Rework

Reworking a model downstream involves significant time delays in the process and can potentially introduce significant differences from the original model

Design Model → **Rework** → **Analysis Model**

→ **Downstream**

Rework → **Manufacturing Model**

The Downstream Rework Explosion

CAD System

Downstream Applications

Product Design

Finite Element Modeling

Rework

Rapid Prototyping

Rework

Rework = 50-70 % x 4

NC Programming

Rework

Data Exchange

Rework

The Cost of Interoperability Problems

➢ Financial cost of rework and delays

➢ Project delays

➢ Serious issue of design intent changes

➢ Product quality

➢ Relationships with customers and suppliers

➢ Failed competitive tenders because unable to respond

➢ Fail to get future work after poor performance

➢ Model rework labor costs are large but often buried

Types of Interoperability Problem

- **Structure**
  - Entities defined and linked together correctly?
    - ◆ Class of modeler - wire frame, surface, solid, hybrid
- **Accuracy**
  - Do model entities fit together properly?
    - ◆ Modeler tolerances - fixed, relative, units
- **Realism**
  - Can it be manufactured?
    - ◆ User or system created problems
- **System Limits**
  - Mathematics too complex?
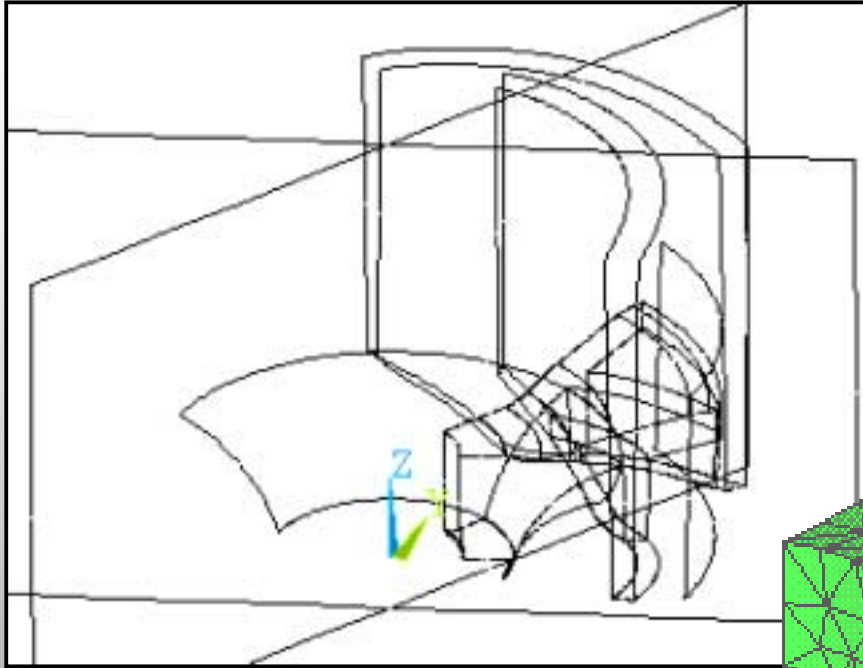   - ◆ Different modeling engine capabilities
- **Translation and Automation**
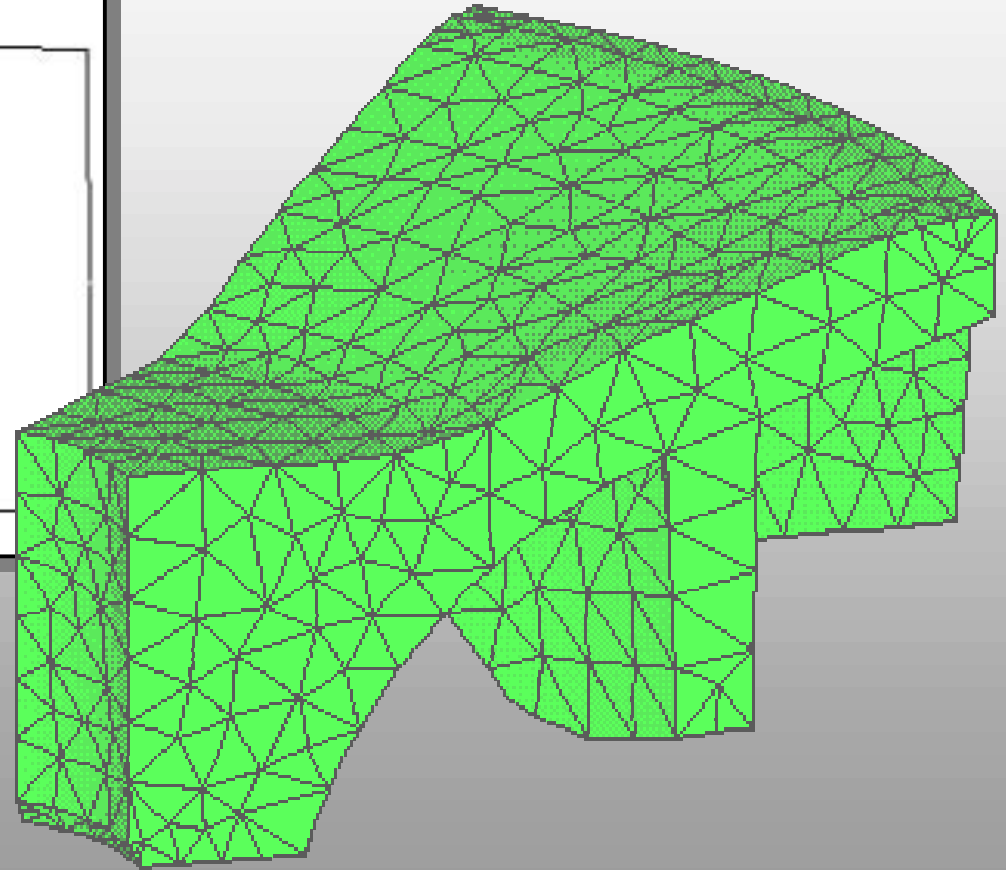 - Standards (IGES) and implementation

Structure

Accuracy

Realism

System Limits

Translation Automation
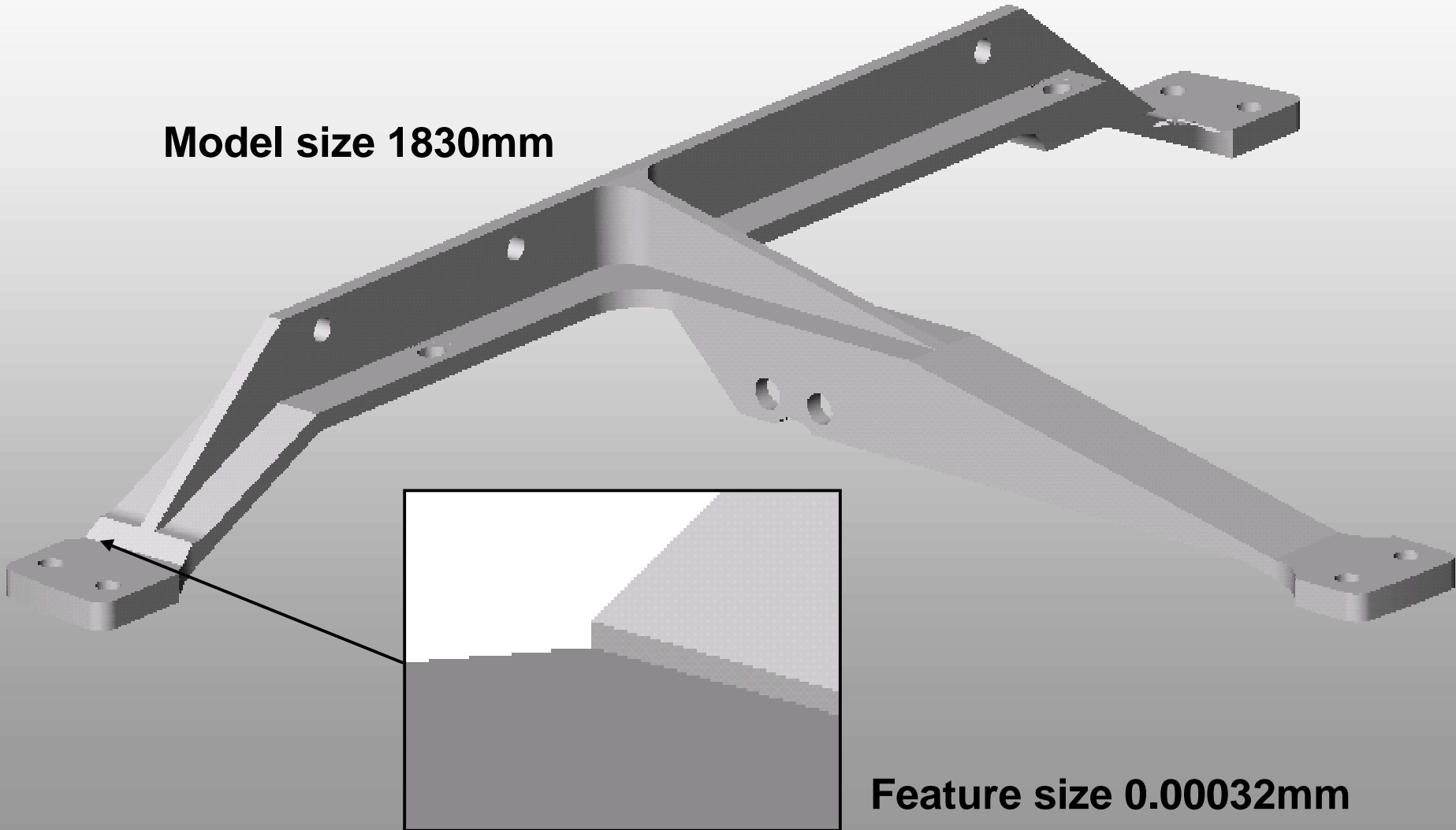
Example Problems - Structural

CAD model

ANALYSIS model

Example Problems - Realism

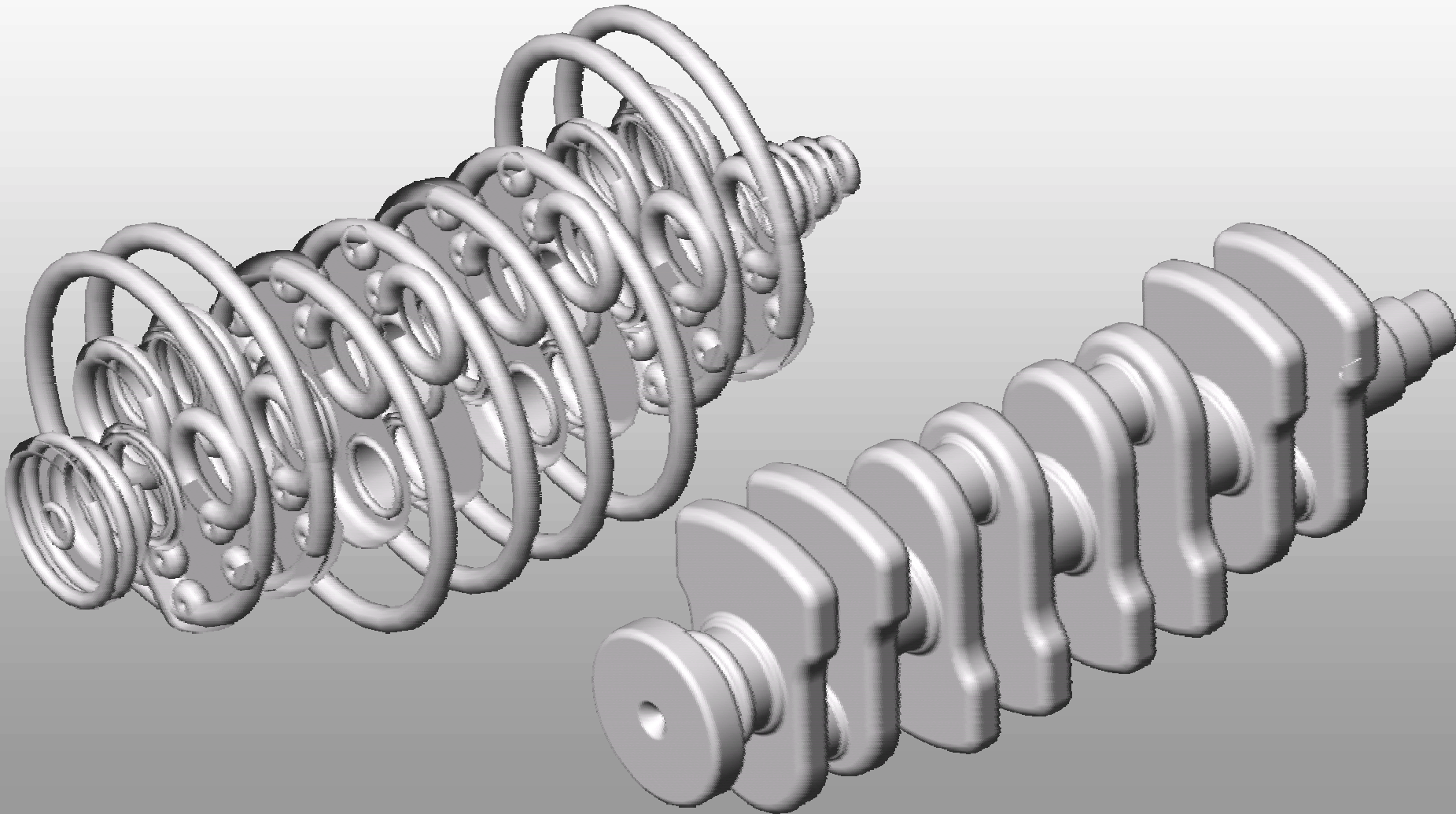> ➤ Native Parasolid translation but with unrealistic features

Model size 1830mm

Feature size 0.00032mm

Example Problems - Translation

➢ Same IGES file in different systems

Solving Interoperability Problems

> CAD developments are improving interoperability

   ✓ Structural - improving with CAD system robustness

   ✓ Realism - improved user awareness and model quality checks

   ✓ System limitations - models must be flavoured for each system

   ✓ Accuracy problems - main hurdle

> Invest in Procedures, Training and Communication

   ✓ Make CAD users aware of downstream applications

   ✓ Modelling procedures to avoid interoperability problems

> Model quality and repair tools

CAD/IQ
The Sure Cure for Bad CAD

International TechneGroup Incorporated

➢ Helps designer build high-quality master models
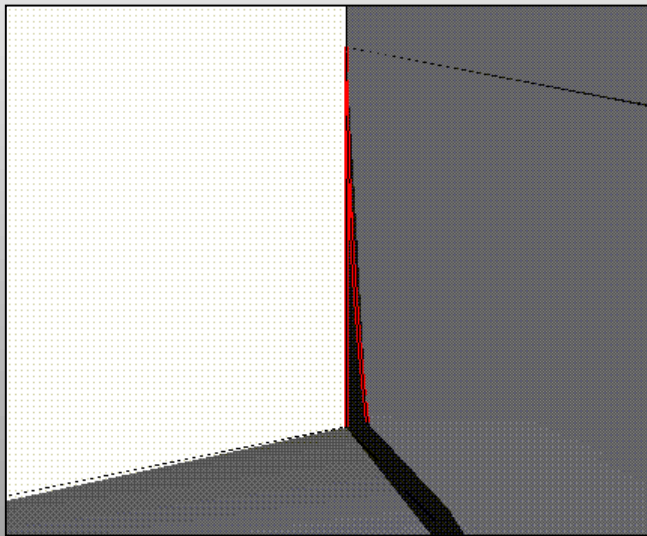➢ Integrated into CATIA, I-DEAS, Pro/E, UG
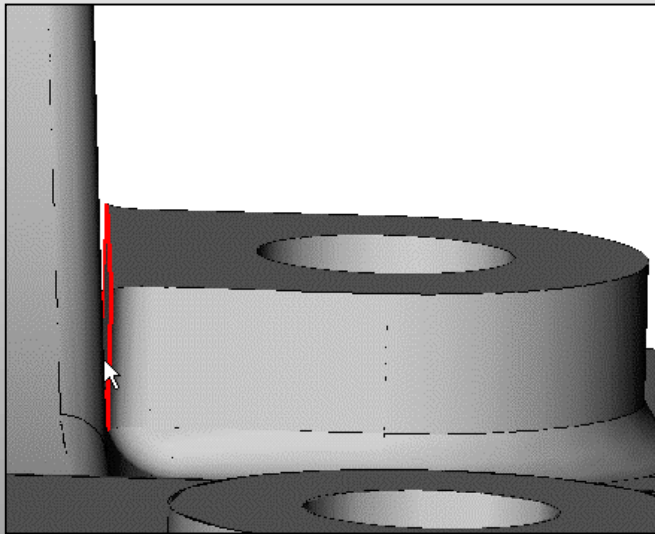
Crack highlighted
by CAD/IQ
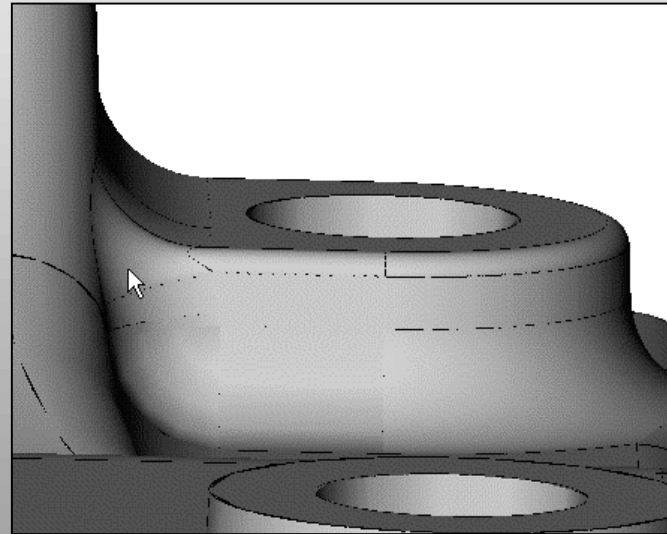
High-quality solid after
designer modification

- ➤ Resolves topology and accuracy problems
- ➤ Supports Catia, STEP, IGES, Parasolid, and ACIS

Gaps highlighted between faces
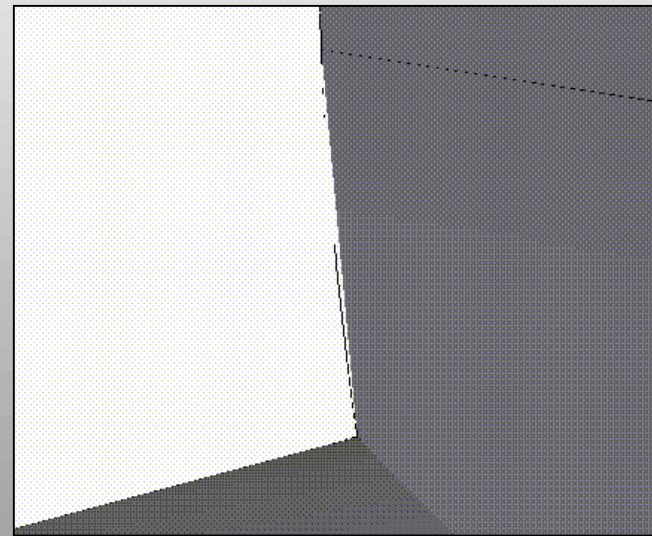
Faces after healing by CADfix algorithms

Upstream and Downstream Problems

➢ **Upstream Users**

- ✓ OEM
- ✓ Prime contractor
- ✓ Data to/from suppliers

➢ **Downstream Users**

- ✓ Several customers
- ✓ Receiving customer data
- ✓ Supply data to customers

Source CAD System ← Interoperability → **Target CAD System**

Model Quality

Model Repair

Solving Interoperability Upstream

CAD System   *Downstream Application*

```
┌──────────┐      ┌──────────┐              ┌────────────────────────┐
│ Product  │ ───> │ Interop  │ ───────────> │ Finite Element Modeling│
│ Design   │      │ Testing  │              │                        │
└──────────┘      └──────────┘              └────────────────────────┘
      ↑                 │                ┌───────┘
      │                 │                │
┌──────────┐            │          ┌──────────┐
│  Rework  │ <──────────┘          │  Rework  │ <──────────┘
└──────────┘                       └──────────┘
```
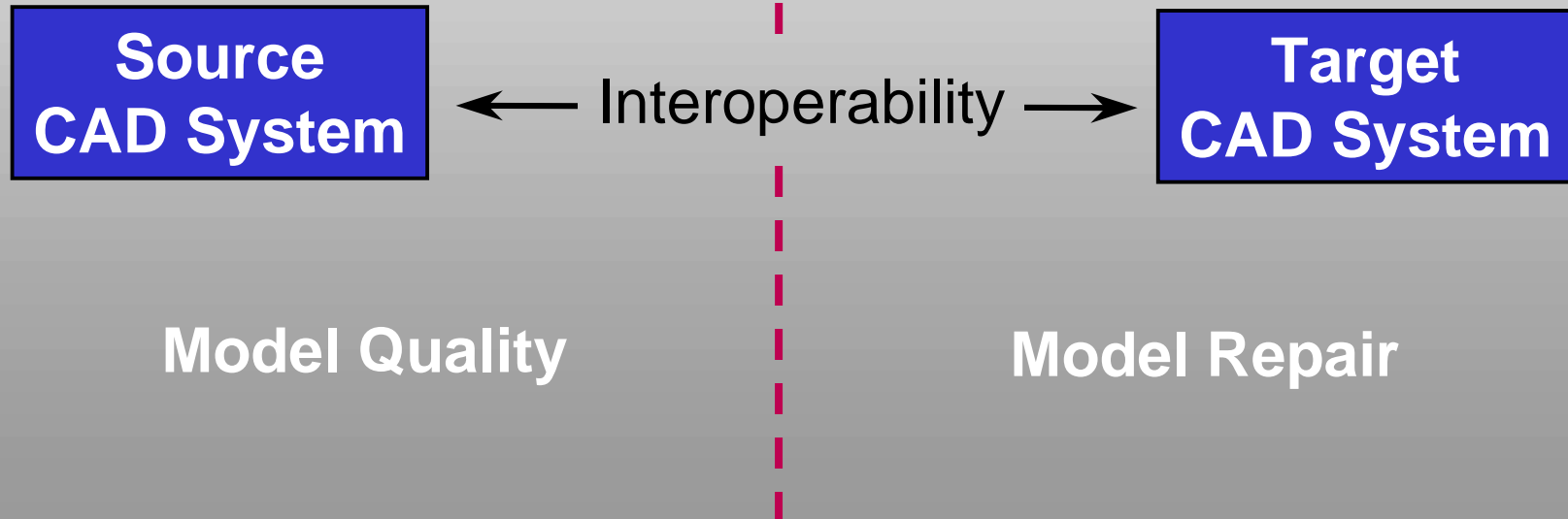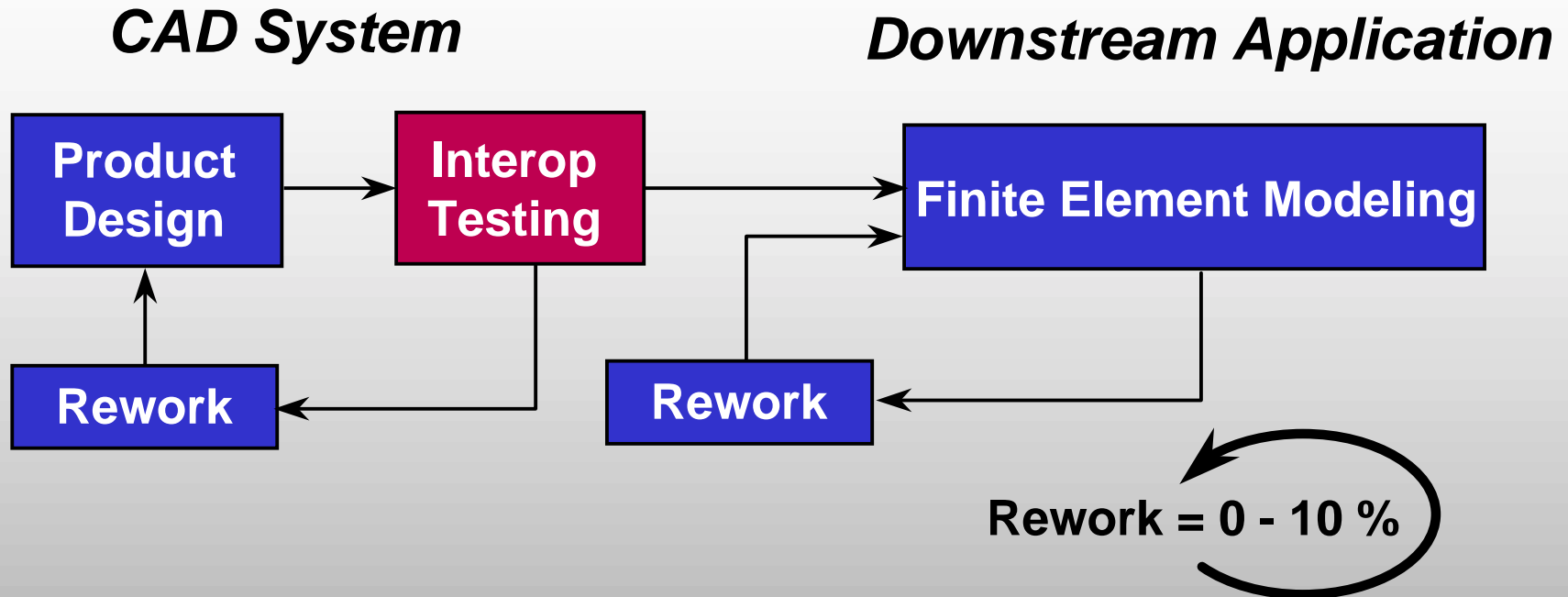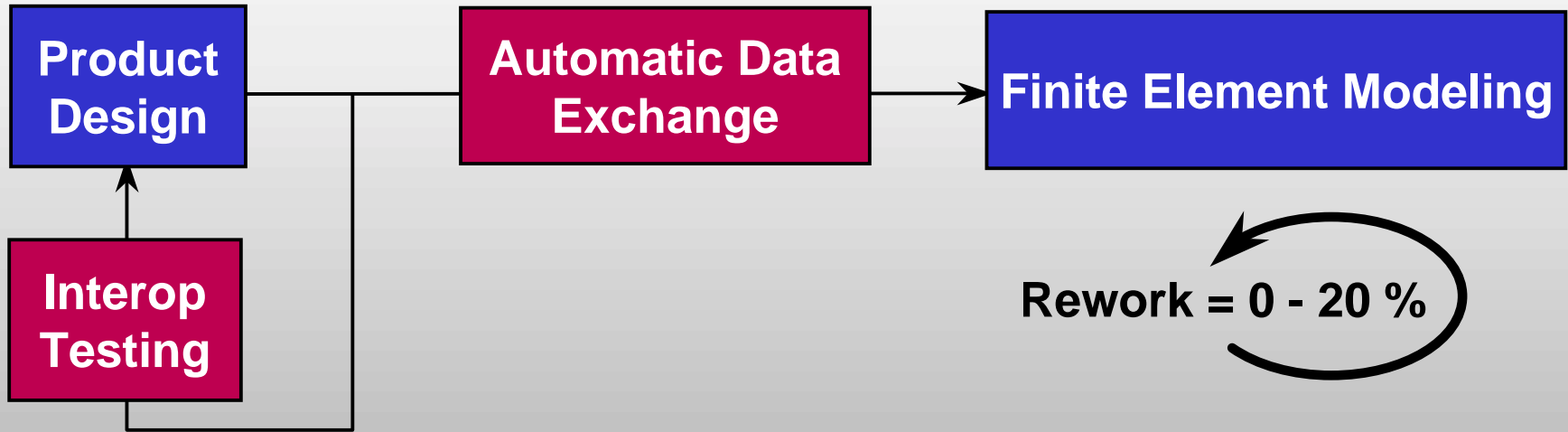
Rework = 0 - 10 %

➢ CAD model quality testing and checking tools

➢ Make sure model at source avoids future problems

➢ Still some rework downstream that needs addressing

Solving Interoperability Downstream

CAD System   *Downstream Applications*

```
┌──────────┐       ┌──────────────┐       ┌─────────────────────────┐
│ Product  │  ───→ │ Automatic Data│ ───→ │ Finite Element Modeling │
│ Design   │       │   Exchange    │      │                         │
└──────────┘       └──────────────┘       └─────────────────────────┘
     ↑
┌──────────┐
│ Interop  │
│ Testing  │
└──────────┘
```
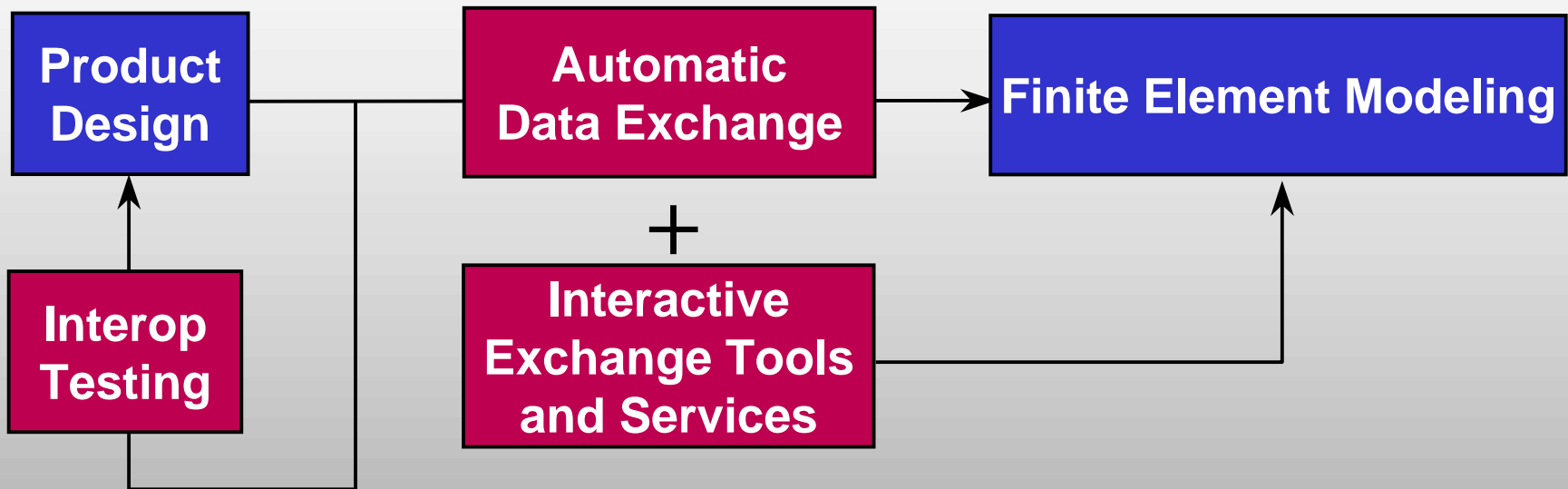
Rework = 0 - 20 %

- Automation can work fine in the majority of cases

- Small but expensive percentage of failures

- When automation fails there is **"NOWHERE TO GO"**
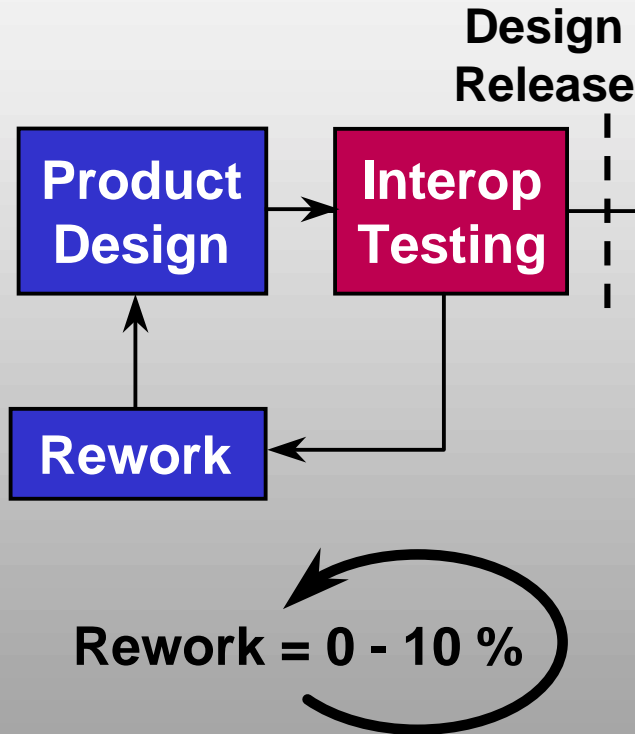
Downstream Tools and Services

CAD System   **Downstream Applications**

| Product Design | → | Automatic Data Exchange | → | Finite Element Modeling |

+

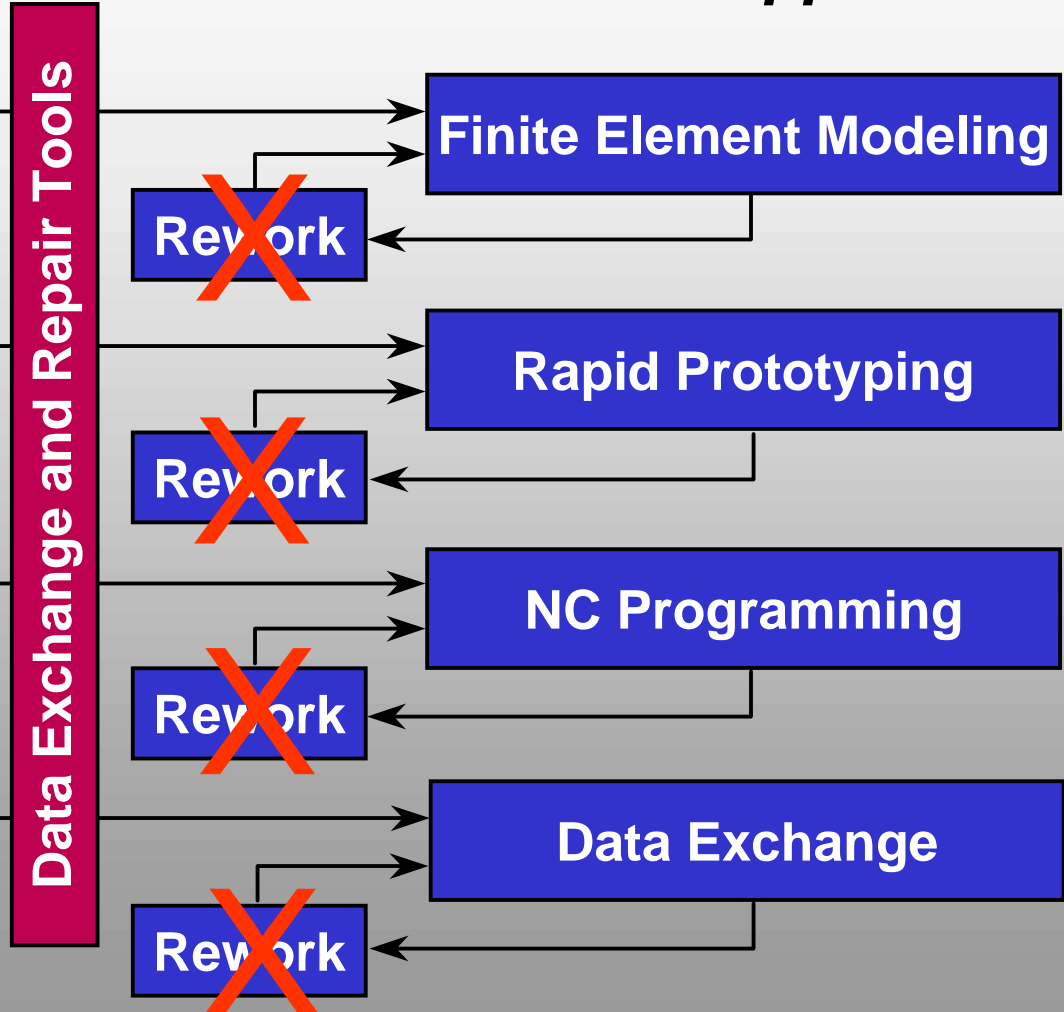| Interop Testing | | Interactive Exchange Tools and Services |

- Key to the data exchange solution is providing options

- Interactive tools provide **"SOMEWHERE TO GO"**

- Consultancy, Bureau and Web services give more options

Full Engineering Data Interoperability

CAD System

Downstream Applications

Design Release

Product Design → Interop Testing

Rework

Rework = 0 - 10 %

Data Exchange and Repair Tools

Finite Element Modeling

Rework

Rapid Prototyping

Rework

NC Programming

Rework

Data Exchange

Rework

Case Studies - Major Automotive OEM

- Vehicle design and manufacture

- CAD-CAD and CAE meshing transfer

- Require clean automatic translation with no rework

- Interoperability tools and consultancy provided
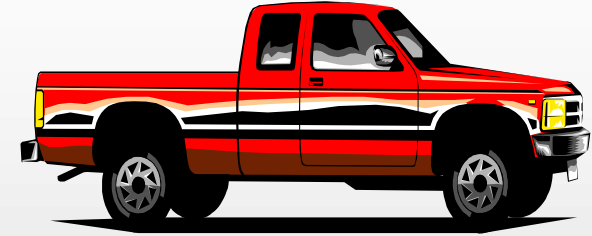
30 hours rework saved on 5 simple test models

3 months and no solution – fixed in 1 week

Huge savings in migrating legacy models

Case Studies - Automotive Suppliers

➢ Tool and Die makers receiving data from multiple sources

➢ Thousands of models received and nearly all need work

➢ Competing for business and tight time scales

➢ Given the the right tools and training

Models imported as solids within an hour

*Estimated 2 week advantage over competitors*

Similar stories everywhere…

Case Studies - CAD to FE Analysis

➢ Aero Engine OEM

➢ Require models for downstream meshing

➢ Geometry problems - short edges, small faces, bad surfaces

➢ Spending weeks or months making meshable models

➢ Interoperability solution provided with interactive repair tools

Rework time reduced from weeks to hours
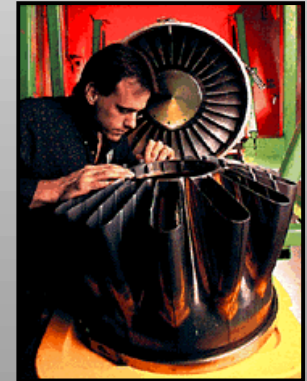
Translating and meshing models previously not feasible

I Don't Have an Interoperability Problem!

➢ "I insist suppliers only receive and supply native CAD data"

   ✓ **Supplier agrees but still translates your data for their system**

➢ "No problem because my downstream users know how to handle bad data"

   ✓ **Workarounds do not make it acceptable - wasted resource**

➢ "I'm happy for my engineers to spend time on this"

   ✓ **If they did not have to rework data, what else could be done with their time and resources?**

➢ "Nobody's told me there's a problem"

   ✓ **Experts proud of their skills reworking data and are protective**

➢ "It doesn't cost me anything"

   ✓ **You pay as suppliers add rework time and cost to projects**

Summary

➢ Geometry Exchange is improving but …

➢ Engineering Data Interoperability Problems Still Exist

   ✓ Structural, Realism, System, Translation, Automation, Accuracy

➢ Problems effect everyone in some way

➢ Tools exist to address interoperability problems

   ✓ Upstream - CAD model quality and interoperability testing

   ✓ Downstream - CAD model translation repair tools and services

➢ Clear savings from investment in interoperability solutions

➢ Engineers able to spend time on the real tasks - not DX