The Fracture of the Blueprint: How Mechanical Design divorced from Reality

The Assembly Show – Learning Theater

Trevor Smith, Dirac, Inc.

WWII Henry Kaiser’s Liberty Ships

- Designed with standardization for rapid assembly
- Production time reduced from months to days
- A seamless connection between design intent and manufacturability

ENG & MFG feats before CAD

1962
Ferrari 250 GTO

1966
SR-71 Blackbird

1967
Saturn V

The Proliferation of CAD

1956

The Birth of CAD

CAD was developed by Dr. Patrick Hanratty, known as the "Father of CAD," in 1957 with his PRONTO system, one of the first numerical control programming languages.

1963

The first Graphical User Interface (GUI)

Ivan Sutherland developed the first graphical user interface in CAD, called "Sketchpad," which introduced a new way to visualize engineering designs.

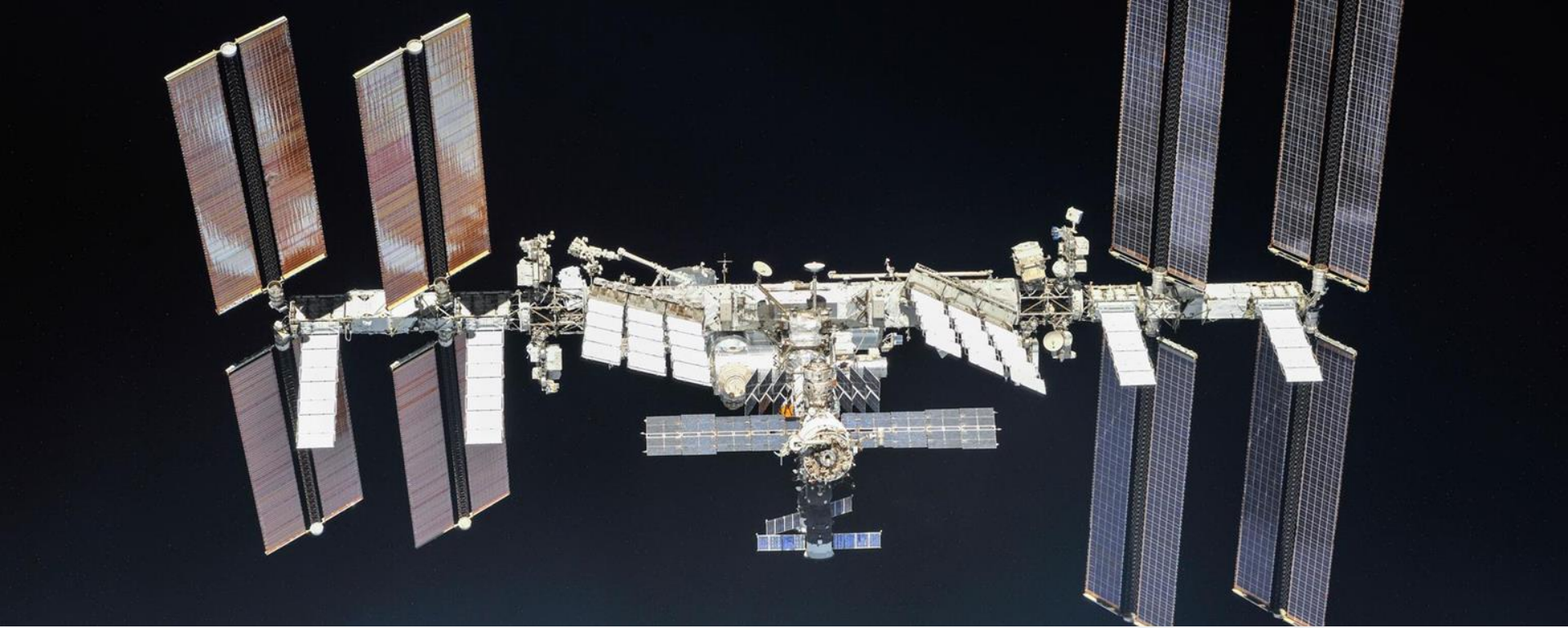
1970s

Industry Adoption

The Automotive, Aerospace, and Defense industries adopt accelerate the use of CAD in design of product.

CATIA Release 1 in 1982, note the IBM PC it runs on.

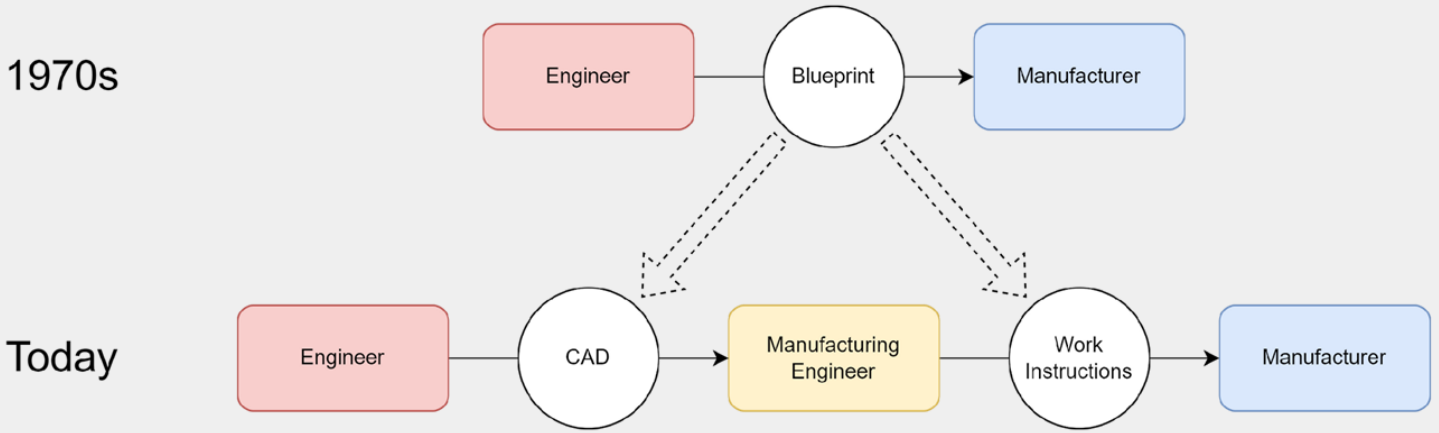
Engineers are relegated to the cubicle farms



Design complexity increases dramatically

Manufacturing context has been Forgotten

Mechanical design divorces from reality



The emergence of CAD software fractured the blueprint into two parts:

CAD software (design/engineering) and **work instructions** (build/manufacturing).

The Cost of the Status Quo

Work Instruction creation is **time consuming** and **manual**

- High cost to create and maintain Work Instructions
- Bottle neck to transition from Design to Manufacturing
- Data is unstructured and siloed

Industry is overly reliant on **Tacit Knowledge**

- Vulnerable to knowledge loss
- High cost of employee onboarding and training
- Increased process variability in manufacturing

Design for Manufacturability feedback loop is broken

- Engineers lack the context to design for manufacturing
- Hardware gets to the shop floor that is difficult or impossible to manufacture and assemble
- Scaling production becomes difficult

F-16 v F-35

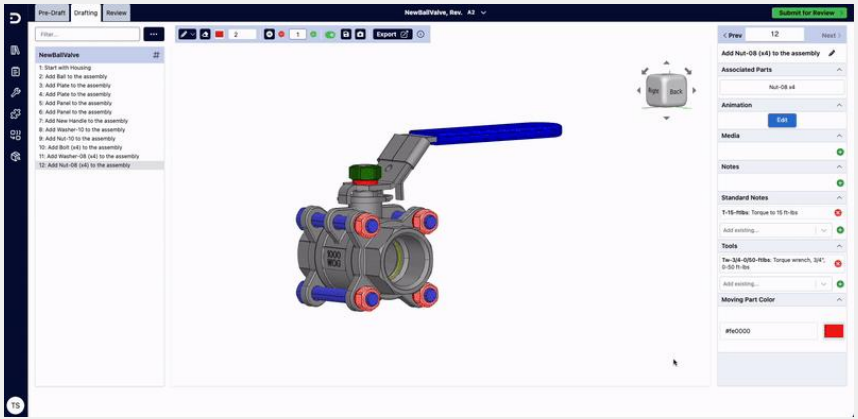
F-16

- Designed late 60s early 70s
- Peak production: 286 in 1987 (Fort Worth facility alone)
- Over 3,000 F-16s delivered in first 20 years of production

F-35

- Designed late 90s early 00s
- Peak production: 13/month (156/yr)
- 1,000th F-35 delivered 20 years into production
- 91% of F-35s are delivered late

Bridging the Gap with Modern Technology



- Consider manufacturing earlier
- Model-based Work Instructions
- Automate the Monotony
- Retain Tacit Knowledge
- Structure the Data

Thank you!

Come visit Dirac at booth 839!