US ARMY RDECOM

U.S. Army Research, Development and Engineering Command

Malcolm Baldrige National Quality Award 2007 Award Recipient

Integrating Manufacturability into Fuze Design

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Fuze Development Center

US Army RDECOM ARDEC Fuze Division
Picatinny Arsenal, NJ

Stephen Redington, PE
973-724-2127

May 12, 2010

NDIA 54rd Fuze Conference – Kansas City

How to blow the competition away

(above results not typical, individual results may vary)

- INTRODUCTION
  - The Fuze Development Center
- Common pitfalls in development
- Two design approaches
- Integrating manufacturability
  - Key concepts
- Infrastructure examples
- Summary

US ARMY RDECOM

The Fuze Development Center
Picatinny NJ, Building 1530

Fuze Development Center Mission:
Accelerate New technology to the Field

Malcolm Baldrige National Quality Award 2007 Award Recipient

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

- You know your project is in trouble when:
  - Cost, schedule and performance are equally weighted.
  - The plan to meet the schedule requirement assumes none of the planned risk factors are ever encountered.
  - Requirements change but cost and schedule do not.
  - Your successful concept demonstration leads management to believe they have a product.
  - The formula (2 x Manpower = ½ Schedule) is applied.

- Common pitfalls that impact schedule & cost
  - Using concept development for product development
    - Misleading results
    - Schedule and cost overruns
    - Dead end projects
  - Insufficient documentation during development
    - Results cannot be reproduced
    - Lost progress / wasted money
  - Uncontrolled materials used in development
    - Results cannot be reproduced
    - Misleading results

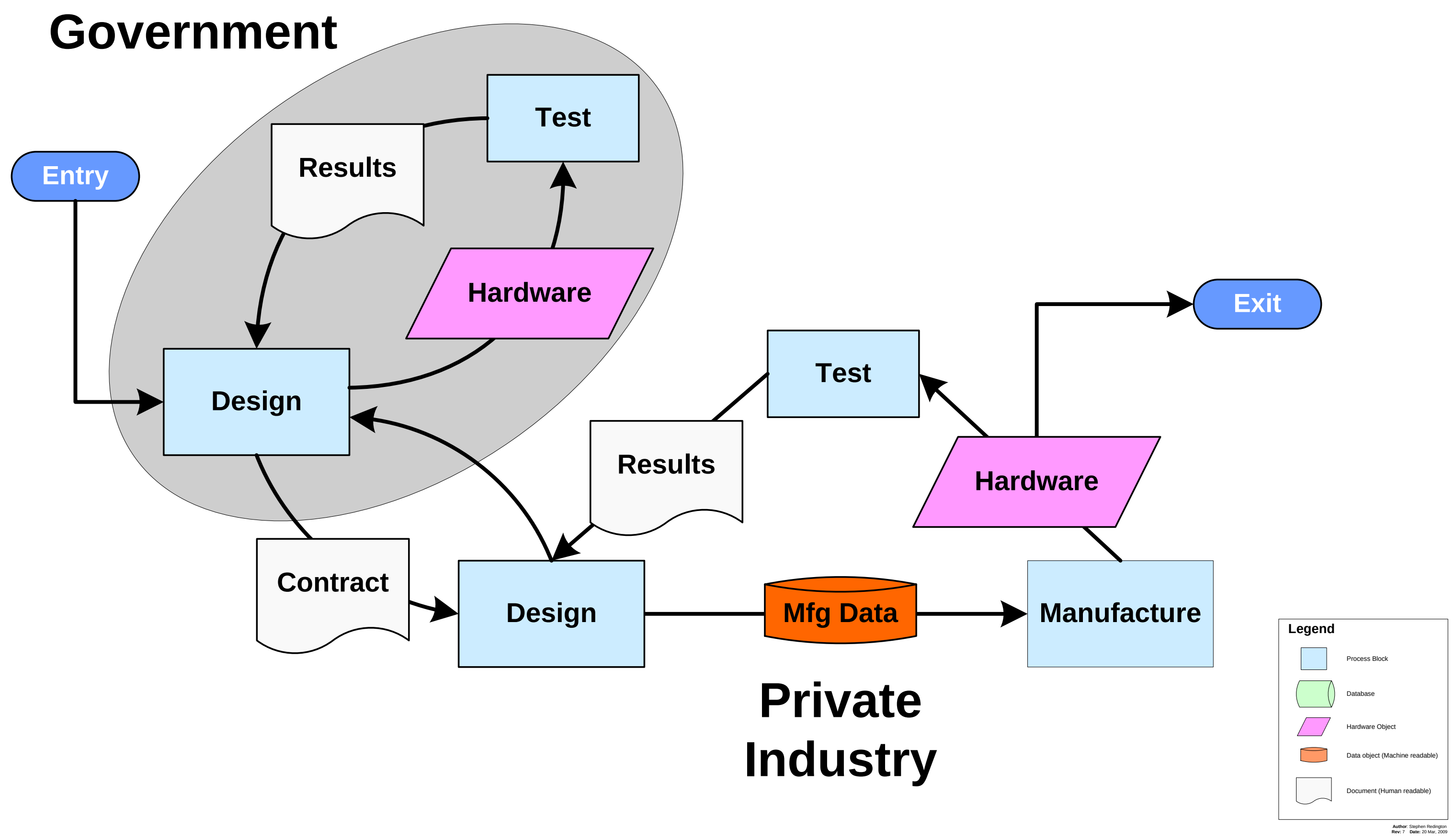
Integrating Manufacturability
Common Pitfalls

- Uncontrolled development processes/methodology
  - Diminishes teamwork
  - Duplication of effort
  - Lack of focus
- Lack of teamwork
  - Results cannot be reproduced independently
  - Duplication of effort
  - Schedule delays
- Absence of configuration controls during development
  - Results cannot be reproduced
  - Schedule delays
  - Cost overruns (Rework)

- Lets get something straight !!!
  - Experimentation (A few of a kind)
    - Focus on answering questions (is it useful?, how does it work?)
    - Ideal for exploring new or unknown technology
    - Documentation nonexistent or incorrect due to uncontrolled changes
    - Limited or no direct product transition (product potential only)
    - Foundation for a new competency
    - Often mislabeled as prototyping
  - Prototype (The first of many)
    - Focus on fielding a new capability
    - Results reproducible by an independent party
    - Easily transitions to production
    - Foundation for spiral development / product improvement

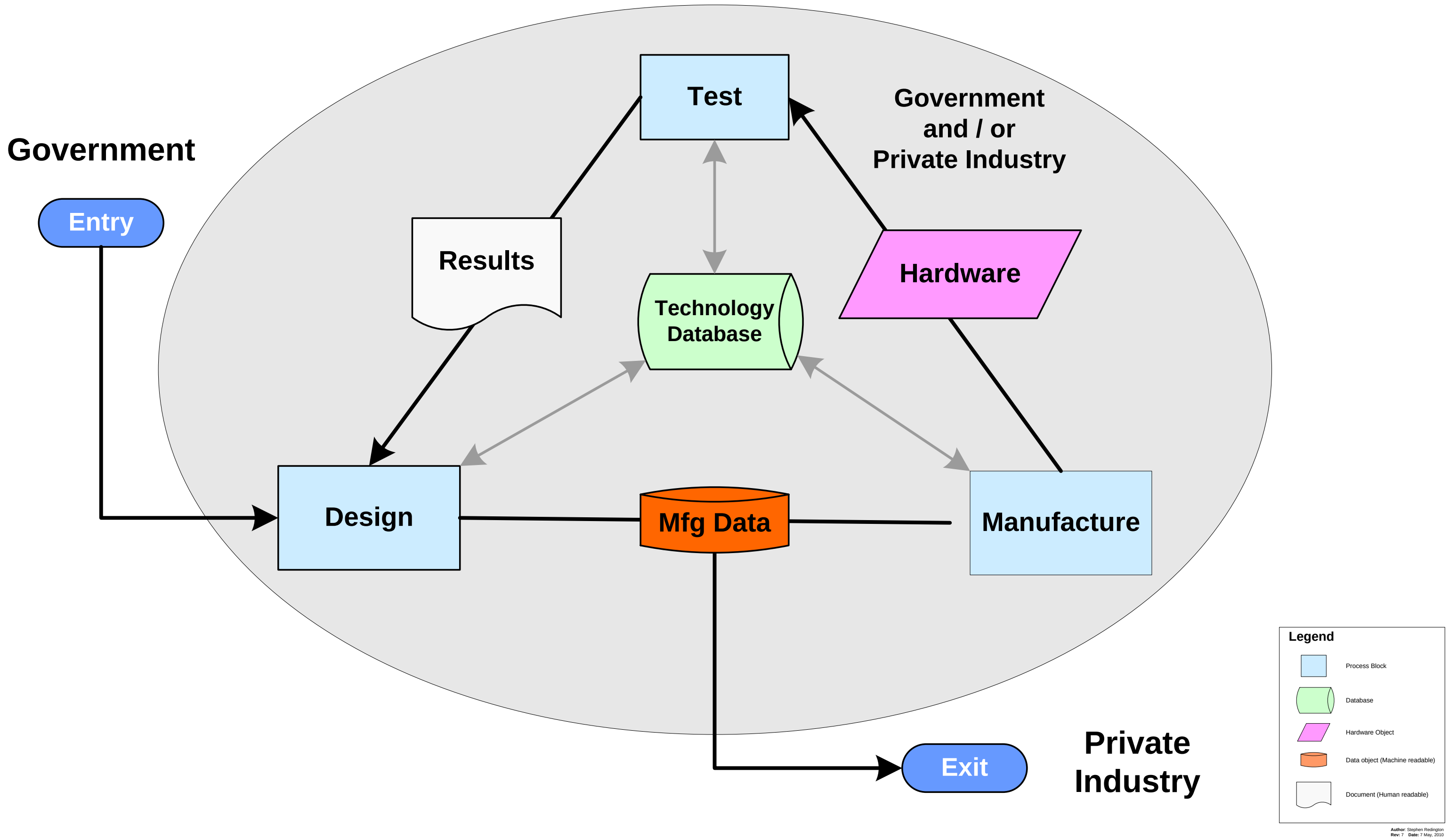
Concept Prototyping

A model for experimentation and development



Integrated Producibility

An integrated model for experimentation and product development



- Integrating manufacturability in development
  - Focus on the product more than the part
    - Products can be delivered, parts cannot
  - Focus on documentation up front
    - Assume nothing, specify everything
    - Is there enough detail for someone else to fabricate the design
  - Stay under control
    - Follow a design process
    - Enforce a mechanism for identifying prototype configurations
  - Promote teamwork
    - Minimize schedule delays
    - Share and incorporate specialized knowledge

- This is extra work. Why Bother?
  - Benefits
    - Less rework down the road
    - Shorter time to field
    - Lower overall cost
    - Improved uniformity / consistency of performance
  - Key concepts for success
    - Information Identification
    - A Self Documenting Design Process
    - A Self Explanatory Design Process
    - Feedback Controls
    - Design for Reuse / Prevent rework
    - Manufacturing Awareness

- Information Identity is Key to Producibility
  - Identify information first, then create it
    - Enables product level documentation up front
    - Don’t create information, then identify it (indicates lack of planning)
  - Promotes teamwork / Enables information sharing
  - Mechanism depends on enterprise philosophy
    - Stupid numbers
      - Imply no information about the item / No classification errors
      - Simple rule to create / No exceptions to deal with
      - Requires an IT system to be useful
    - Smart numbers
      - Embed information about the item / Subject to human error
      - Must follow rules to create / Exceptions create problems
      - May or may not require an IT system to be useful

- Self Documenting Design Process
  - Shared common templates are key
    - Establish drawing format pages for all CAD tools
    - Establish common fabrication notes for all applicable technologies
    - Use your ID system to manage
  - Integrate the design process with your ID system
    - Make getting an ID number the first step in design
    - Promote configuration control up front
  - Leverage IT to make it work
    - Avoid human factor road blocks
      - Generate your ID numbers automatically
    - Automate repetitive tasks

- Self Explanatory Design Process
  - Consider human factors to minimize error
    - Minimize misinterpretation of design information where possible
    - Eliminate superfluous / irrelevant information
    - Accurate schematic representation of all elements in assembly
    - Physical location on schematic implies physical grouping on a PCB although no rules exist in reality
  - Group all appropriate information together
    - One archive per item to be fabricated
    - Natural enforcement of configuration
  - Review designs like your seeing them for the first time
    - Is it clear and easy to understand
    - Is it complete

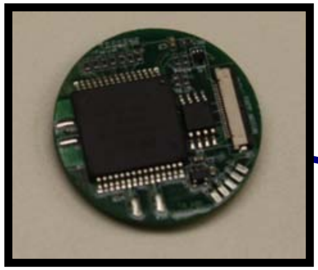
- Enable feedback control in development
  - Capture and retain cost information where possible
    - Enable design to cost
    - Use as a metric (not actual cost) due to volatile nature
    - Use to quickly focus attention to “big ticket” items driving cost
  - Inventory information
    - Avoid designing in new parts / maximize reuse
    - Reduce schedule and cost at development time
  - Tracking and monitoring
    - Manage product development by managing its physical (tangible) parts rather than work breakdown on the project schedule
    - Track metrics that are easily quantifiable (tangible)
    - Avoid metrics that involve time (process over schedule)

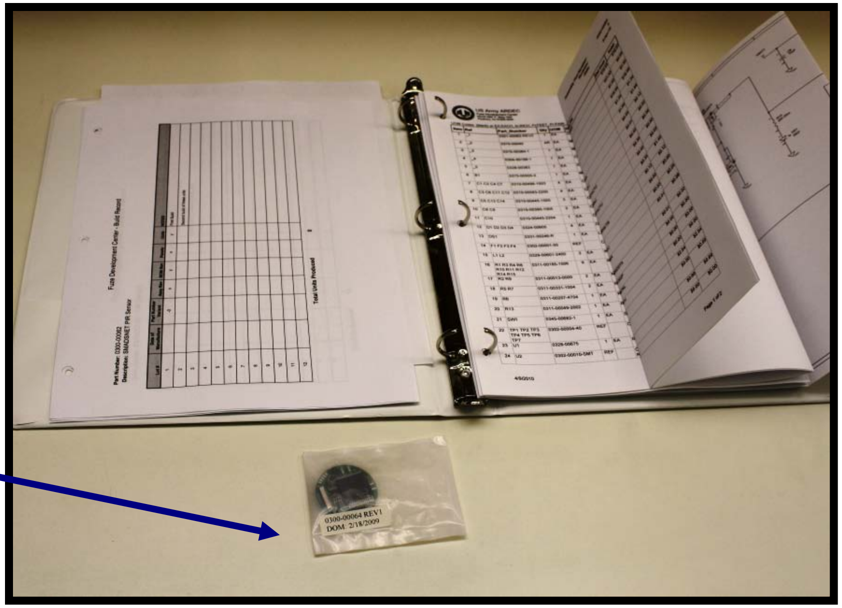
- Design for reuse / Prevent rework
  - Design history is the core competency of the enterprise
    - Provide a foundation for repeat work
    - Provide a foundation for new work
    - Success or failure is irrelevant, either result builds knowledge
  - Centrally locate Information
    - CAD tools share common libraries
    - CAD information is the foundation for the next iteration
    - Make historical data accessible
  - Correct erroneous information immediately
    - Think of the next design error you will be preventing

- Increase Manufacturing Awareness
  - What can be made verses what can be drawn
    - What can done by machine / What needs to be done by hand
    - When are tooling holes needed and how are they used
    - What is a reference datum
      - How are they used
      - Where should they be located
  - What kind of machines are applicable / available
    - How do the machines work
    - Where do they get their reference
    - What kind of tolerances are they capable of
  - What kind of tools are applicable / available
    - How are the tools used

Infrastructure

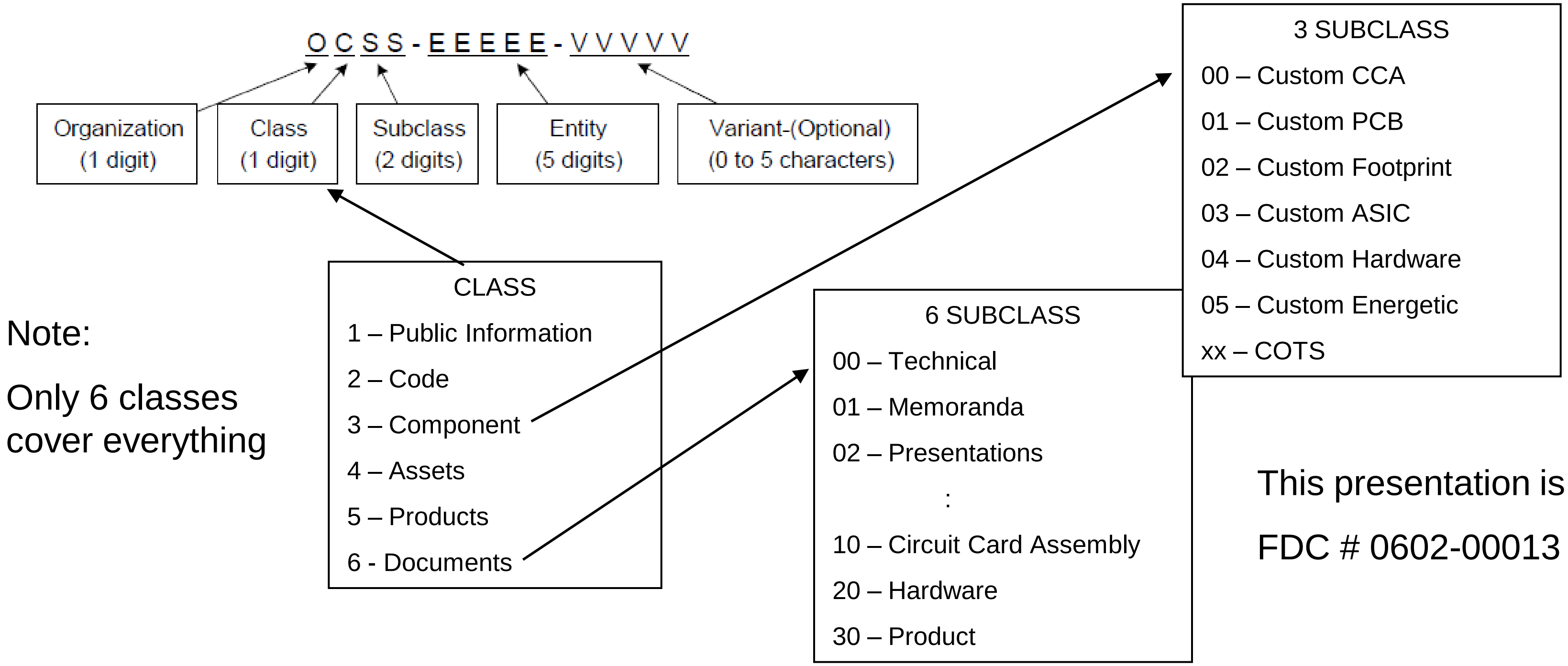
How to go from here……





To here

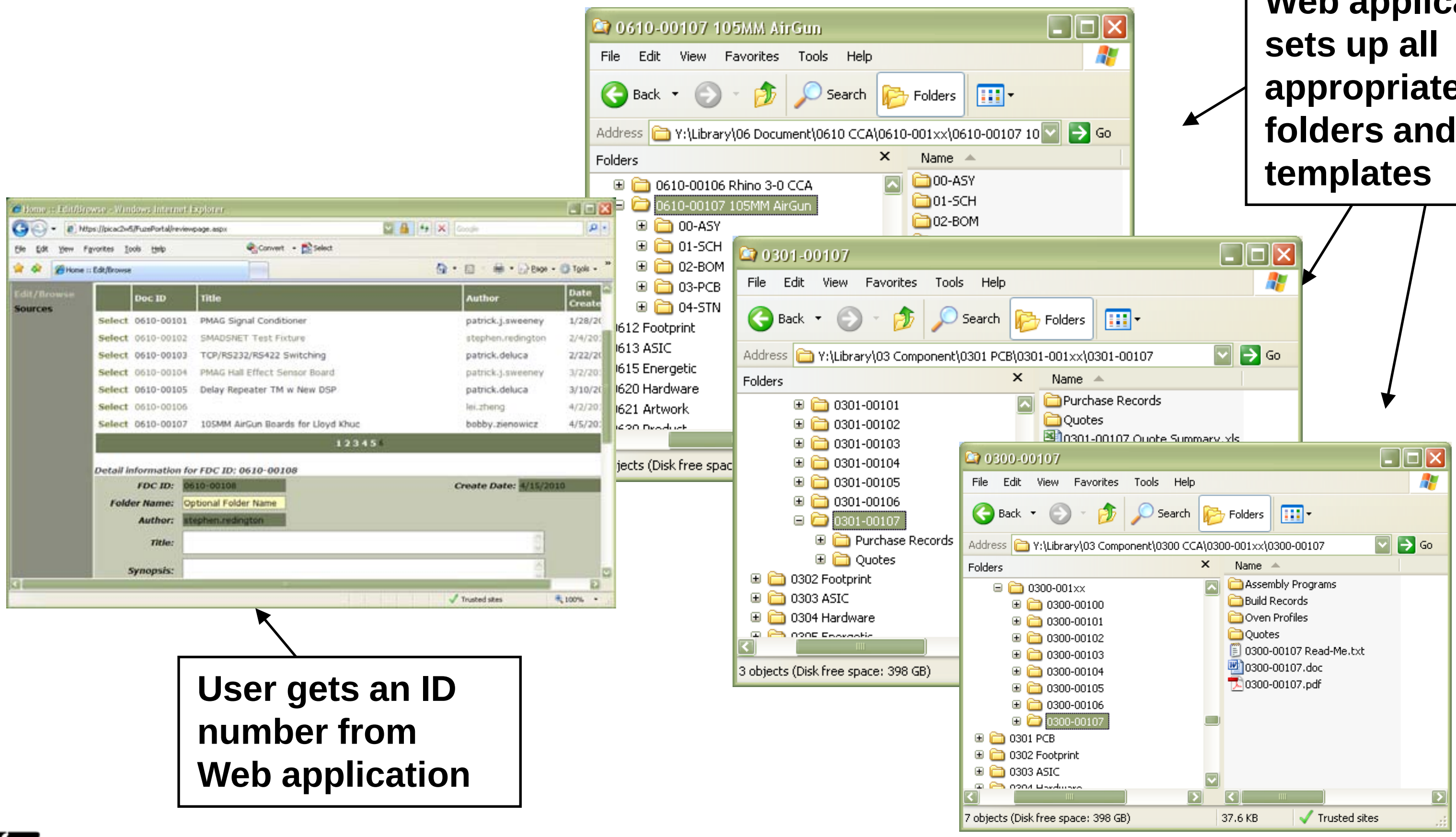
- A universal ID numbering system
  - Select the best compromise of number intelligence



Example of an Information identification scheme used by the FDC

- Self Documenting Process

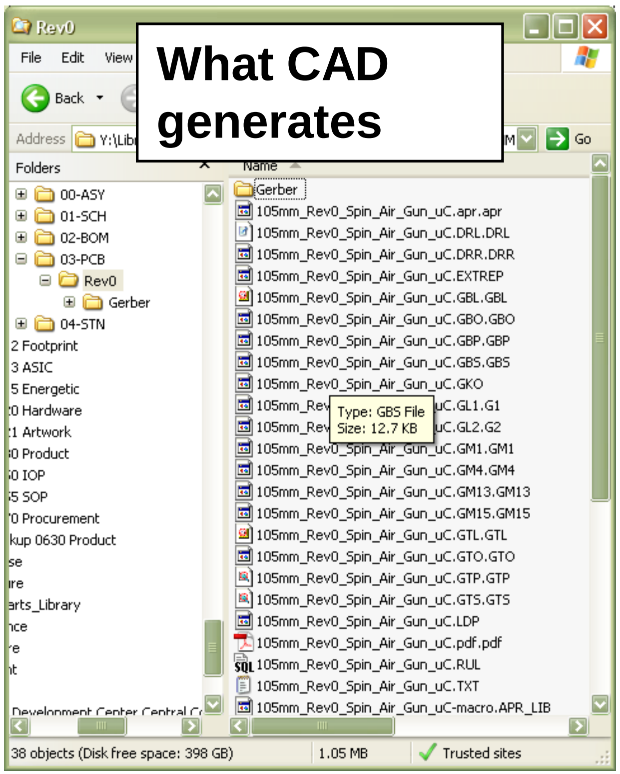
Web application sets up all appropriate file folders and CAD templates

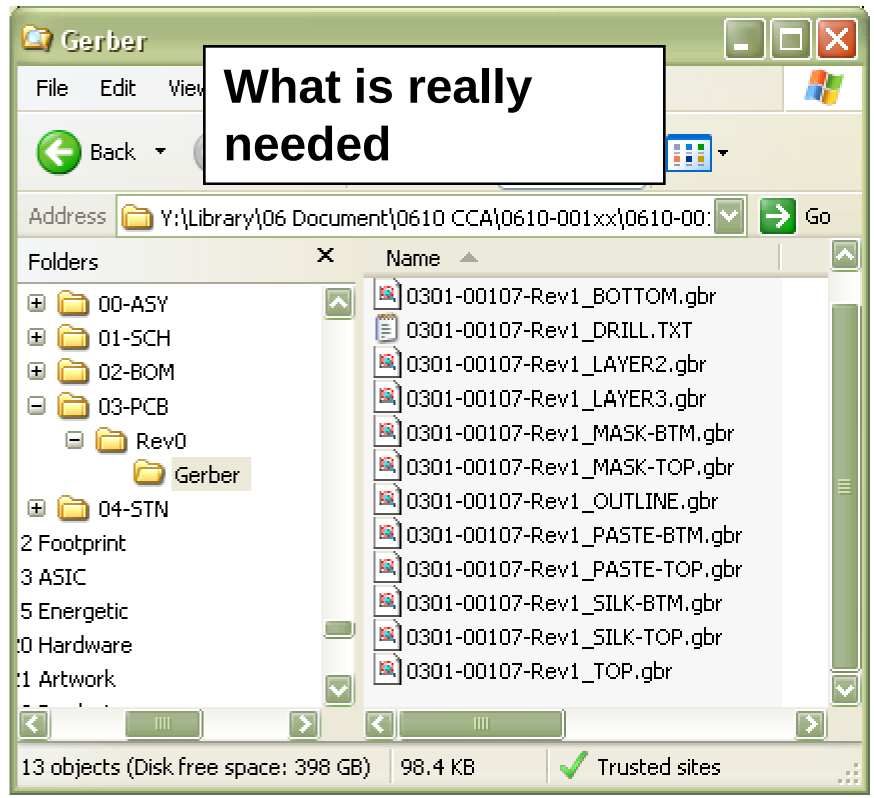


User gets an ID number from Web application

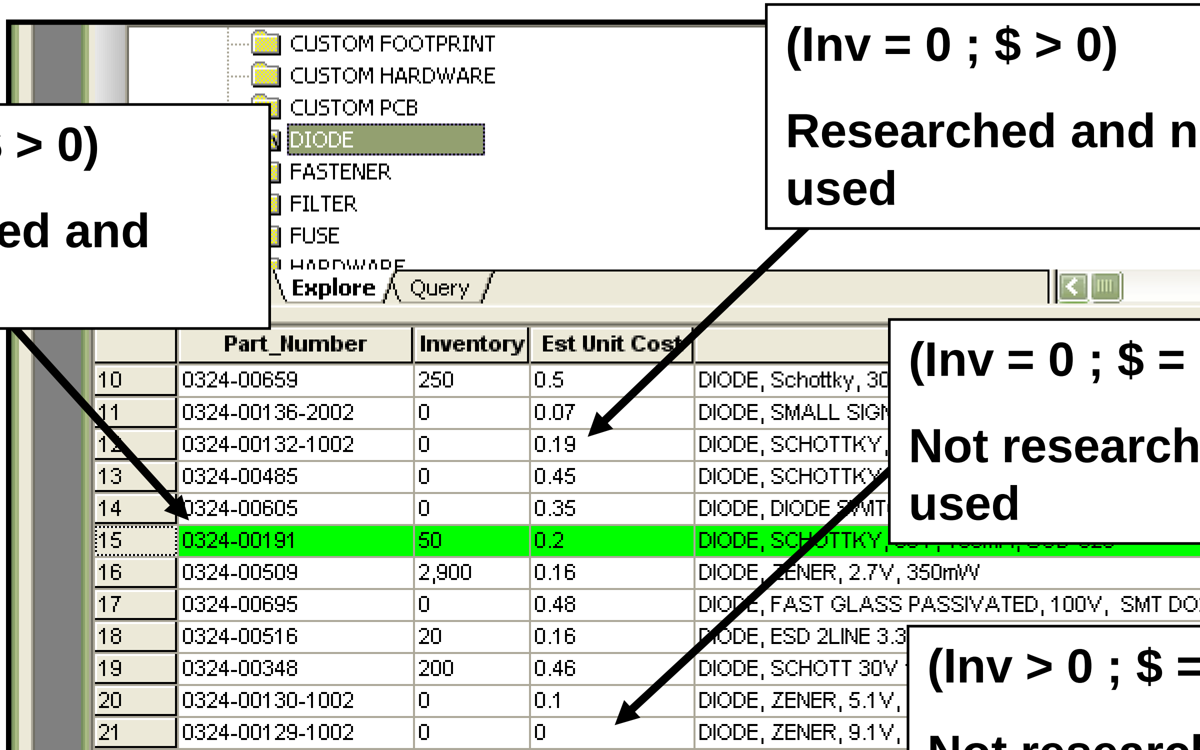
- Self Explanatory Process

Look from the recipient point of view





- Feedback control example (cost & inventory)



	Part_Number	Inventory	Est Unit Cost	
10	0324-00659	250	0.5	DIODE, Schottky, 30
11	0324-00136-2002	0	0.07	DIODE, SMALL SIGN
12	0324-00132-1002	0	0.19	DIODE, SCHOTTKY,
13	0324-00485	0	0.45	DIODE, SCHOTTKY
14	0324-00605	0	0.35	DIODE, DIODE SMT
15	0324-00191	50	0.2	DIODE, SCHOTTKY,
16	0324-00509	2,900	0.16	DIODE, ZENER, 2.7V, 350mW
17	0324-00695	0	0.48	DIODE, FAST GLASS PASSIVATED, 100V, SMT DO2
18	0324-00516	20	0.16	DIODE, ESD 2LINE 3.3
19	0324-00348	200	0.46	DIODE, SCHOTT 30V
20	0324-00130-1002	0	0.1	DIODE, ZENER, 5.1V,
21	0324-00129-1002	0	0	DIODE, ZENER, 9.1V,

(Inv >0 ; $ > 0)

Researched and used

(Inv = 0 ; $ > 0)

Researched and not used

(Inv = 0 ; $ = 0)

Not researched and not used

(Inv > 0 ; $ = 0)

Not researched but Used (not shown)

Integrating Manufacturability
In closing...

- Pay as much attention to little problems as you would the big problems
  - Unlike experimentation, one unsolved little problem will kill a product just the same as one big problem.
  - Solving little problems early can help you solve big problems latter.
- Its easier said than done
  - Everyone agrees that integrating manufacturability up front is a good thing. How many actually do it?
    - Expect resistance on both sides: engineering and management
  - Infrastructure and Management support are essential.

Questions

Fuze Development Center

US Army RDECOM ARDEC Fuze Division
Picatinny Arsenal, NJ

Stephen Redington, PE
973-724-2127