



# Cost Estimating and Management in Virtual Manufacturing Networks

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SCEA-ISPA June 2007



# Agenda

1. Virtual Manufacturing Networks
2. Legacy Part/Assemblies
3. Manufacturing Launch of New Products or Manufacturing Processes





# Virtual Manufacturing Network

Network-Centric Manufacturing Enterprise:

*"a loosely coupled enterprise, which is formed by many partners (whole or parts of real companies) enabling a group of individual real enterprises to operate more efficiently and effectively, as if it is a single global enterprise to fulfill a specific mission".*

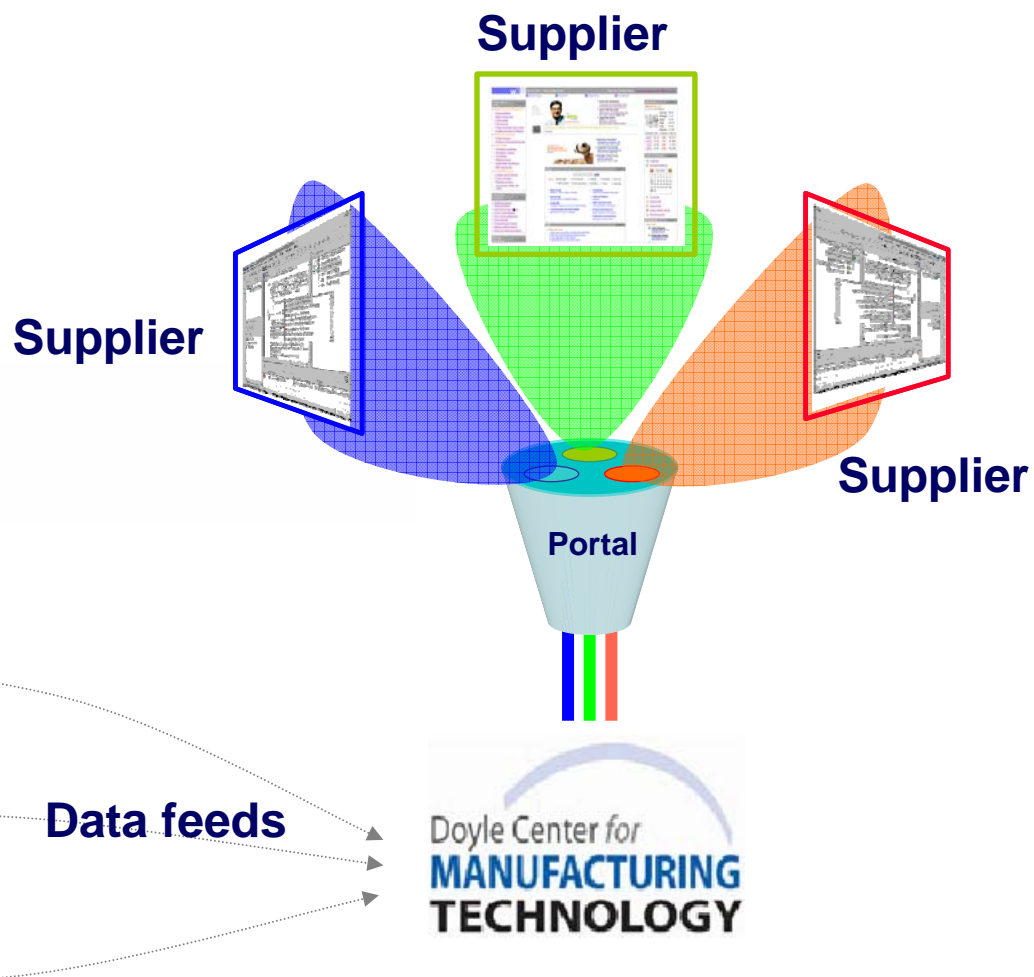




# Network Collaboration Portal

## Supply chain information synchronization:

- Data is fed to the Doyle Center from supply chain partners.
- Data is accessed through the Doyle Center Portal.
- Supply chain partners see permission driven views.





## Supplier Proprietary Info

- DCAA overheads and rates
- Identities of some sub-tier suppliers
- Details of manufacturing process
  - Process sequence and some process parameters
  - Direct and indirect materials
  - Production equipment
  - Tooling
  - Process limits
- Some derived specifications





## Legacy Parts Problem

- Out of production (legacy) equipment still in use in the field by the DoD, but no longer supported by the original manufacturer (OEM)
- Surge in demand depleted inventory
- Procurement and supply base at capacity
- Result: lead-time and cost for spares are excessive







## Recommended Solutions

- GAO recommends that DoD (GAO-07-281)
  - Set lead time reduction goals and measure progress
  - Report on cost and financial impact of initiatives to reduce lead times
- Recommended approaches
  - Streamline administrative processes
  - Improve oversight
  - Develop joint strategic relationships with suppliers





# Virtual Manufacturing Network Solution

- Streamline administrative processes
  - Web portal to support workflows
  - Reduce duplication of efforts
  - Blanket purchase orders
- Improve oversight
  - Portal transaction visibility and archive
  - Business intelligence dashboard for metrics
- Develop joint strategic relationships with suppliers
  - Suppliers pre-qualified by capability and capacity
  - Manufacturing networks assembled of suppliers providing manufacturing services







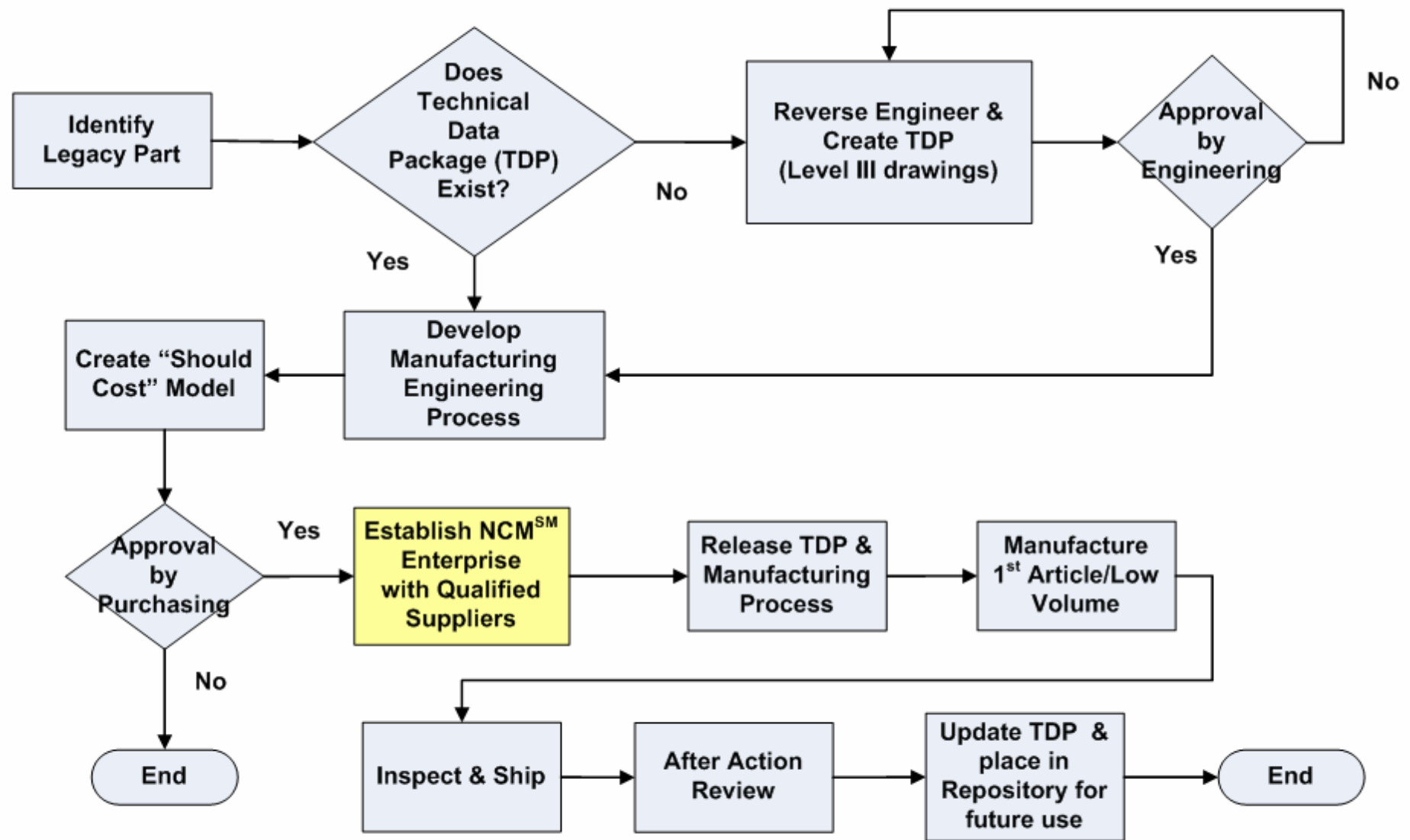
## Rapid Response Solution Components

- Business process to reverse engineer hard to source parts resulting in
  - technical data package
  - manufacturing process
  - “should cost” model
- a pool of qualified suppliers, organized into a NCM<sup>SM</sup> enterprise





## Proposed Rapid Response For Legacy Parts Model





# What is technical data?

- Technical data packages
  - All applicable drawings, associated lists, specifications, standards, performance requirements, quality assurance provisions, and packaging details necessary to support an acquisition strategy and ensure the adequacy of item performance.
- Technical manuals
  - Publications that contain instructions for the installation, operation, maintenance, training, and support of weapons systems. A maintenance technical manual normally includes maintenance procedures, parts lists or parts breakdown, and related technical information or processes.



## Technical Data Package (TDP)

- Typical Legacy Data Challenges
  - Flat folder with hundreds of documents
  - Drawings, BOM, specifications
  - Drawings often scanned images with hard to read notes
  - Suppliers of parts may be out of business
  - Parts may be obsolete
  - Questions to prime/agency customer may take long time to answer
- Every bidder must re-build the TDP to create bid
  - Adds cost and time to process
- Proposed Solution
  - Professional engineering services firm to create single TDP in neutral formats





# Long Term Data Retention

**At least three technology life cycles must be considered:**

## Product

The products defined by the design data  
(50+ yrs)

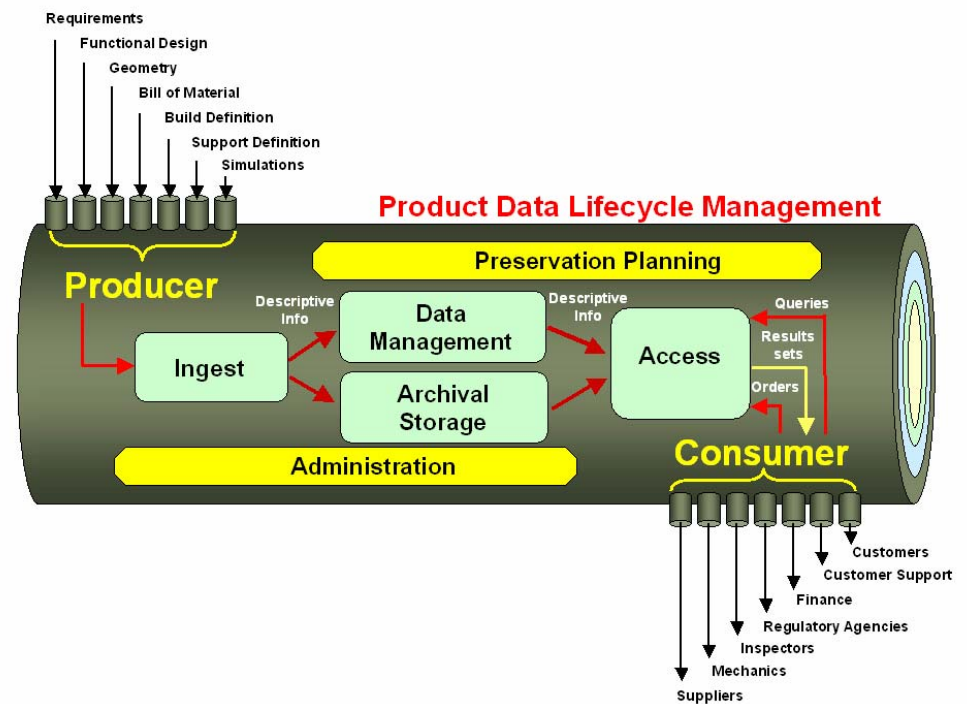
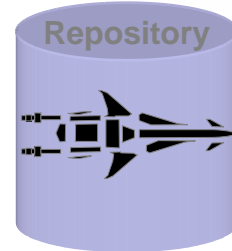
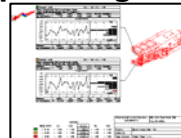
## Storage

The technologies used to store & retrieve the digital data  
(~10 yrs)

## Applications

The technologies used to interpret the data  
(~3 yrs)

Engineering Release  
(Type Design Data)



Source: AIA





## DoD and ISO 10303 STEP for Technical Data

- Kenneth Krieg, US Under Secretary of Defense for Acquisition, Technology and Logistics (DoD USD ATL)
- Memorandum "Standard for the Exchange of. Product Model Data (STEP) --- ISO 10303", June 23, 2005
- Recommends:
  - Implementing an approach for managing digital product/technical data across DOD
  - Ensure product model data meets ISO STEP requirements
  - Adoption of ISO 10303 to enhance interoperability
  - Ensure procuring activities plan, purchase and accept delivery of product/technical data only in digital formats specified by the Guidance on contracts awarded





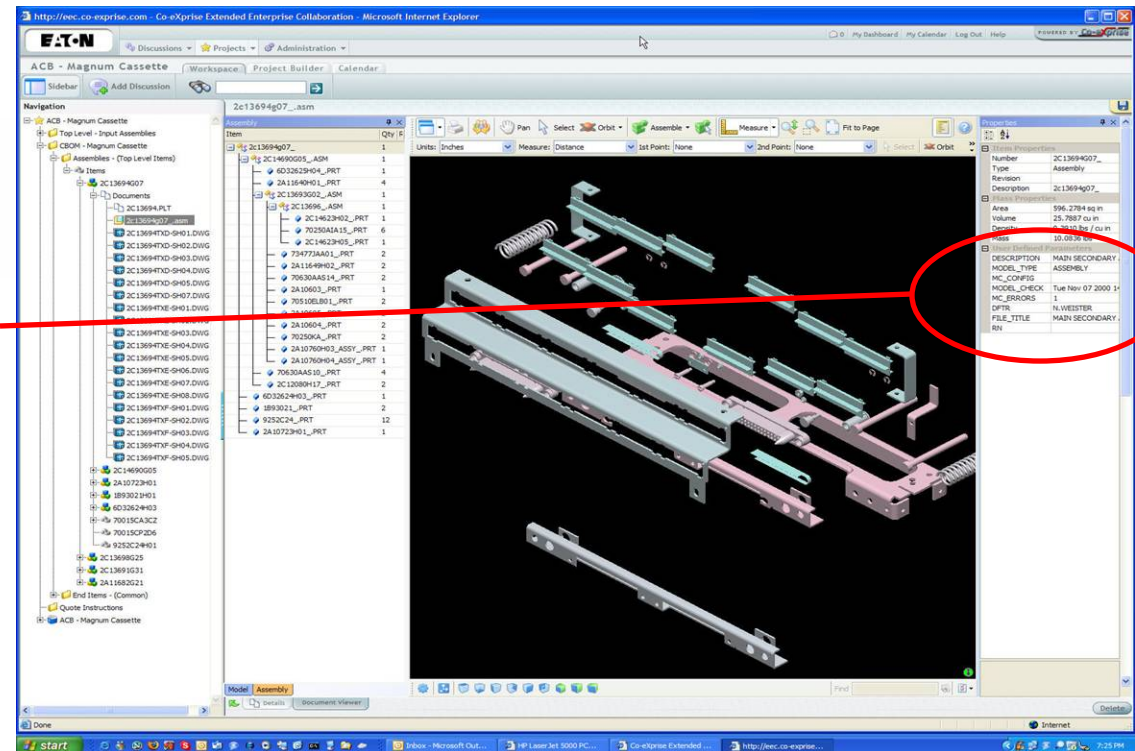


# TDP and Sourcing Management

## Co-eXprise's Extended Engineering Collaboration (EEC)

### •Capabilities

- Web-based
- Parts & assemblies
- Parameter templates
- CAD conversion
- Viewing
- Secure access
- Message threads
- Project management



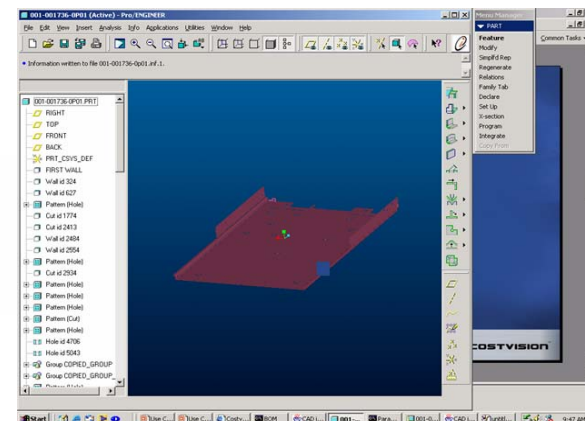


# Reverse Engineering the Product

## CostVision's Cost2Target

- CAD Integration

- Extract parameters
  - dimensions
  - tolerances
  - properties
- Filter and map to cost drivers



- Part/Assembly Specifications

- From CAD or EEC templates
- Derived specifications

Description	Specification	BOM	BOM Explore	BOM Material Cost	Estimate Cost
Parameter					
Name	Variable Name	Value	Unit		
area	area	28	mm^2		
diameter	diameter	120	mm		
height	height	6	mm		
length	length	height + thickness	mm		
thickness	thickness	1	mm		









1. Click add new to add rows to the table, then type the parameter information directly into the table.
2. Drag in existing parameters from the global parameters folder in the data menu.
3. Delete parameters from the table by right clicking and selecting delete parameter.





# Bill of Materials

- BOM
  - Raw Materials
  - Components
  - Supplier Parts/Assemblies

Description	Specification	BOM	Configuration Matrix	ECO	Add Alternate Part	Estimate Cost	Report Configuration	Report		
BOM  										BOM Status:Open
<input type="radio"/>	Name	Material	Required	Config	Qty per	EUOM	Effective	Make	Unit Cost	Material Cost
<input type="radio"/>	Rings Nozzle	Rings Nozzle 	Yes 	<input checked="" type="checkbox"/>	1	Ea	12/13/200	M	1464.59	1464.59
<input type="radio"/>	Honeycomb	Honeycomb Panels Nozzle 	Yes 	<input checked="" type="checkbox"/>	2	Ea	12/13/200	M	3336.13	6672.26
<input type="radio"/>	Sheet Metal	Sheet Metal Throat 	Yes 	<input checked="" type="checkbox"/>	1	Ea	12/13/200	M	1990.81	1990.81
<a href="#">Add New</a>										
<div>1. <a href="#">Click add new to add rows to the BOM table,then type item information directly into the table.</a></div> <div>2. <a href="#">Drag in existing materials and components from the data menu into the BOM table.</a></div> <div>3. <a href="#">Delete BOM items by right clicking and selecting delete item.</a></div> <div>4. <a href="#">Create a configuration of the bom by entering the configuration name in the configuration name field,entering a part number then clicking the Save</a></div>										

- Material Library
  - Suppliers
  - Volume pricing
  - Lead times
  - Price schedules
  - Landed costs

Description	Parameter	Material Schedule
Material Schedule - Calibre		
Supplier:	Dow ▾	<a href="#">Add Suppliers</a>
Lead Time Unit:	Week ▾	
<input type="radio"/> Monthly <input type="radio"/> Quarterly <input checked="" type="radio"/> Yearly		
Year	2002	
Volume (ea)	Unit Price (\$/ea)	Lead Time
5,000.00	0.0400000	5.00
25,000.00	0.0300000	5.00





# Reverse Engineering the Process

- **Standard Process Library**

- IE time standards
- MIL-STD +/-5% accuracy
- Mech., Elec., Assembly

- **Build Process Flow**

- Steps, yield, scrap
- Labor, tools, equipment
- Store in library



Process Flow Table					
Process Flow Name: simple round process					
Efficiency: 100 %					
	Operation Name	Adjustment Factor	Yield	Scrap(%)	Labor
1	cut rod		1	.00	Sawing and Cutting
1.1	Setup			.00	
1.2	Load bar, angle, pipe on side table	1/Product_Num		.00	
1.3	Vise, tighten and loosen on stock, position stock against stop			.00	
1.4	Start and stop blade			.00	
1.5	CRS material abrasive sawing	1		.00	
1.6	Position and clear coolant line			.00	
2	grind rod		1	.00	Sawing and Cutting
2.1	Setup			.00	

1. Enter new process information into the table directly or drag operation elements and single operations from the data menu.
2. Drag an existing process flow into the table and edit it as needed.
3. Click the process viewer tab to view a graphic representation of the process flow and create macros.





# Should Cost Analysis

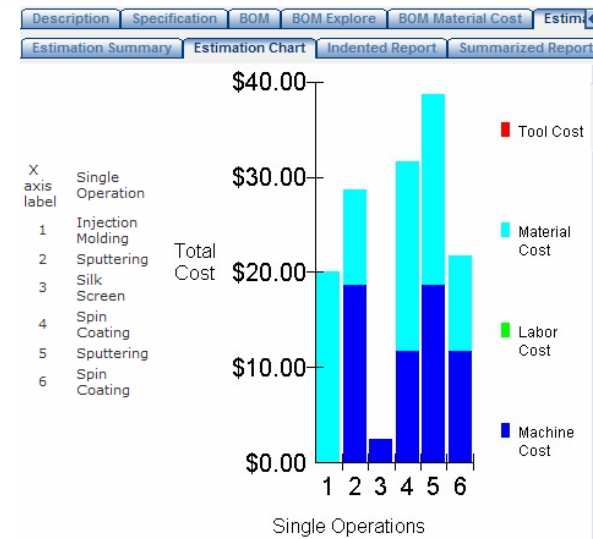
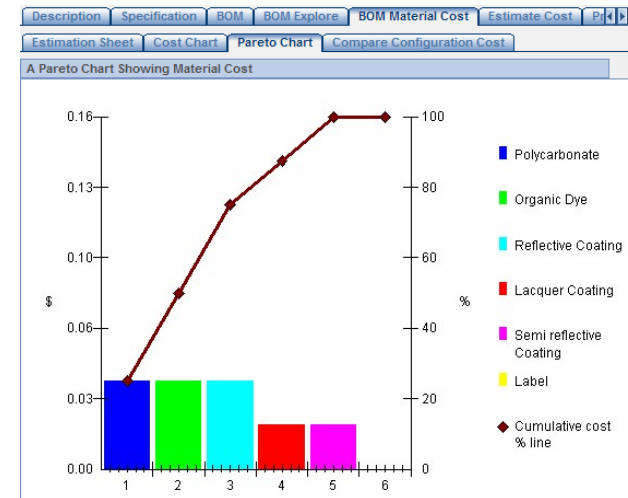
- Compare different manufacturing approaches

**BOM**

- Volume
- Cost
- Lead-time

- Select approaches that meet program and war-fighter needs

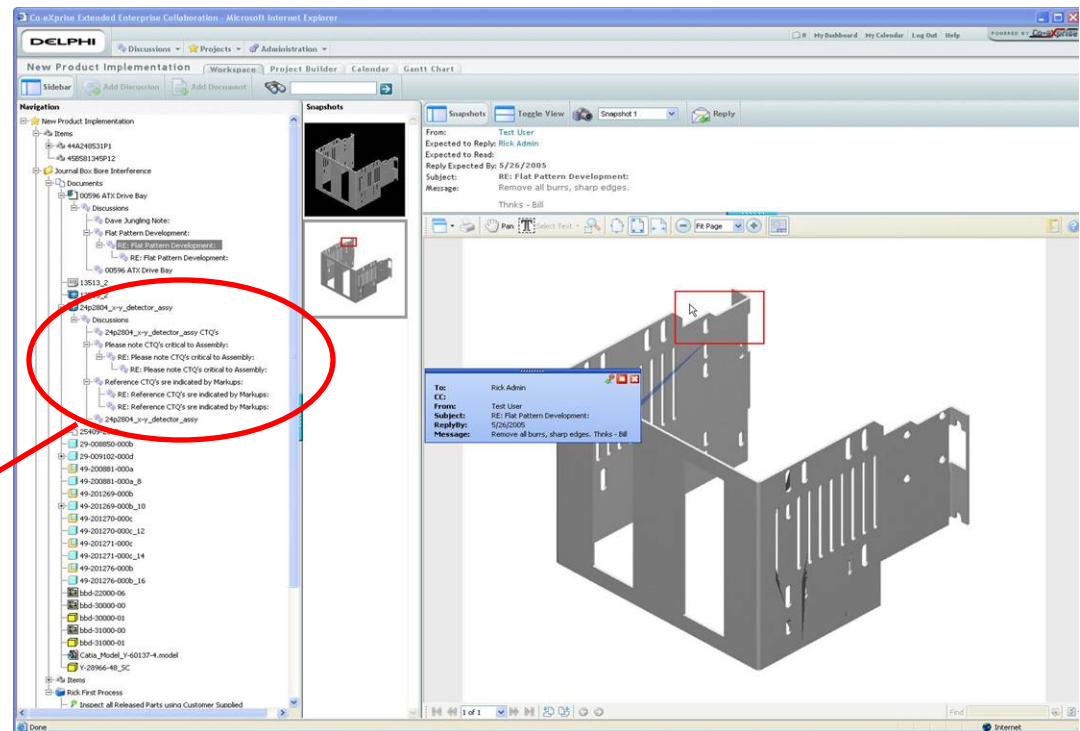
**Process**





# Buyer RFx Management

- Database of suppliers with pre-qualified process capabilities and histories
- Send out TDP for supplier quoting
- Collaboration tool manages clarification messages and discussions







# Supplier Quote Management

- Access TDP to qualify opportunity
- Clarifications through portal
- Supplier proprietary information
  - Labor, machine, material, overhead rates
  - Process set-up/cycle times, yield, scrap, tooling

A screenshot of a web-based form titled "Single Operation Description". The form has a header with tabs: "Description", "Operation Sequence", "Operation Tools", "Parameter List", "Resource", and "Estimation Cost". The "Description" tab is active. The form contains several input fields and dropdown menus:

- "Process Family:" with a dropdown menu showing "Molding Machines".
- "Process:" with a dropdown menu showing "Thermoplastic Injection".
- "Name: \*" with a text input field containing "Injection Molding".
- "Yield: \*" with a text input field containing "0.989".
- "Material Scrap Rate: \*" with a text input field containing ".00" and a "%" symbol to its right.
- "Time Calculation:" with two radio buttons: "Input Time Directly" (unselected) and "Calculate Time" (selected).

- Manage quoting and discussions with second tier suppliers





## Business Intelligence / Supply Chain Visibility

- Key Performance Indicators (KPI)
- Performance to schedule
- Inventory velocity (RM/WIP/FG)
- Quality (Scrap, work on quality hold)
- Performance to cost targets (Actual unit cost)
- Supplier scorecard



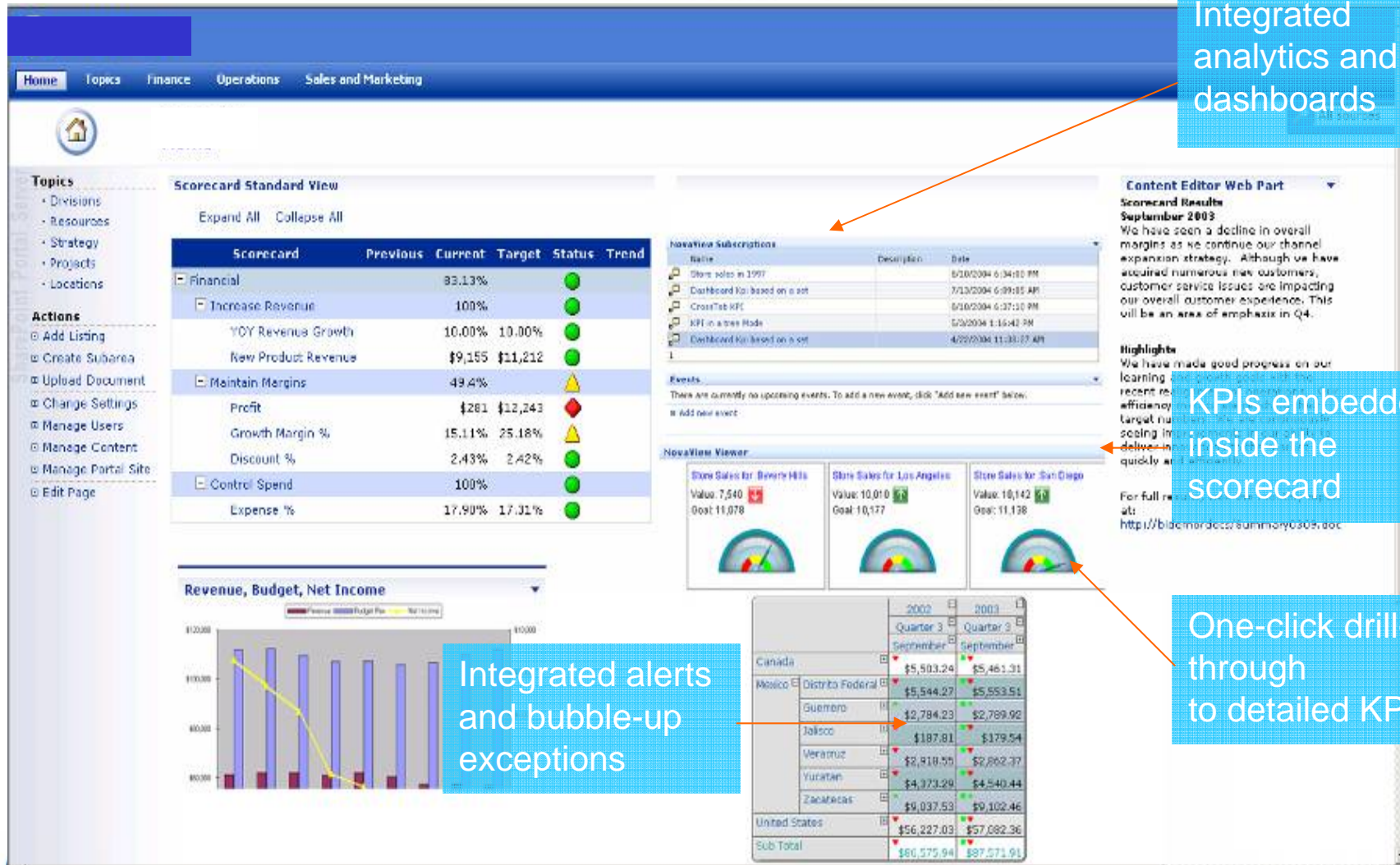
# Business Intelligence

Integrated  
analytics and  
dashboards

KPIs embedded  
inside the  
scorecard

One-click drill-  
through  
to detailed KPI

Integrated alerts  
and bubble-up  
exceptions





## Total Solution Benefits

- Delivers legacy parts at the desired mix of cost and lead-time
- Streamlined administrative processes
  - Eliminates duplicative efforts
  - Creates a technical data package that can be stored for future use
- Improves oversight
  - Portal visibility and archive to transactions
- Establishes joint strategic sourcing relationships
  - Provides an expanded pool of pre-qualified suppliers
  - Fosters collaboration across the supply chain
  - Applies to all types of parts, assemblies and processes







# Manufacturing Launch





## Sources of Innovation

- Performance of DoD systems driven by innovations (materials, mfg processes, IT)
- Corporate R&D labs are focused on sustaining innovations
- Small businesses develop primary disruptive product/process innovations
  - Universities have limitations for military & security
    - International Traffic in Arms Regulations
    - Foreign graduate students in science and engineering
  - Commercial Venture Capital (VC)
    - After technical risk has been mitigated
  - DoD Small Business Innovative Research (SBIR)
    - High technical risk







# Manufacturing Transition

- How does an organization that has never manufactured in volume plan to?
  - Transition to contract manufacturer
  - Build up internal capability
  - Strategic partner
- Producibility and affordability are secondary to performance and evaluated too late





# Commercialization Failure

- Phase II Small Business Innovative Research (SBIR) grantees survey
  - National Science Foundation in 2006
- Open ended question
  - Why was commercialization unsuccessful?
- Most common response
  - Product or mfg process not cost competitive





# Manufacturing Readiness Tools

- MRL 3 Process Flow Chart
  - Identify cost drivers with initial cost models
- MRL 4 Detailed Process Flow
  - Key manufacturing processes with detailed costs
- MRL 5 Value Stream Map (VSM)
  - Current state cycle times, capacities and waste
- MRL 6 Simulation Models
  - Initial simulation of current state, VSM future states
- MRL 7 Simulation for improvements
  - Determine bottlenecks, cost reductions





# MRL Matrix Criteria

MRL Thread	Sub-Thread	MRL 5	MRL 6	MRL 7
<b>Engineering</b>	Producibility Program	Initial producibility of technology completed (components).	Initial trade studies conducted - performance vs. producibility.	Producibility enhancements have begun (i.e. DFMA).
<b>Program Management</b>	Cost- Weapon System Level	Manufacturing costs considerations affect technology choices and development.	Evaluation performed on subsystem DTC goals to show that they are achievable.	Detailed production cost estimates established.
<b>Manufacturing</b>	Modeling and Simulation (Production Line)	Production simulation software identified	Initial production line simulation models developed	Simulation models used to determine bottlenecks and improve process.

- The models and simulations for the MRL threads are inter-dependent.
- Models belong to different organizations in the extended enterprise.
- For simulation based acquisition, models must be integrated.



## Summary

- Costing is a critical function of Virtual Manufacturing Networks
- Legacy parts need should-cost models for buyers and suppliers
- Manufacturing launch of new products/processes needs costing for feedback

