NDIA
6th Annual CMMI Technology Conference
Denver, Colorado
November 13-16, 2006

Developing Systems Engineering Processes from Existing Software Processes

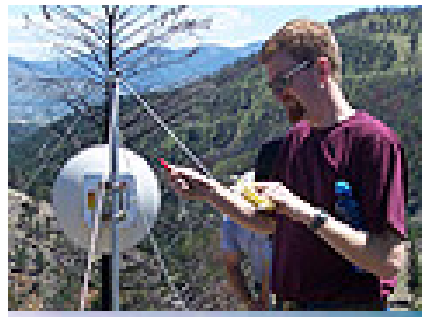
Lee Sheiner
Jeanne Balsam
Mark Pellegrini

Electronic Systems Laboratory
Georgia Tech Research Institute
Georgia Institute of Technology

Georgia Tech Research Institute

Georgia Tech Research Institute (GTRI) Overview

- Unit of the Georgia Institute of Technology
- 1200+ employees
- 70% of research employees hold advanced degrees
- Wide variety of products
- Customers include federal and state government; and industry
- Competitively bid projects range greatly in size and duration
- More Info: http://www.gtri.gatech.edu/



Overview

Transitioning to Systems Engineering

Configuration Management

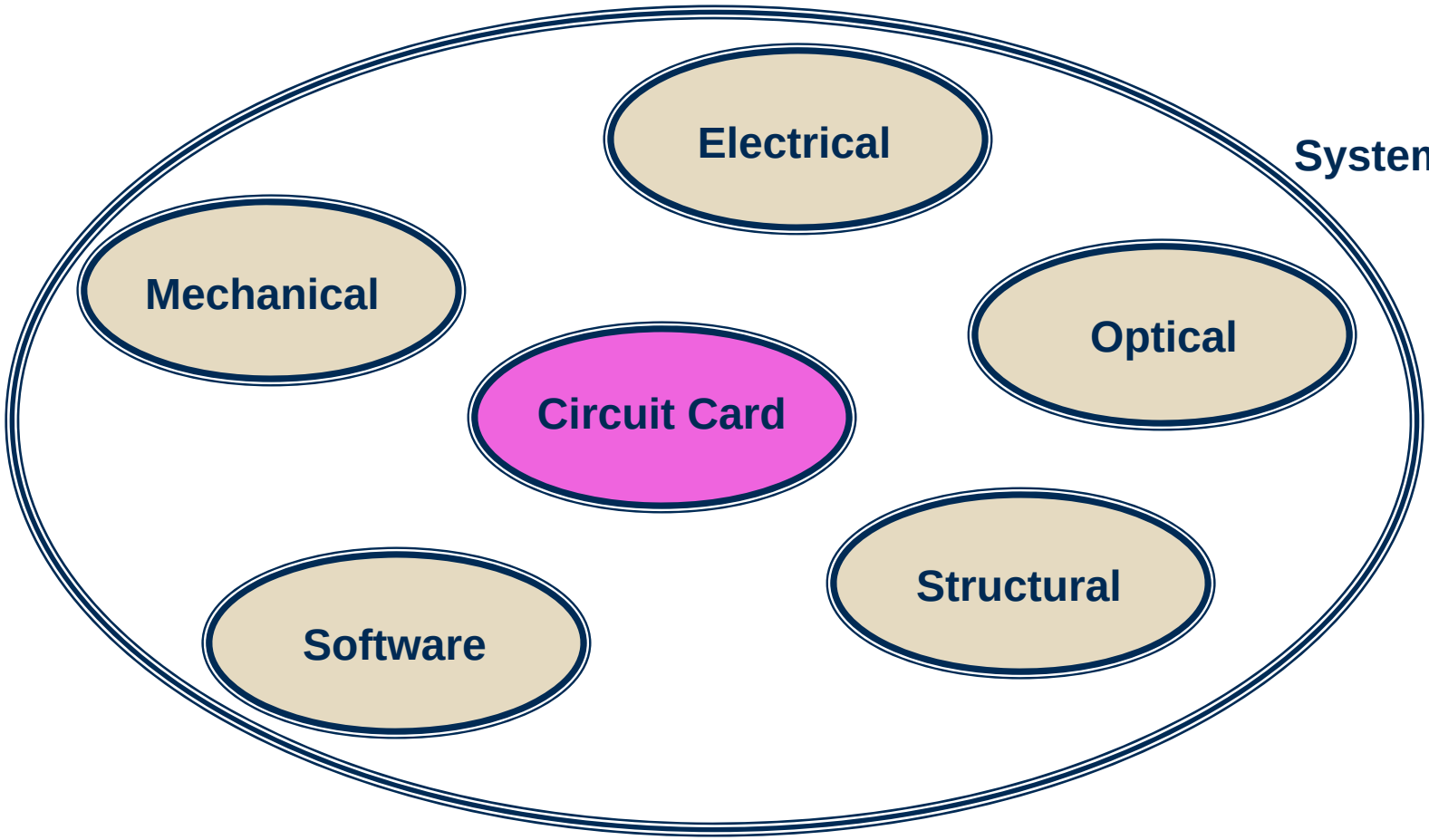
Project Planning

Peer Reviews

Summary

Questions

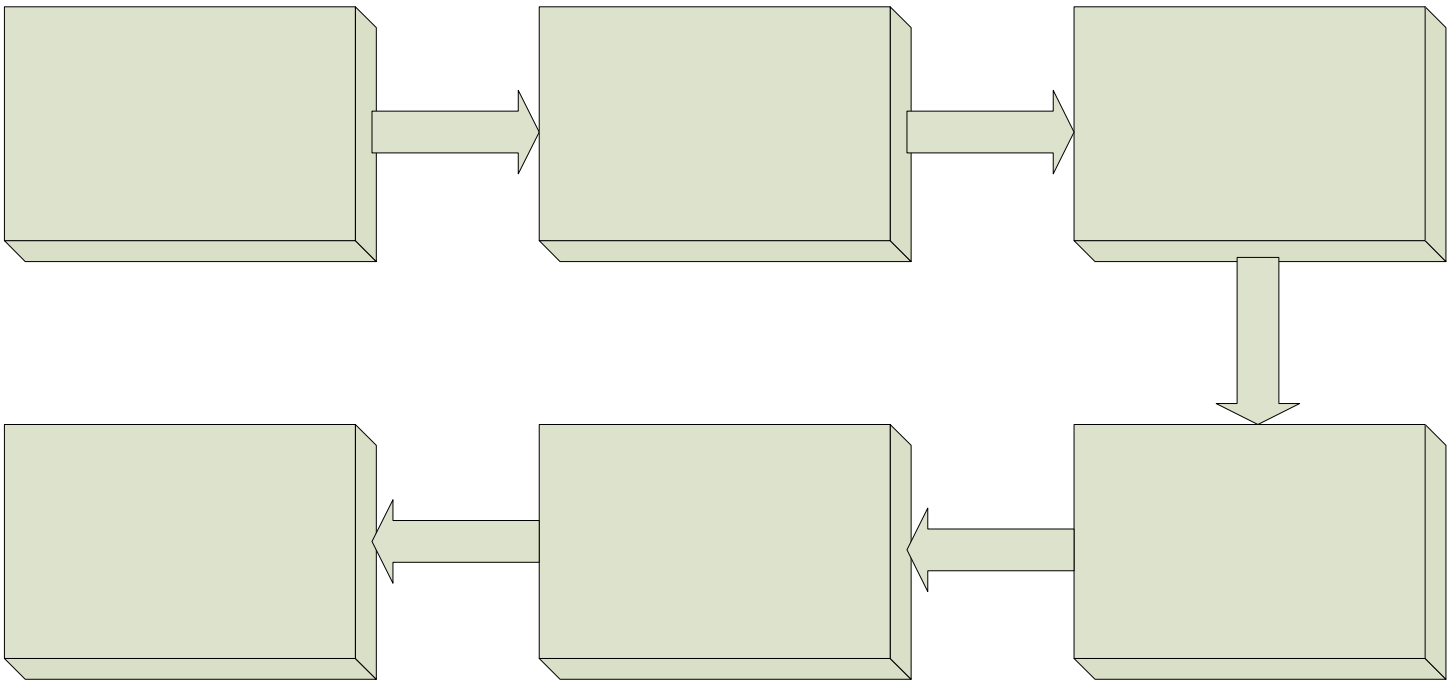
Systems Engineering



Starting Point

- Software developers were using CMM level 3 development processes
- An increasing number of programs included hardware components
- Developers with SW and HW expertise were informally carrying some processes to HW development
- Hired additional QA/Process Engineer with hardware development experience

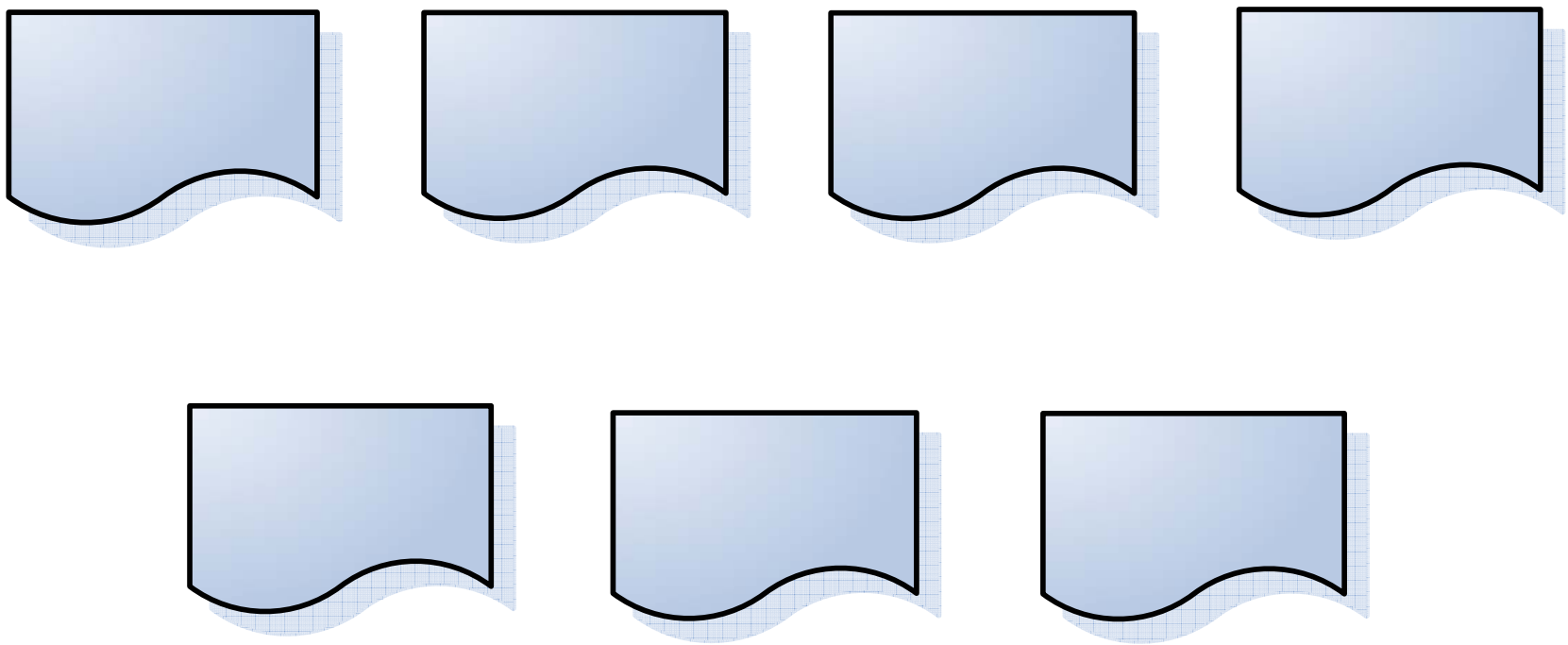
HW Development Process Overview



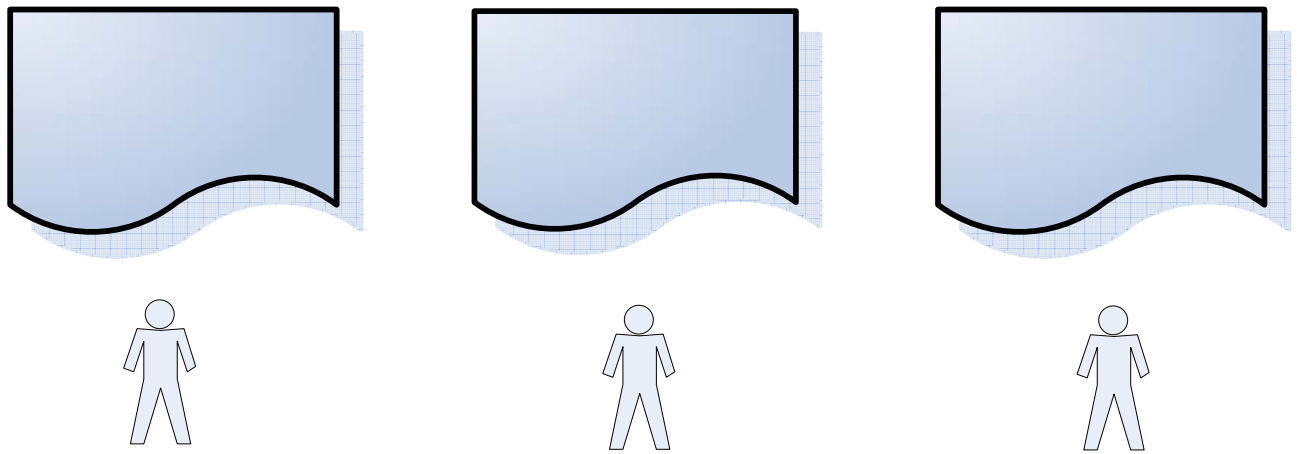
Beginning the Transition

- Removed “software” from our documented processes and procedures where appropriate
- Discovered that many existing procedures mapped reasonably well to Systems Engineering
- Identified additional items for project planning and peer reviews
- Configuration management did not map well at the lower-level details

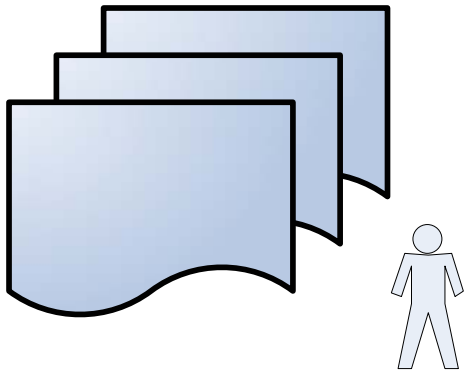
Work Products by Phase - Planning

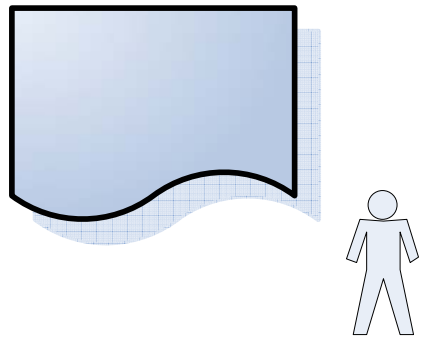


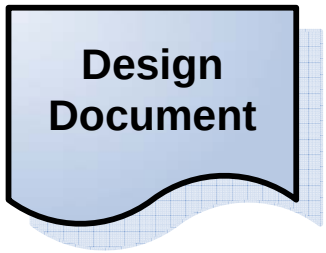
Work Products by Phase - Requirements

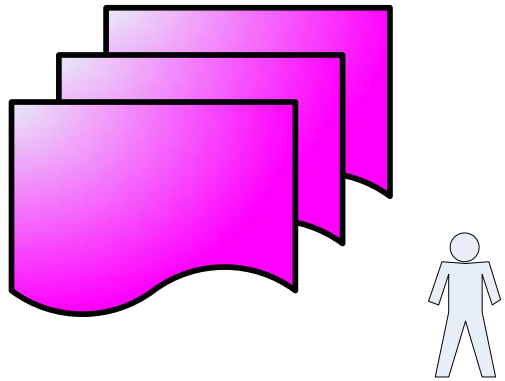


Work Products by Phase - Design

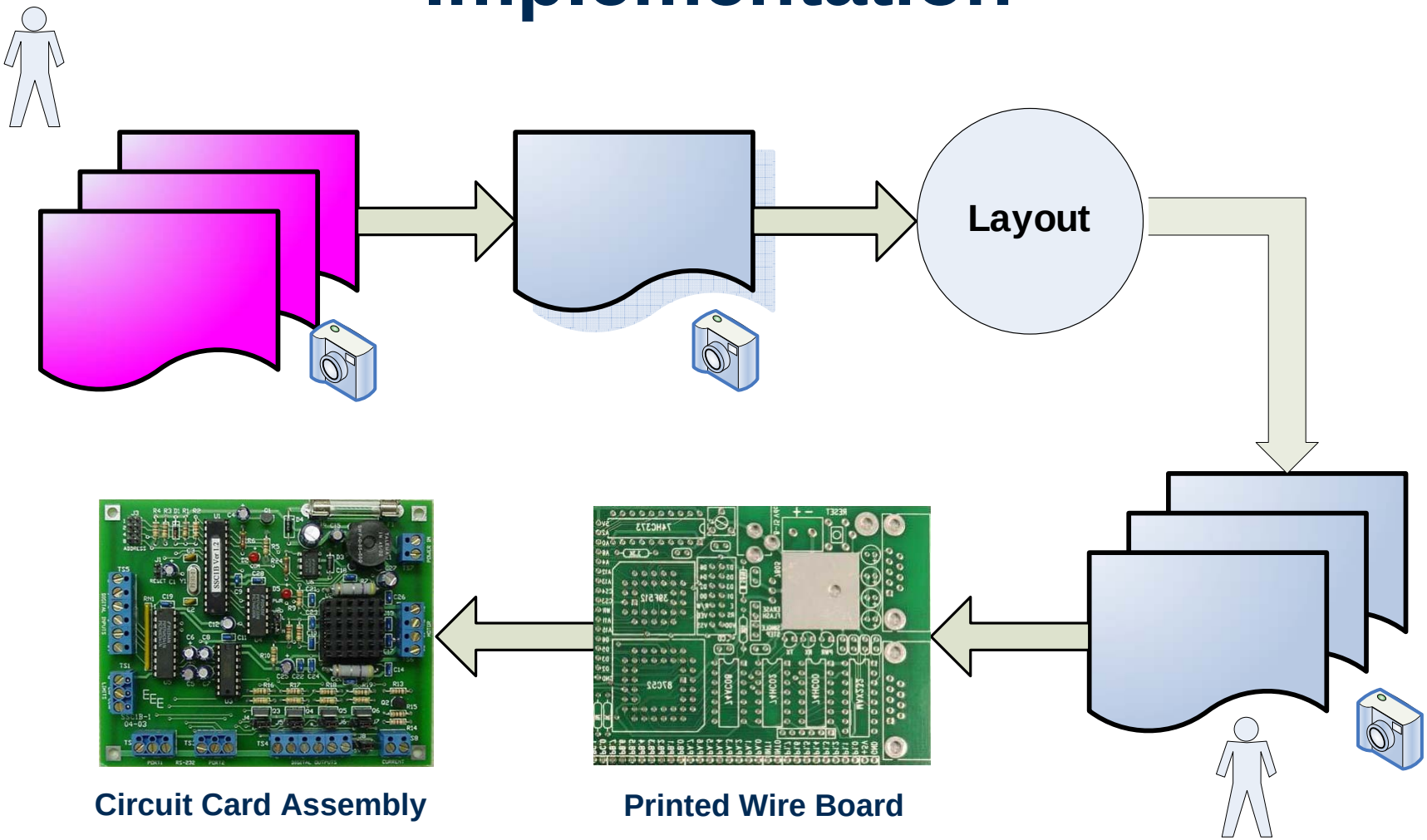




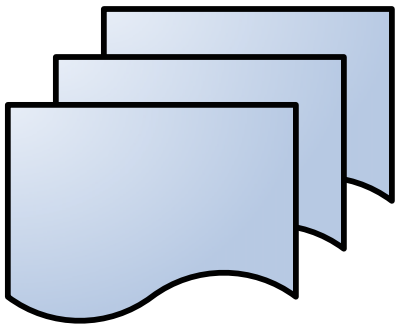


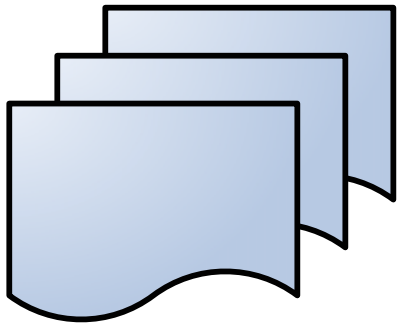


Work Products by Phase - Implementation



Work Products by Phase – Integration and Test





CM Issues: What to Control?

- **Many new types of configuration items are introduced with hardware**
- **Developers need guidance in what to control – important interim CIs are often overlooked**

CM Issues: New CIs to Control

- Gerbers
- VHDL
- Netlists
- Schematics
- Cable Drawings
- BOM / Parts List
- Data Sheets
- Symbol Libraries
- Technical Data Packages
- Assembly Drawings
- Text Fixtures / Test Code
- Master Pattern Drawings

CM Issues: Don’t lose Control

- **Remember to control all files associated with HW development**
- **Items being fabricated (internally or externally) must be put under configuration control in advance**
- **Maintain control of physical HW items – which version of the card, firmware, embedded SW, and wire-mods are on the card**
- **Work products documented using multiple configuration items must be baselined**
- **Beware of “back-of-the-envelope” and red-line issues in fabrication**

Example Directory Structure

- System
  - CCA-1
    - SW
    - HW
      - Assembly
      - Datasheets
      - Development Folder
      - Documents
      - Gerbers
      - Plans
      - PLDs
      - Schematics
  - CCA-2
  - CCA-N

File Types

Schematics

Sheet 1
:
Sheet N
Netlist
Symbol Library

Assembly

Mechanical Outline
Assembly Drawing
Master Pattern Drawing
BOM / Parts List

Gerbers

Layer 1
:
Layer N
.ipc Test File

PLDs

FPGA
VHDL
CPLD
VHDL

File Types – Continued

Documents

- *Requirements*
- *Design Description*
- *Interface Control Document*
- *Baseline Documents*
- *Test Descriptions*
- *Product Version Description*

Development Folder

- *Test scripts*

Plans

- *CM Plan*
- *Project Plan*
- *HW Development Plan*
- *Test Plan*

Data Sheets

- *Parts vendor info*

Project Planning Issues

- **Long lead times / critical path**
- **Facilities and equipment management**
- **Developmental baselines needed for fabrication**
- **“Hidden” software items**

Peer Review Issues

- **Consider schedule impact as well as cost-effectiveness**
- **Proper baselining of reviewed materials with multiple configuration items**
- **VHDL (Very High-speed Integrated Circuit Hardware Description Language) is software!**

Peer Review Issues

- Review hardware configuration items such as Gerber files, drawing packages (schematics, wiring diagrams, assembly drawings, parts lists, mechanical part designs, etc.)
- Select reviewers with HW and SW knowledge – be aware of software denial
- Review test software needed to exercise hardware

Beware

- Software “hiding” inside hardware items
- Tracing hardware requirements to hardware design
- Fabrication from uncontrolled designs
- “Quick fixes” that don’t get documented
- Changing HW configurations
- Software needed for HW testing

Acronyms

- BOM – Bill of Materials
- CCA – Circuit Card Assembly
- CI – Configuration Items
- CMM – Capability Maturity Model
- CMMI – Capability Maturity Model Integration
- GTRI – Georgia Tech Research Institute
- HW – Hardware
- PLD – Programmable Logic Device
- SW – Software
- VHDL – Very High-speed Integrated Circuit Hardware Description Language

Contact Information

- **Lee Sheiner**
  - lee.sheiner@gtri.gatech.edu
- **Jeanne Balsam**
  - jeanne.balsam@gtri.gatech.edu
- **Mark Pellegrini**
  - mark.pellegrini@gtri.gatech.edu

- **More Info about GTRI:**
  http://www.gtri.gatech.edu/