

Configuration Management in Aerospace and Defense

presented by

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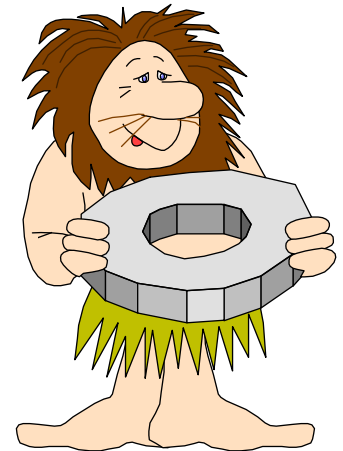
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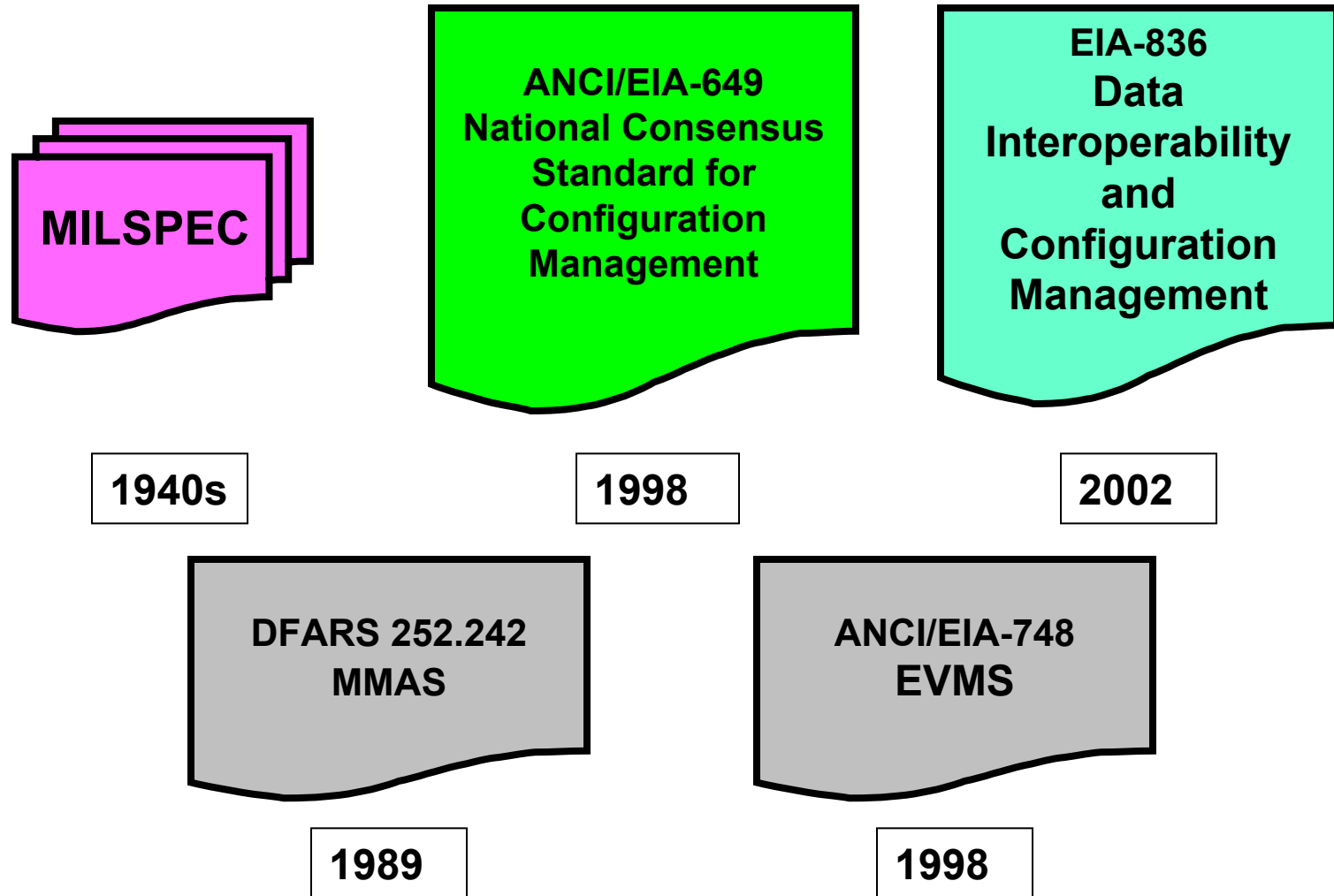
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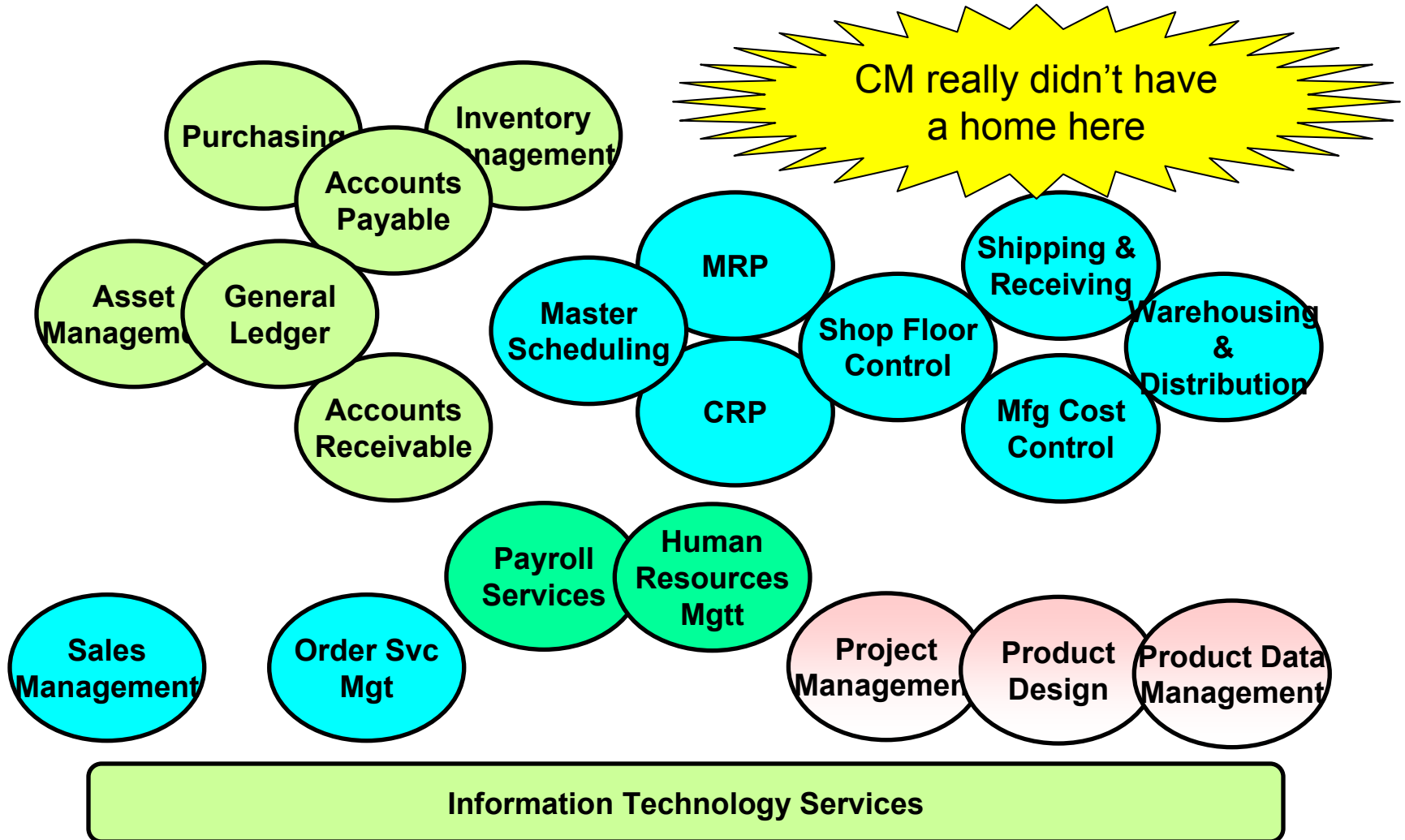
Our Focus

- Configuration Management defined
- Specific A&D issues and concerns
- CM and the Product Life Cycle
- CM v Engineering Change
- Some lessons learned
- Conclusions

Evolution of Standards



The Enterprise View Phase I



Definitions

Definition of Configuration Management*

- Applied over the life cycle of a product
- Provides visibility and controls of its performance, functional and physical attributes
- Verifies that a product performs as intended
- Is identified and documented in sufficient detail to support its projected life cycle

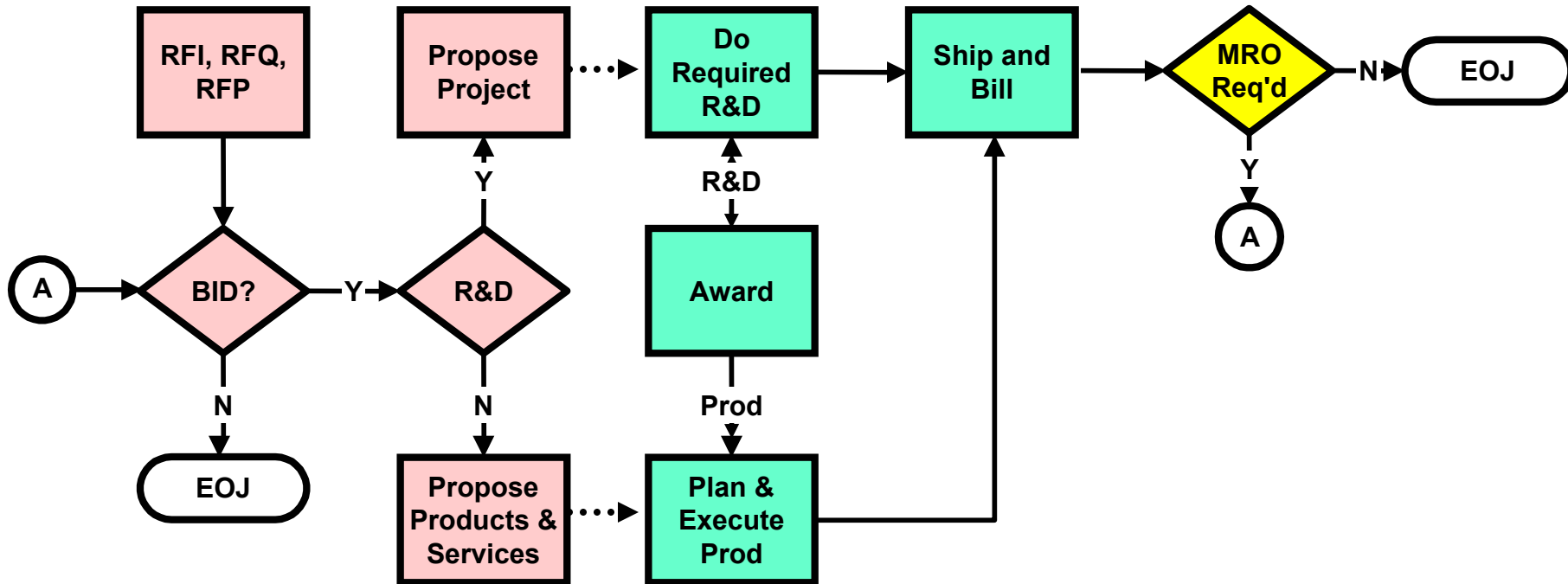
* Abstracted from EIA-649

Configuration Management Data Exchange And Interoperability*

- Facilitates the interoperability and exchange of configuration management data
- To be most effective, the capabilities of the process, tools or systems, should embody the CM principles in ANSI/EIA-649 in conjunction with the business objects and data element definitions in EIA-836
- Provides a set of standard definitions and business objects that can be used by XML frameworks in interfacing the content elements among one or more systems or databases.
- The extensible markup language (XML) facilitates data sharing and exchange among different systems
- The level of interoperability between dissimilar systems is determined by trading partner agreement

* Abstracted from EIA-836

The Configuration Continuum



Capture Configuration, Cost, Schedule & Performance

Aerospace & Defense Environment

Aerospace and Defense Functional Needs

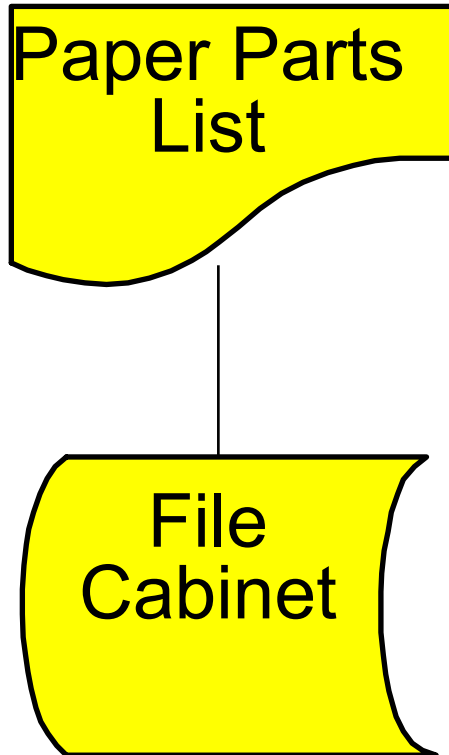
- Managing massive bid activities
 - FAR, DFARS, CAS, EIA, ANCI/EIA etc.
- Managing massive design activities
 - Program and project management
 - Work Breakdown Structures (WBS)
- Managing manufacturing operations
 - Many, many open work orders
 - Constant engineering change
- Government reporting requirements
 - MMAS
 - Cost/pricing disclosure
 - Etc., etc., etc.
- Configuration management
 - The “As-Something Syndrome”

Aerospace and Defense Specific Constraints

- Government oversight
- Design/Engineer to order
- Project oriented activities
 - R&D
 - Devices
- Deep Bills of Material
- Constant engineering change
- Long (30+ years) product life cycles
- Legacy mindsets
 - Both Government and Contractors

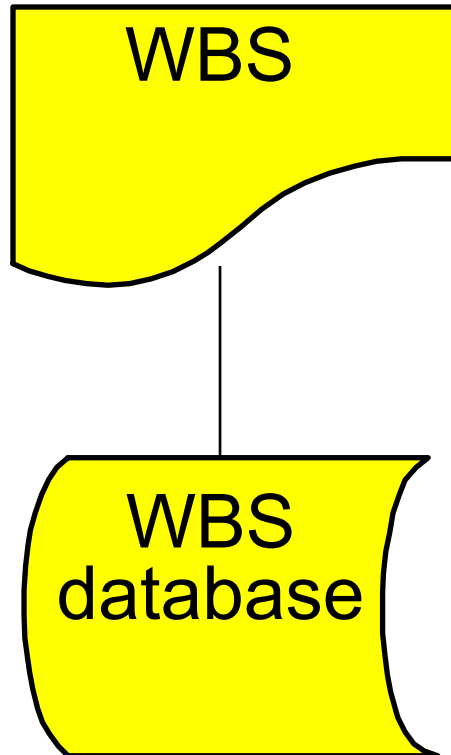
Product Life Cycle Phases

As Quoted Program Management



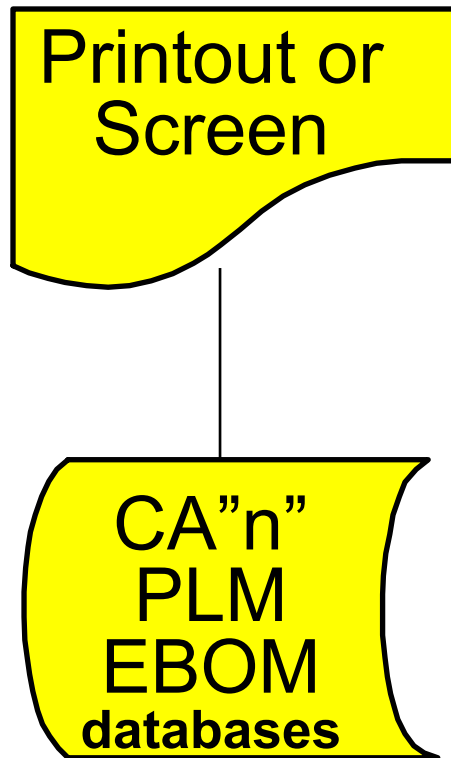
- RFI, RFP, etc.
- More or less informal
- Spreadsheets?

As Accepted Program Management



- Negotiated Contract
- Deliverables and Schedule Committed
 - R&D
 - Hardware
 - Software
 - Ancillary Activities
- Project Management

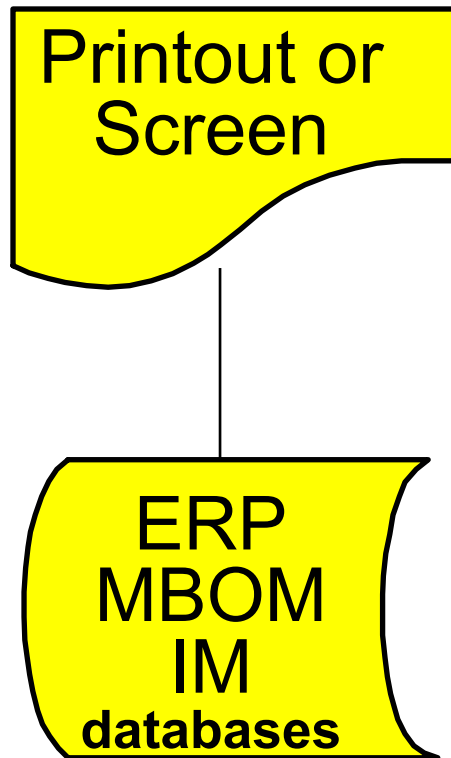
As Designed Engineering



- CA'n'
- Part Definition
- CSM
- PDM
- Workflow & Red Lining
- EBOM
- Release(s) to Manufacturing
- Engineering Changes

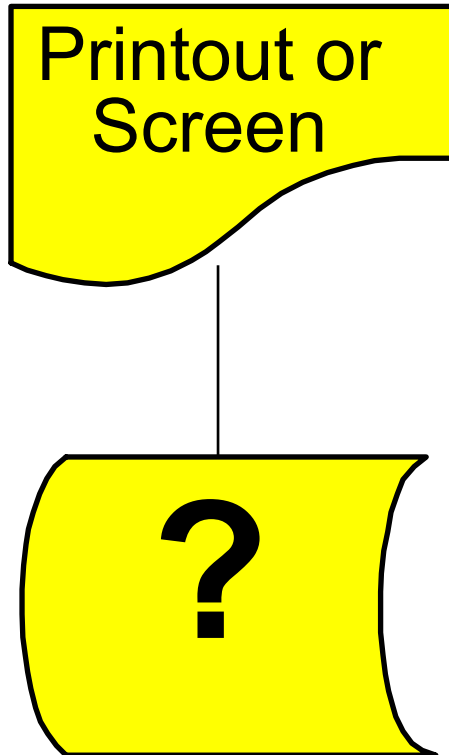
As Planned

Materials Management



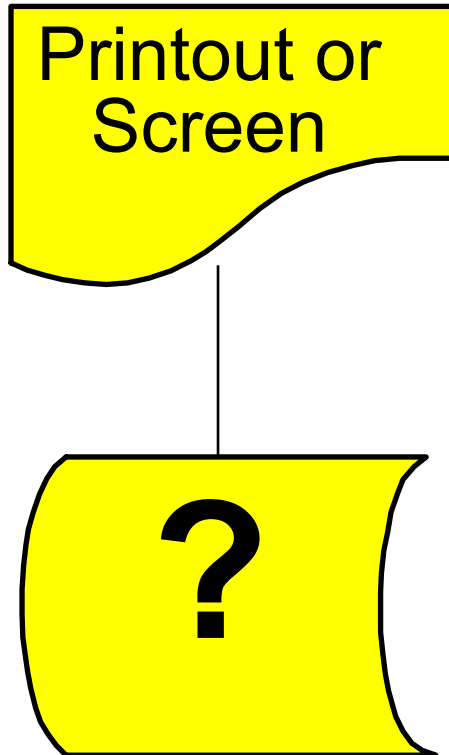
- MBOM
- Resource Planning
- Procurement
- Manufacture
- Ship
- Absorb Engineering Changes

As Built Manufacturing



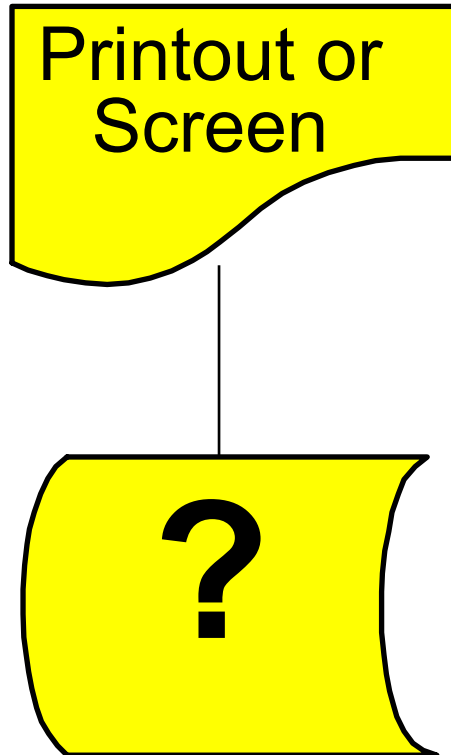
- Effectivity
 - By Date
 - By Lot Number
 - By CLIN
 - By Serial Number
- ?BOM

As Documented Configuration Management



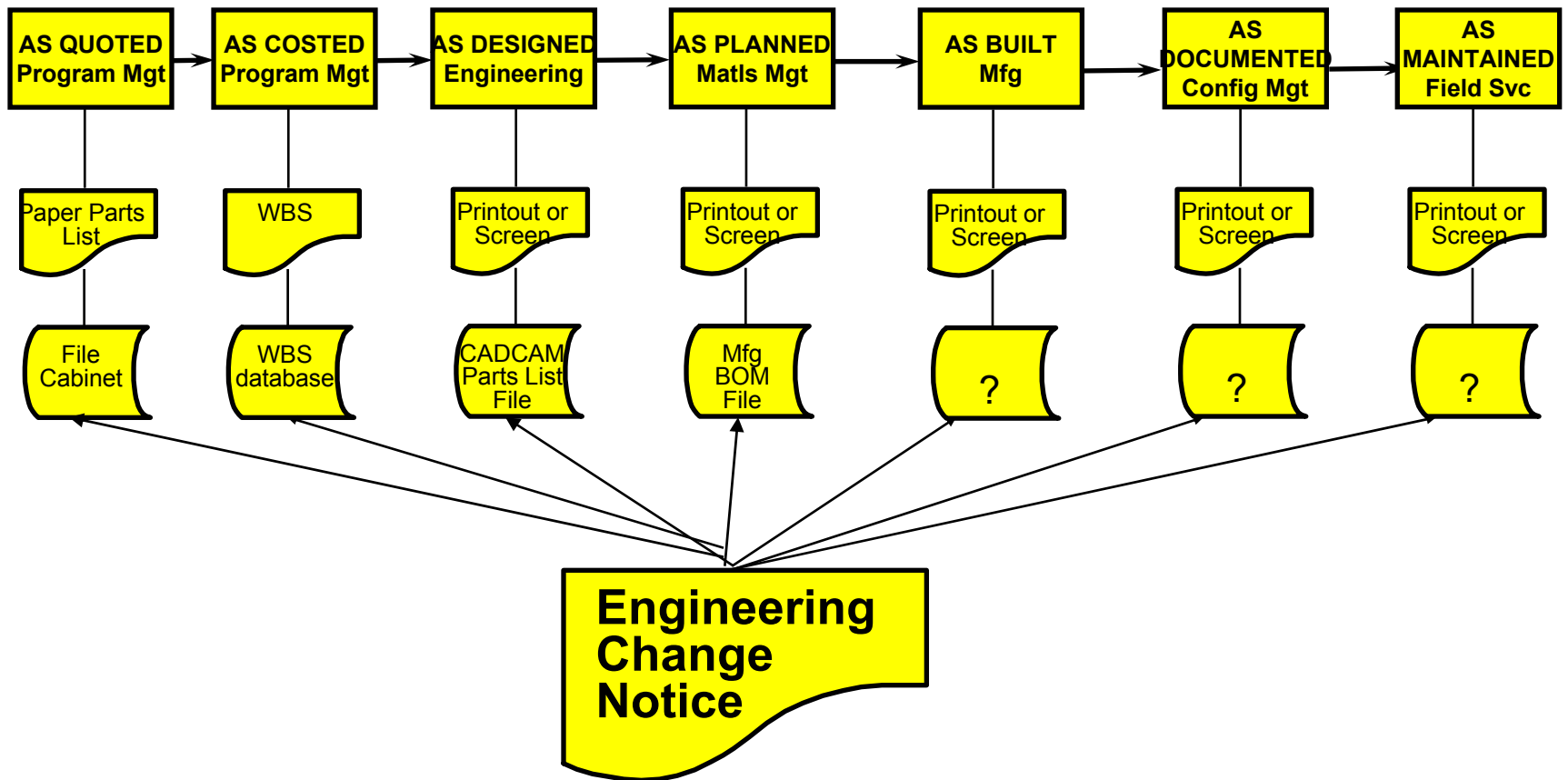
- All Deliverables
 - Hardware
 - Software
 - Test & Inspection Data
 - Certificates
 - Pack-up Data

As Maintained Field Service



- Individual Unit History
- Maintenance Echelons
- Deployment
 - Schedules
 - Skills
 - Material
 - Documents
- Upgrades

Who Owns the Configuration?



Where is the Source Document?

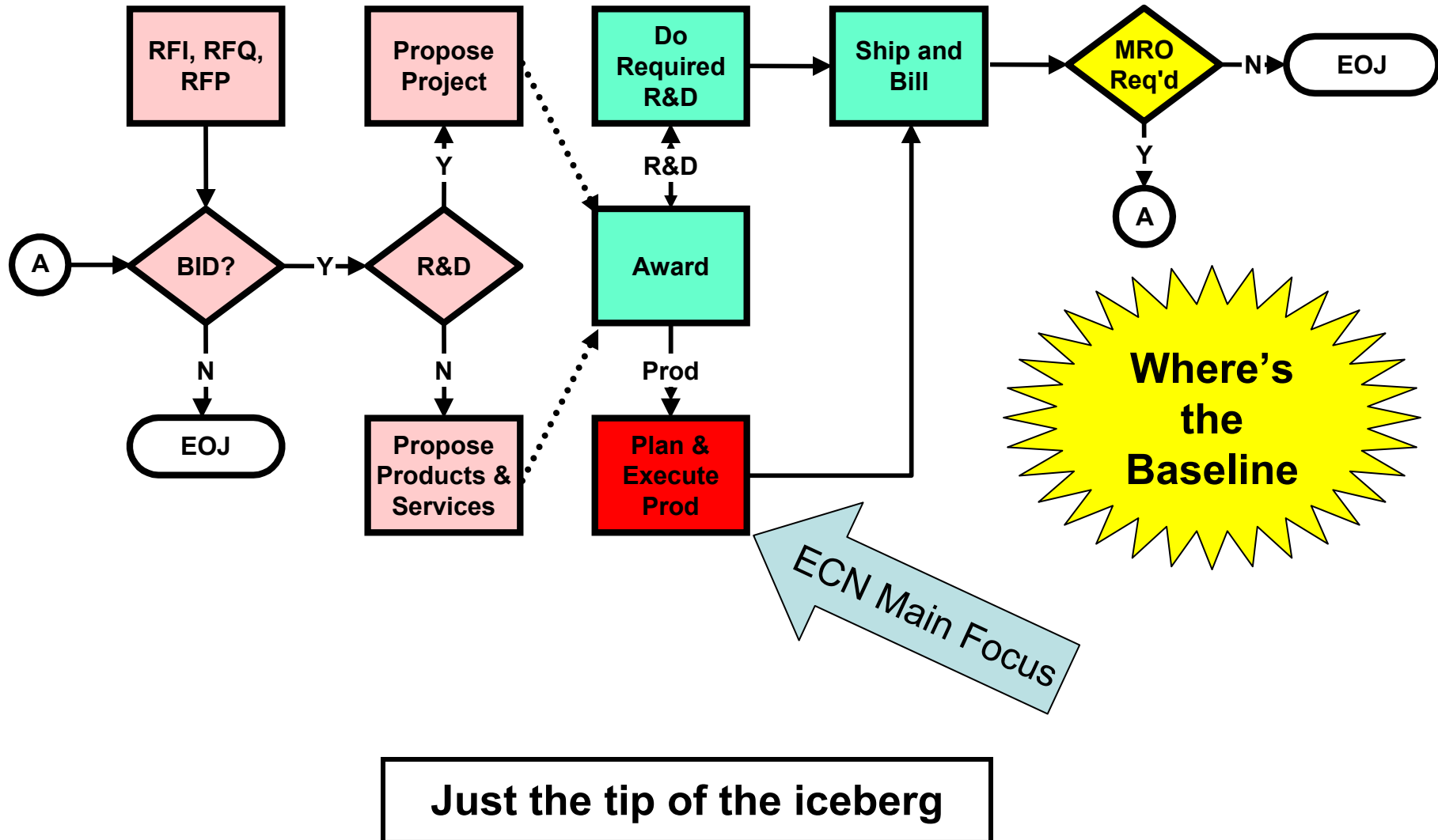
Who Owns the Bill of Material

- Engineering
- Program Management
- Manufacturing
- Accounting
- Purchasing
- Planning
- None of the above
- All of the above

A short quiz

CM v Engineering Change

The Configuration Continuum



What is an Engineering Change

- Changing the Product Structure (BOMs)
 - Adding a part
 - Deleting a part
 - Changing the quantity per assembly
- Changing the Part Itself
 - Changing specifications
 - New Part Number?
 - Changing approved sources
- Changing the Routing (?)
 - Changing the process
 - Changing the process sequence

Do all Engineering Changes affect form, fit or function?

The 4F Principle

- Function: What does it do
- Form: What does it look like
- Fit: How does it interface
- Fee: What do we charge for it

Too many of us forget the 4th “F”

What must the ECN Do

- Tell us WHAT to change
- Show us HOW to make the change
- Tell us WHEN
 - Effectivity
- Tell us WHO
 - Define tasks
- Show us WHERE
 - What documents
- Tell us WHY
 - Really explain the reasons

Revision Letter Concepts Assigned To

- The Physical Item
- The Engineering Drawing
- The Part Master Record (?)
- The Bill of Material Record
- The Routing Record (?)
- All Customer Order Line Items
- All Work Order Line Items
- All Purchase Order Line Items

How well do we do this?

Revision Letter Concepts

Attributes

- Has an associated ECN Document
- Has an Unique ECN Number
- Has an ECN Initiation Date
- Has defined Effectivity
- Suggested Formats
 - Numerical prior to manufacturing release
 - Alpha after Manufacturing release
 - Omit I, O, Q, S, X, Z
 - After Y, to to AA, AB, etc.
- MIL-STD-100 is a good guide

How well do we do this?

Effectivity of Change

- By Revision Letter
 - Engineering's preference
- By Dates
 - Do not use before, do not use after
 - Most manufacturing software does this
- Other methods (needs)
 - Use to depletion of old part
 - Lot (batch) Number
 - Project (contract) Number
 - Customer Number
 - Purchase Order Number
 - Serial Number

Engineering and manufacturing have differing views of effectivity

Some Lessons Learned

Effectivity of Change Revisited

- Engineering traditionally manages changes via Revision Letter upgrades
- Engineering change systems do not always consider Effectivity
- Manufacturing software systems do not do a good job of managing change by Revision Code
- Effectivity dates are subject to change
- Ways to close the gap
 - Put an ECN Czar in charge of bridging the gap
 - Only allow manufacturing BOM maintenance via an ECN screen with restricted access, requiring Revision Letter update and Effectivity statement

Change impact must be communicated to manufacturing ... quickly

The Triage Principle

Engineering Change Priority Planning

- **A Stop work and fix**
 - The sun will not set before preliminary action is taken
- **B Define Effectivity and schedule into the manufacturing planning and execution process**
 - Plan for least disruption and part obsolescence
 - No more than 2-3 working days until preliminary release
- **C Aggregate and hold for product upgrade**
 - Batch release no less often than quarterly

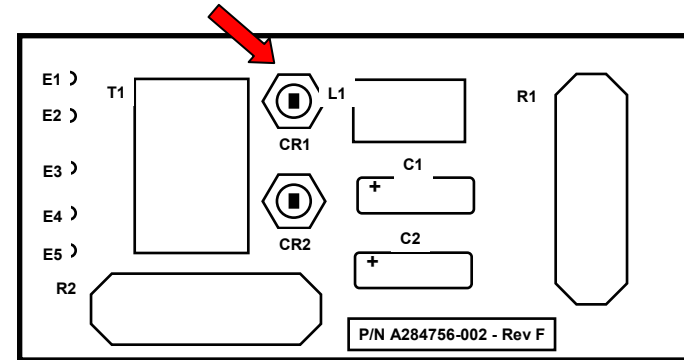
The business side of EC processing

Reference Designators

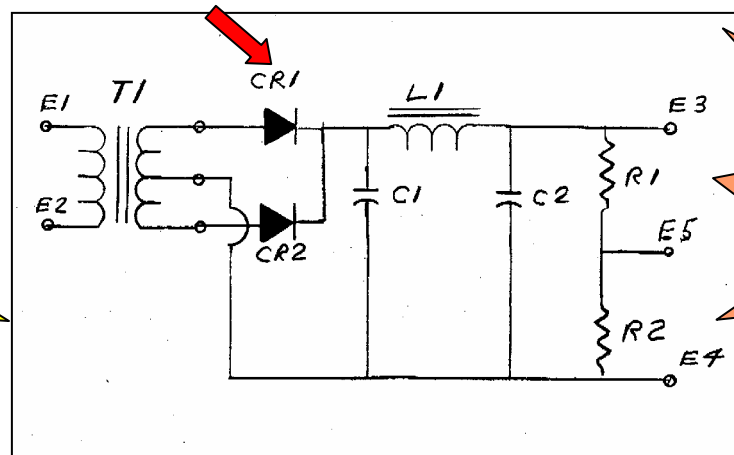
Krarfnod Mfg Co. - Mfg Bill of Material - Sheet 1 of 1 as of: 950715

Part No: A2874756-002 Desc: Pwr Supply 15V 20A Rev: F
 Lot Size: 1500 Lead Time: 10 Days Planner: Joe Knarf

Item	Ref	Part No	Rev	Description	Qty	UM	Eff
1	A1	A2874756	C	PC Card Power Supply	1.0000	EA	950105
2	C1	12345	A	Cap Tant 25MF, 20 V	1.0000	EA	960102
3	C2	28475		Cap Tant 50 MF, 20 V	1.0000	EA	000000
4	CR1	79687		Diode Rectifier 30A 200V	1.0000	EA	000000
5	CR2	79687		Diode Rectifier 30A 200V	1.0000	EA	000000
6	E1	48576		Terminal Swage 0.125D 0.5H	1.0000	EA	000000
7	E2	48576		Terminal Swage 0.125D 0.5H	1.0000	EA	000000
8	E3	48576		Terminal Swage 0.125D 0.5H	1.0000	EA	000000
9	E4	48576		Terminal Swage 0.125D 0.5H	1.0000	EA	000000
10	E5	48576		Terminal Swage 0.125D 0.5H	1.0000	EA	000000
11	L1	68473	C	Swing Choke 25H, 25A	1.0000	EA	950725
12	R1	94375-004		Res Fixed WW 1000 20W 5%	1.0000	EA	000000
13	R2	94375-007		Res Fixed WW 2500 20W 5%	1.0000	EA	000000
14	T1	68794	B	Xformer 115/27V 300W	1.0000	EA	960602
15	1	57682		Assembly Dwg	A/R	EA	000000

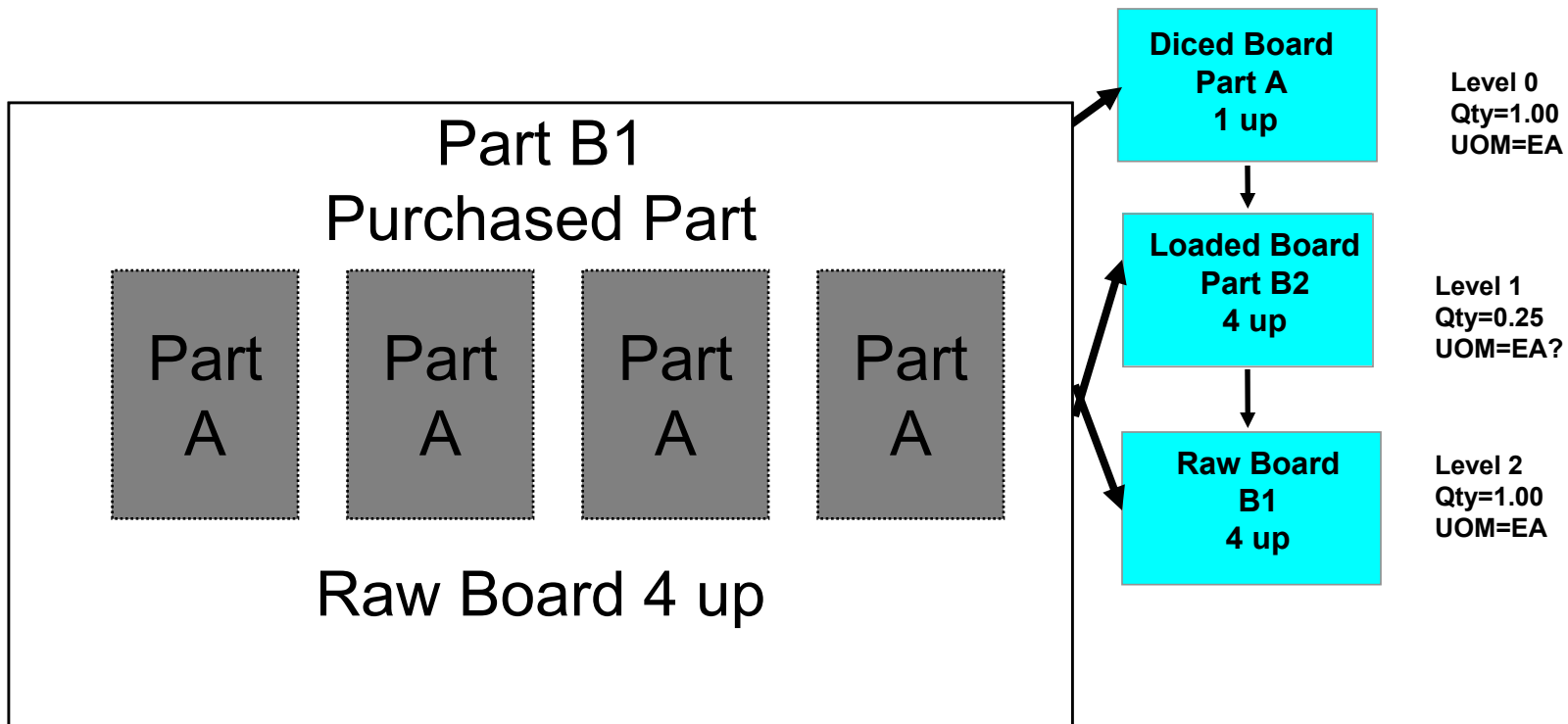


Links Dwg,
Schematic
and Parts List

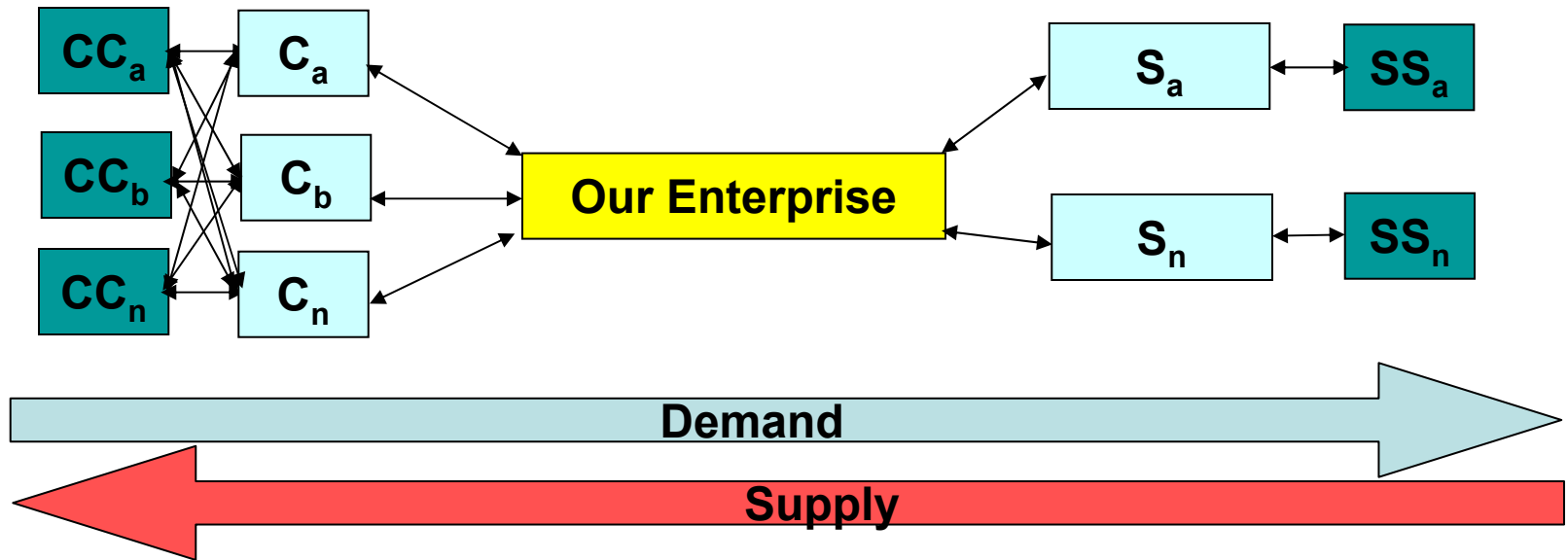


Is there
another Bill of
Material
here?

Panelized Circuit Card UOM Issue



The Total Supply Chain



**Whose Master Schedule should we use?
Who controls the product configuration**

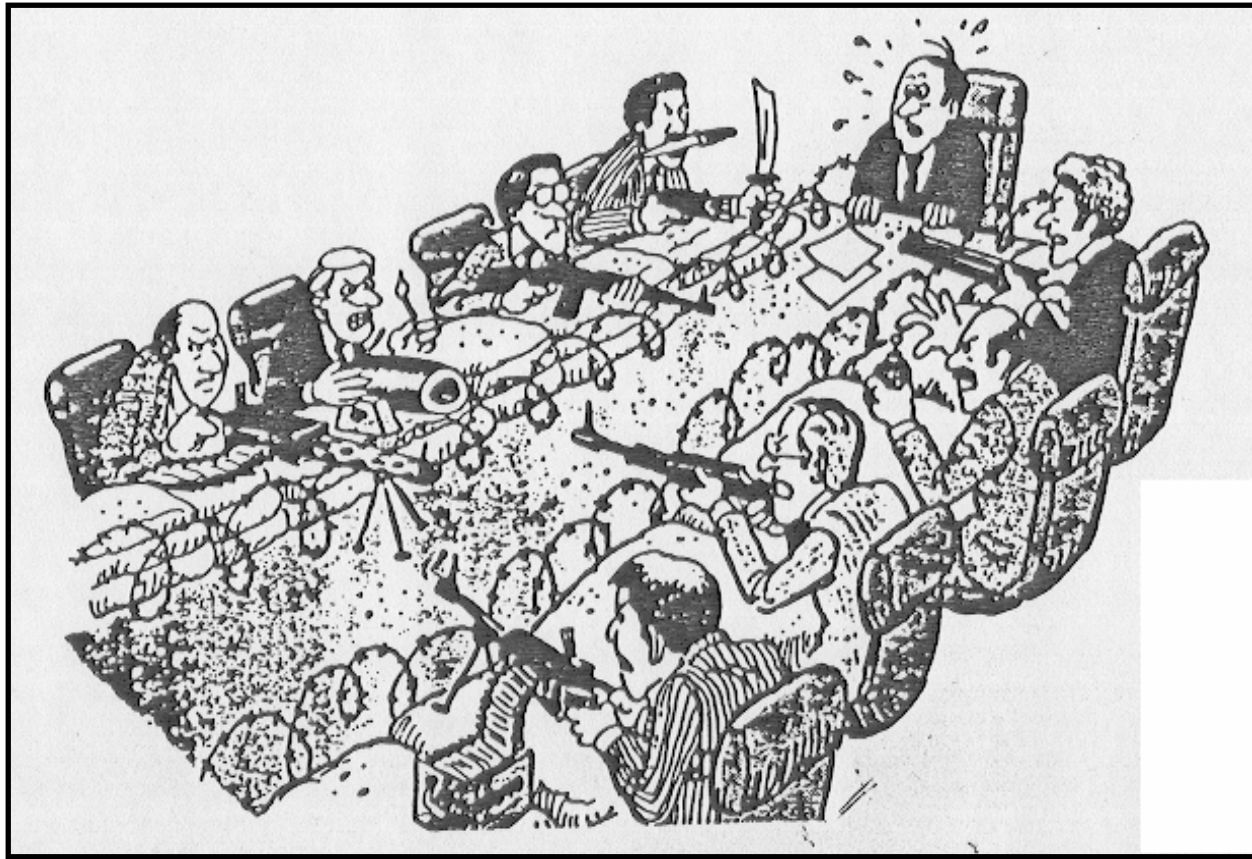
C = Customer
CC = Customer's Customer
S = Supplier
SS = Supplier's Supplier

Conclusions

The Old Way



How We View Each Other



Quick BOM Quiz

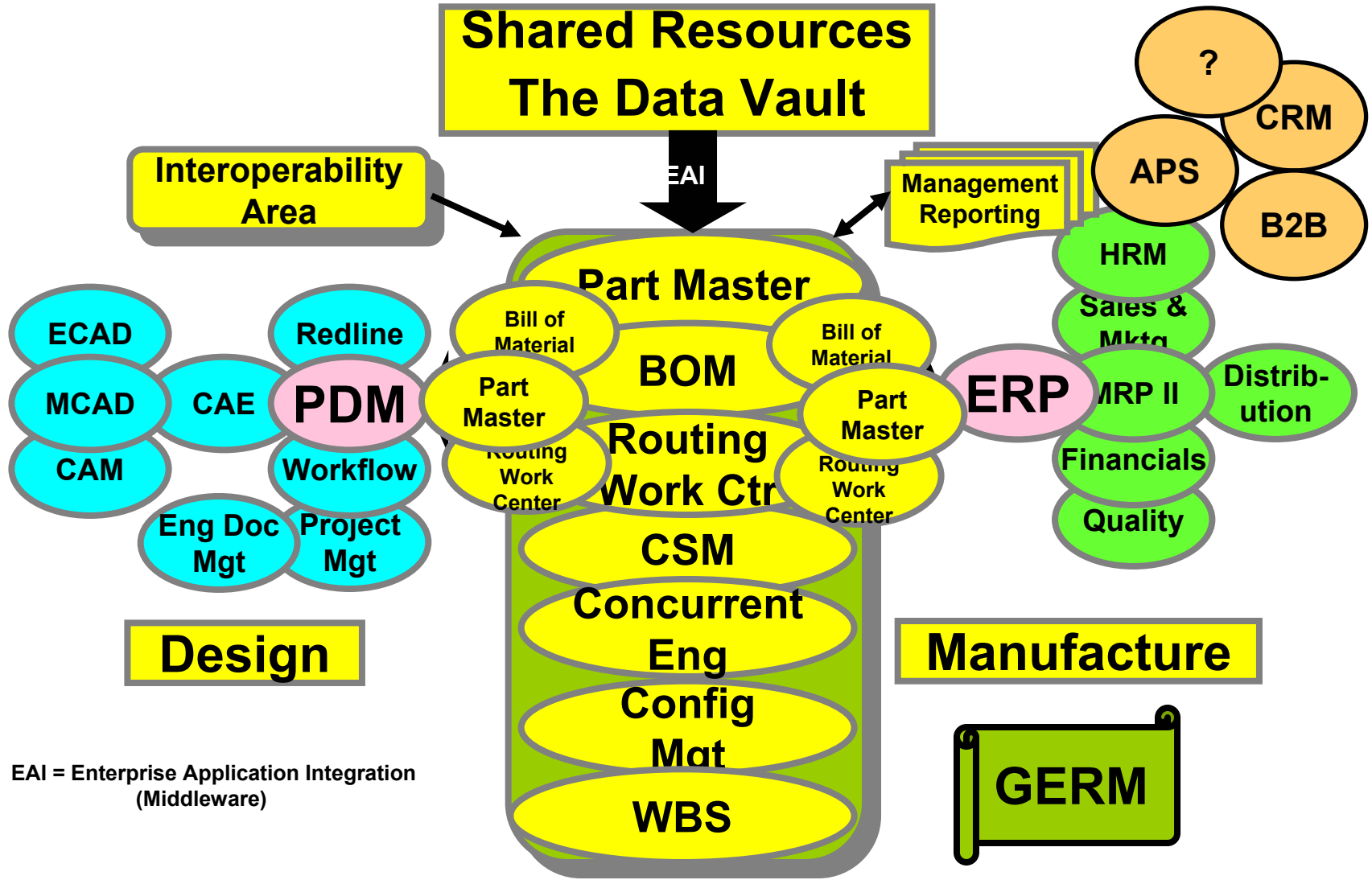
- How many bill of material systems do we have?
- How many bill of material systems do we need?

The View from the Foxhole

***Oh EBOM is EBOM and MBOM is MBOM,
and never the twain shall meet,
Til Earth and Sky stand presently at God's
great Judgment Seat;
But there is neither Designer or Planner,
border, nor breed, nor birth,
When two strong [people] stand face to
face, though they come from the ends of
the earth!***

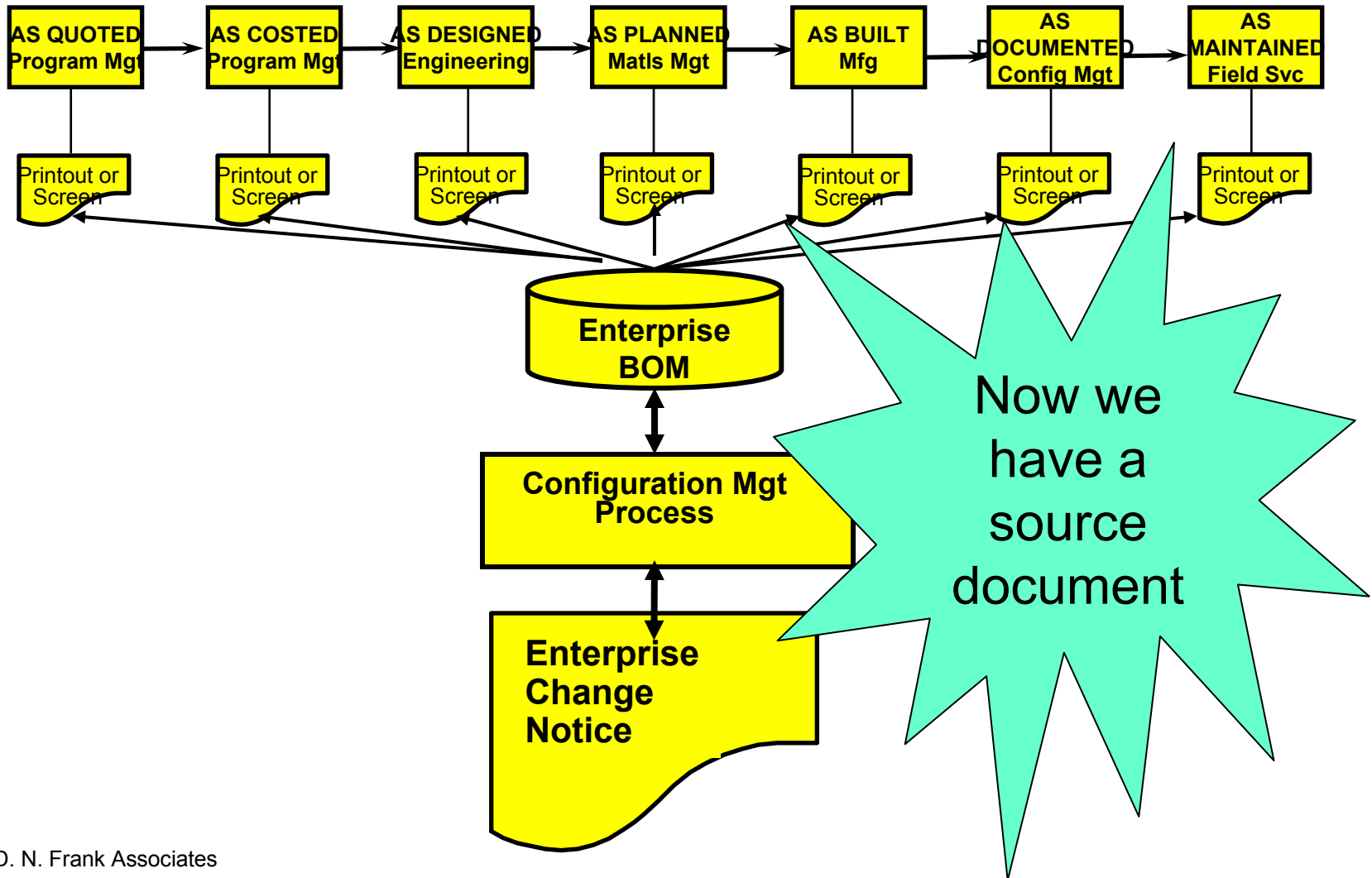
Stolen from Rudyard Kipling's
Ballad of East and West

The Enterprise View Phase II



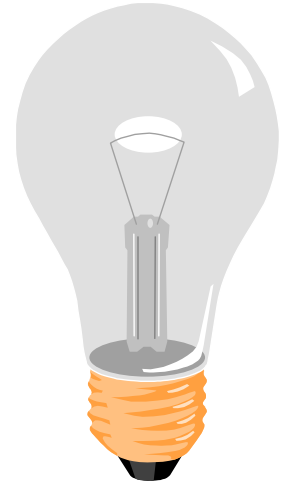
EAI = Enterprise Application Integration (Middleware)

Now who owns the Configuration



The Germ of a New Idea

- Understanding ERP is not enough
- Doing Concurrent Engineering is not enough
- Understanding PDM is not enough
- Understanding SCM is not enough
- These initiatives are only parts of the 21st century unified approach



Global Enterprise Resource Management
A New FLA

Prerequisites

- Engineering
 - Accept the Single BOM concept
 - Assume cradle to grave data integrity responsibility
 - Understand configuration management implications on the Master Schedule
 - Willingness to be an enterprise team player
- Manufacturing
 - Accept the single BOM concept
 - Participate in configuration management activities
 - Understand Master Schedule implications of configuration management
 - Willingness to be an enterprise team player
- Management
 - Be the champion of the GERM process

Ten Steps to the Single BOM

1. Understand that the design objective is to provide effective documentation for manufacturing
2. Manufacturing and planning participate in the design process
3. Document the bills of material into the manufacturing database
4. Use the master schedule to show design status
5. Start “As-Planned” early in the design process

Ten Steps to the Single BOM (con't)

6. Document the design for manufacturing the first time out
7. Use the Single BOM to capture drawing numbers and revision status
8. Use the Single BOM to maintain the “As-Something” status
9. Use the Single BOM for customer and/or Government reporting requirements
10. Use the Single BOM as the catalyst for engineering/manufacturing integration

A Final Thought

- If we consider the bill of material as a living document that migrates from one phase to another,
 - We could measure the quality of the quotation against the accepted configuration
 - We could measure the quality of the design against manufacturing being able to build from the engineering documentation ... directly
 - We could measure manufacturing performance against the baseline configuration
 - We can capture the “as-maintained” and compare to any “as-built” for effective maintenance and upgrade
 - We could measure the enterprise performance against what the customer really wanted

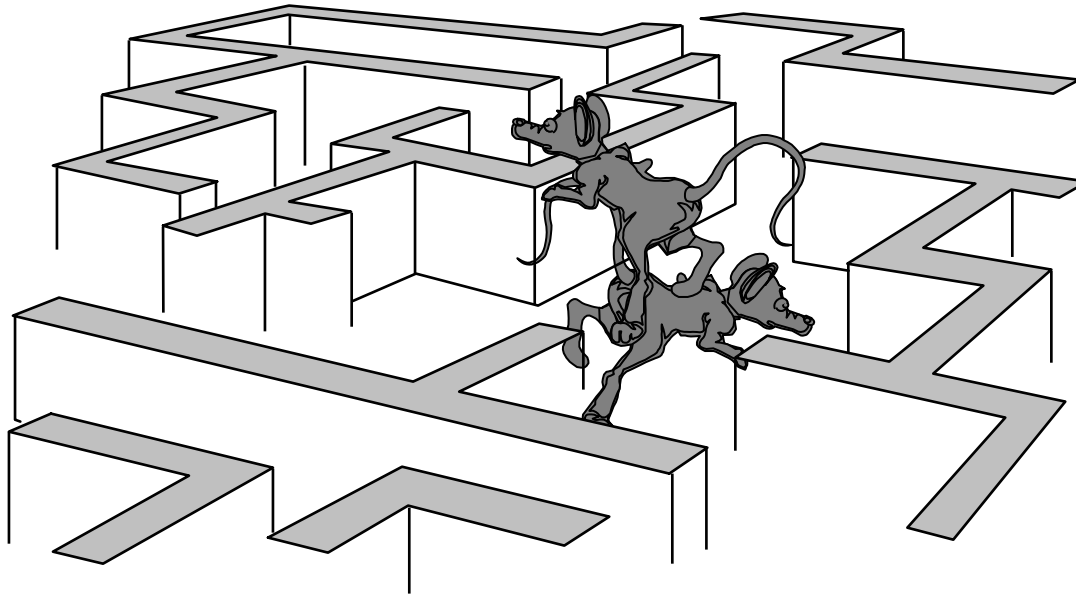
40

~~35~~

In over ~~25~~ years, I've never found
a real reason for more than one
Bill of Material system

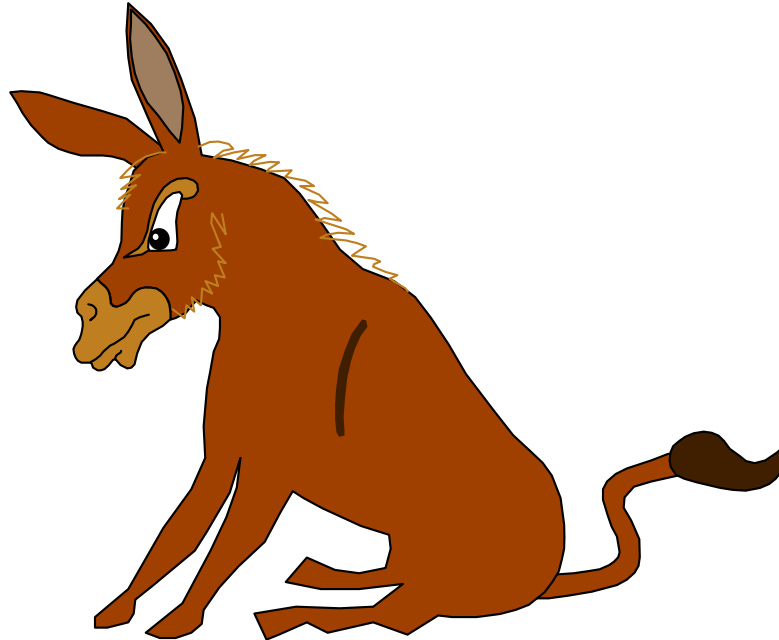
Frank's 15th Law

The New Way



Teamwork produces a'mazing results

The Kiss Principle



**If your solution is overly complicated ...
You probably do not understand the problem**

BOM System Evaluation Quiz

Score 1 to 5, where 5 is high

- Does your BOM system meet real needs**
- Is it simple and easy to understand**
- Does it have flexibility for future growth**
- Does it really describe the manufacturing process**
- Are BOM functions & responsibilities focused**
- Is there good feedback of BOM effectiveness**
- Is the BOM a good communicator of information**
- Is BOM maintenance simple and effective**
- Is the BOM System cost effective**
- Does Management participate in BOM decisions**
- Is there only one enterprise BOM system**

**Email responses to dfrankasso@optonline.net
I'll share results with all responders**

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Questions?

**Thank
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