Product Lifecycle Management Overview

Purdue University PLM Center of Excellence
Rex LaRowe, Director - Manufacturing Industry Framework
Agenda

- Introductions
- Definition of PLM
- The Problem
- EDS’ Approach
- Suggestions for PLM Center of Excellence
- Discussions
Product Lifecycle Management (PLM) Definition

PLM is defined as:

- A strategic business approach that applies a consistent set of business solutions that support the collaborative creation, management, dissemination, and use of product definition information
- Supporting the extended enterprise (customers, design and supply partners, etc.)
- Spanning from concept to end of life of a product or plant
- Integrating people, processes, business systems, and information

PLM is not a definition of a piece, or pieces of technology.

Source: CIMdata
Fundamental Concepts of PLM

- Universal, secure, managed access and use of product definition information
- Maintaining the integrity of that product definition and related information throughout the life of the product or plant
- Managing and maintaining business processes used to create, manage, disseminate, share and use the information.
The Scope of PLM

Plus the engineering business systems to make the PD process work with the rest of the company
The Challenge for PLM
It has been difficult to document impact of PLM on companies financial performance

This example opportunity and gap analysis identifies the specific operations improvements and associated opportunities.

<table>
<thead>
<tr>
<th>Financial Statements</th>
<th>Opportunity</th>
<th>Operations Improvements</th>
</tr>
</thead>
<tbody>
<tr>
<td>Income Statement</td>
<td>Sales</td>
<td>Increase in revenue</td>
</tr>
<tr>
<td></td>
<td>COGS</td>
<td>Unit Cost reduction</td>
</tr>
<tr>
<td></td>
<td>SG&amp;A</td>
<td>Reduction in SG&amp;A</td>
</tr>
<tr>
<td></td>
<td>R&amp;D and Engineering</td>
<td>Reduction in engineering costs</td>
</tr>
<tr>
<td></td>
<td>Materials and Supplies</td>
<td>Sourcing component standardization</td>
</tr>
<tr>
<td></td>
<td>Fixed Assets</td>
<td>Reduce capital expenditures</td>
</tr>
<tr>
<td></td>
<td>Accounts Receivable</td>
<td>Working Capital</td>
</tr>
</tbody>
</table>

Source: EDS/A. T. Kearney - Confidential
Technology Modernization

The technology modernization process enables the transformation from the function specific applications and data stores to an enterprise view of data and a services-based approach toward business applications.

The “Re-” steps used modernize the technology set the foundation for a services approach toward the technology layers of an organization’s solutions.
Levels of Optimization

**Level 1 - Siloed Optimization**
- Business processes are optimized and work well during normal operations. “Like” operations require duplicative systems and data.

**Level 2 - Aggregated Optimization**
- Business processes are grouped together to reduce duplication; and work well during normal operations. Does not solve enterprise investment & irregular operations issues.

**Level 3 - Cross Functional Optimization**
- Business processes are grouped together; data is shared in context of the business situation. The customer & supplier views are optimized as well as the internal business structures.
There are several stages of maturity within an product development organization’s IT environment

<table>
<thead>
<tr>
<th>IT Element</th>
<th>Level 1 Initial</th>
<th>Level 2 Repeatable</th>
<th>Level 3 Defined</th>
<th>Level 4 Managed</th>
<th>Level 5 Optimized</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Infrastructure</strong></td>
<td>•Disconnected, slow, narrow pipe</td>
<td>•Area solutions developed to manage increased load</td>
<td>•Regional solutions developed to manage increased, integrated load</td>
<td>•Common architecture developed</td>
<td>•Single common, high-speed, wide bandwidth, high availability, flexible architecture deployed</td>
</tr>
<tr>
<td><strong>Applications Architecture</strong></td>
<td>•Disconnected, uncoordinated, no version control</td>
<td>•Major applications choices limited to a handful</td>
<td>•Applications become more and more integrated – complexity ensues</td>
<td>•Single Bill of IT decided but not totally implemented</td>
<td>•Single integrated Bill of IT with common versioning implemented</td>
</tr>
<tr>
<td><strong>Data</strong></td>
<td>•Individually developed and stored data files, formatted per engineer preference (hard copy included)</td>
<td>•Virtually all data moves to electronic</td>
<td>•File naming conventions promulgated</td>
<td>•File naming conventions, format, storage, retention and availability standardized globally</td>
<td>•Single formatting design, integrated and globally accessible</td>
</tr>
<tr>
<td><strong>Applications development</strong></td>
<td>•CMMi 1</td>
<td>•CMMi 2</td>
<td>•CMMi 3</td>
<td>•CMMi 4</td>
<td>•CMMi 5</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
<td>•Unique ops processes by site</td>
<td>•Each site has documented ops processes</td>
<td>•Common metrics developed and deployed</td>
<td>•Global common processes, tools and metrics developed</td>
<td>•Fully deployed ITIL processes</td>
</tr>
<tr>
<td></td>
<td>•No metrics developed or captured</td>
<td>•Metrics developed at site level</td>
<td>•Tools and processes continue to be site-specific</td>
<td>•Delivery transformation commences</td>
<td></td>
</tr>
<tr>
<td></td>
<td>•No common ops tools deployed</td>
<td>•No common ops tools deployed</td>
<td>•Common metrics developed and deployed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EDS’ Approach
There are natural dependencies in moving towards Level 5 product development IT maturity.

Complex applications and data architecture subverts movement towards an agile and easily maintained base upon which companies can transform critical product development processes.
The journey from the current PLM state and the future has several challenges

**Current State**

- Over 300 Systems
- Requires significant funding
- Has long project lead times
- Subject to inherent risk of large COTS deployments
- Must drive business value along the way
- Requires substantial business involvement
- Balancing global and regional needs

**Challenges**

- Large monolith legacy systems – (over 175 mainframe apps)
- Regionally developed systems with hardwired business rules
- Partially rationalized Bill of IT, Bill of Architecture, Bill of Infrastructure
- High degree of uptime but costly to change

**Future State**

- Under 20 Systems
- Global, standard solutions
- Primarily COTS based systems based on industry best practices
- Highly rationalized Bill of IT, Bill of Architecture, Bill of Infrastructure
- High degree of uptime and minimal cost to change

Actual client example
EDS has learned that comprehensive portfolio transformation requires a long term view and some guiding principals to be effective

- **Client Ownership** - The client must take ownership and drive the transformation

- **Global and Common Processes** - IT is the key enabler. IT transformation must be focused on driving globalization while balancing key regional needs

- **Agility is the name of the Game** – Creating an agile IT environment (SOA – A3) is the foundation for driving and keeping complexity out of the IT portfolio.

- **No Quick Fix** - Requires comprehensive approach to the entire IT portfolio (applications, infrastructure, etc.) to effectively transform the IT portfolio to enable business improvements while driving out sustain cost

- **Transformation Roadmap** - A multi-year transformation plan that comprehends all key elements (business, applications, technology, organization and governance) is required to cost effectively transform an IT portfolio

- **IT partner manages the IT transformation** – Portfolio transformation takes time and is most effectively executed by IT vendors
EDS has developed a world-class product development architecture blueprint upon which we base transformations.
What is a Framework?

Available by industry segment, EDS’ **Industry Frameworks** are the lens through which we analyze the current state and chart the course to the future state. EDS’ Industry Frameworks help **chart the path for transformation**.

A successful framework... **DEScribes** what changes are needed. **PREscribes** how the changes should occur.
What is a Framework? (cont’d)

In short, we’re trying to assess and describe how to make change happen for our customers within the context of their competitive world.
How does a Framework guide the process?

We have an evolving view of how to engage in the transformation process with our customers. Industry Frameworks help accelerate existing approaches.

[Diagram: Agile RightStep Framework]

**Discover**
- Enterprise Priorities

**Assess & Align**
- Current Reality, Future Direction

**Action**
- Design
- Develop
- Implement
- Operate

**Modernise**
- Design
- Develop
- Implement

**Manage**
- Operate

**Applications Assessments**
- Analyze portfolio & structures
- Create the baseline metrics
- Establish the modernisation roadmap

**Roadmap**

**Applications Modernisation**
- Re-Learn
- Re-Factor
- Re-Host
- Re-Interface
- Re-Architect
- Replace
- Retire

**Applications Management**
- Production Support
- Transition management
- Knowledge Transfer
## Global Manufacturing Trends

### Trends & Implications

**Manufacturing Overall**
- **Globalization for competitive advantage**
  - Pricing pressures / market volatility
  - Customer demands increasing
  - Accelerated product innovation

**Aerospace**
- **Cost reductions & flexibility / visibility of supply chain**
  - Consolidation – M&A of all tiers
  - Fewer and larger customer orders/contracts
  - Product Innovation

**Automotive**
- **Industry consolidation throughout tiered structure**
  - Manage costs to protect margins
  - Improve customer and dealer relations to increase market share
  - Product development and innovation

**High Tech**
- **Reduce time to market**
  - Innovation and growth
  - Manage operational cost
  - Asset productivity

**Industrial**
- **Manage operational cost and flexible supply chain**
  - Asset productivity
  - Reduce time to market
  - Innovate rationally

### Possibilities

- **Integrated, performance-based portfolio planning & execution**
- **Global design acceleration**
  - Reusable designs
  - Inter-connected design centers
  - Complete product visualization
  - Virtual validation & performance simulation
  - Design for manufacturability and service

- **Network based manufacturing**
  - Supply chain integration
  - Asset lifecycle management
  - Performance based operations management

- **Integrated maintenance, repair and service operations**
  - Knowledge enabled maintenance & repair
  - High touch customer experience

- **Digitally connected & synchronized business ecosystem**
  - Information integration
  - Interdependent business processes streamlined for performance

### Solutions

**Marketing & Sales**
- **Design Anywhere**
- **Build Anywhere**

**Integrated Product Development**

**Digital Manufacturing Operations**

**Aftermarket Services**

**Manufacturing Ecosystem**

Detailed TIPS by segment can be found in Appendix B.
There are six core business processes indigenous to a typical manufacturer.

**Manufacturing / Aerospace and Defense / Commercial Framework**

- **L0 1.0 Marketing and Sales**
  - Analyze market demand (VOC), and formulate product/services strategy.
  - Includes long range and product planning, performing market analysis, conducting R&D, managing portfolio & formulating product strategy, and developing operational and implementation plans.

- **L1 2.0 Integrated Product Development**
  - Define the product, processes and services.
  - Design and validate product, processes, and services in preparation for product, manufacturing and aftermarket support.

- **3.0 Manufacturing Operations**
  - Create finished goods, including products, processes, and services.
  - Includes planning and scheduling production, managing supply and in-plant materials, making or assembling the product, supporting production and managing finished goods to the distribution supply chain.

- **4.0 Manage Supply Chain**
  - All product (physical material and service) transactions, from supplier to customer, including developing supply base, identifying sourcing, managing production support and material, managing warehouse & distribution, and conducting supplier & after market support.

- **5.0 Manage Service Chain**
  - Support the product after it is produced. Maintain engineering information, provide for planned and unplanned maintenance. Ensure that the Service Chain supply is managed. Plan and execute warranty programs. Continuously improve the service chain processes through formal review of metrics.

- **6.0 Manage Enterprise**
  - Perform all corporate staff functions including human resources, legal, purchasing, finance, administrative services, public affairs, real estate, business management (corporate planning, governance, program management, organizational effectiveness), and providing information technology and communications.
## Manufacturing Industry Framework Solutions

all solutions impact Automotive, Industrial, High Tech and Aerospace & Defense

<table>
<thead>
<tr>
<th>Manufacturing Industry Solutions</th>
<th>Business Drivers</th>
<th>Solution Components</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Market Analysis &amp; Portfolio Planning</td>
<td>Time to market; Sales Growth; Margins, ROI, RONA; ROE</td>
<td>Product Portfolio Planning</td>
</tr>
<tr>
<td><strong>2</strong> Integrated Product Development</td>
<td>Time to market; Sales Growth; Margins, ROI, RONA; ROE; Product Returns, Customer Satisfaction</td>
<td>Product Lifecycle Data Management; Integrated Product Design &amp; Validation; Product Development Process Management; Collaborative Digital Design; Manufacturing Process Planning; Knowledge Based Engineering</td>
</tr>
<tr>
<td><strong>3</strong> Digital Manufacturing Operations</td>
<td>Margins; ROI; RONA; ROE; SG&amp;A/Revenue, Inventory Turns; Asset Turns; Receivable Turns; DSO, Revenue or Income / Employee</td>
<td>Production Operations; Asset Lifecycle Management; Manufacturing Operations Visibility &amp; Decision Support; Production Support; Supply Chain Operations Support; Supply Chain Warehousing &amp; Distribution</td>
</tr>
<tr>
<td><strong>4</strong> Sales &amp; Aftermarket Services</td>
<td>SG&amp;A/Revenue; Revenue or Income / Employee, Customer Satisfaction, Sales Growth; Margins, ROI, RONA; ROE</td>
<td>In-Service Product Maintenance; Incident Management; Sales Manager; Create Product Demand</td>
</tr>
<tr>
<td><strong>5</strong> Manufacturing Ecosystem</td>
<td>Time to Market; Sales Growth; Product Returns; Customer Satisfaction</td>
<td>Knowledge Center</td>
</tr>
</tbody>
</table>

Detailed Solution Write-Ups in Appendix C
# EDS PLM Solution Suite

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product Lifecycle Data Management</strong></td>
<td>The Product Lifecycle Data Management Solution architects, implements and provides hosting support for As-Designed, As-Built, As-Tested and As-Maintained Bill of Materials that are maintained through a consistent configuration and change management control system. The architecture is scalable to support centralized and decentralized models. The solution includes product data vaulting, engineering release, manufacturing release, aftermarket service release, and integrated configuration and change control.</td>
</tr>
<tr>
<td><strong>Integrated Product Design &amp; Validation</strong></td>
<td>The Integrated Product Design and Validation solution provides mathematical information, engineering analytics and product definition artifacts necessary to more effectively design and validate products. The solution enables product development personnel to initiate design and validation processes including new product development, design review, product validation, configuration management, engineering change management, and design and validation release.</td>
</tr>
<tr>
<td><strong>Product Development Process Management</strong></td>
<td>The Product Development Process Management solution provides a seamless environment (leveraging best-in-breed processes, tools &amp; information) to monitor, control and report product development productivity. Product development productivity is defined by scheduling, standard product development process control, program/project management, and time tracking.</td>
</tr>
<tr>
<td><strong>Collaborative Digital Design</strong></td>
<td>The Collaborative Digital Design solution takes design information including multi-CAD data into a seamless “global secure network” environment that facilitates product and process decision making. The solution provides the basis for bringing together the knowledge, experience and skills of multiple team members, partners, suppliers, and global sites, for idea sharing and decision making that contributes to concurrent business integration. The collaborative environment integrates the processes and tools that connect multi-site Design Centers, and global Design Partners &amp; Suppliers.</td>
</tr>
<tr>
<td><strong>Manufacturing Process Planning</strong></td>
<td>Manufacturing Process Planning solution provides the real-time information, business processes and workflows for manufacturers to digitally design, test and simulate production environments. The solution includes manufacturing data management, visual 3-D design of facilities, tools, equipment and plant layout; material flow optimization; and computer-aided process planning.</td>
</tr>
<tr>
<td><strong>Knowledge Based Engineering</strong></td>
<td>The Knowledge Based Engineering (KBE) Solution provides a hosted environment integrating Computer-Aided Design, Computer-Aided Manufacturing, Computer-Aided Engineering, Computer-Aided Test into an end-to-end process. The solution enables knowledge capture and re-use with specific emphasis in the capture of corrective action. A set of services are provided to customers to support the proper application of KBE software within their business environment.</td>
</tr>
</tbody>
</table>
Suggestions for the PLM Center

- Emphasize cross-discipline teams in a concurrent product/process/service development environment
  - Systems engineering
  - Mechanical engineering
  - Electrical engineering
  - Software engineering
  - Manufacturing engineering
  - Industrial engineering
- Emphasize the link of the student’s individual discipline into the enterprise and the lifecycle of a product/process/services
- Develop the interoperability between tool sets
- Document the impact on a company’s financial performance
Manufacturing Industry Framework

Market Analysis & Portfolio Planning
- Long Range Product Planning
- Conduct Research & Development
- Develop Operational & Implementation Plans
- Perform Market Analysis
- Manage Portfolio & Formulate Market Strategy

Integrated Product Development
- Refine Plan & Define Product/Service
- Validate Product/Service Design to Requirements
- Prepare & Validate In-Service Environment
- Design & Release Product/Process & Service
- Prepare & Validate Production Environment

Manage Enterprise
- Provide Admin Svcs
- Manage Business
- Provide HR Support
- Provide Legal Support

Digital Nervous System


Competitors  Knowledge Databases  As Designed  Process Execution  Inventory  As Built  In-Service Data  As Maintained

Business Plans  Specifications  Product Definitions  Assets  Suppliers  Schedules  Quality  Customers

SCM Gateway  PMO Gateway  PLM Gateway  ERP Gateway  MES Gateway  QMS Gateway  CRM Gateway  MRO Gateway

Manufacturing Operations
- Plan and Schedule Production
- Support Production
- Manage Supply & In-Bound Logistics
- Make or Assemble Products
- Manage Finished Good & Out-Bound Logistics

Sales & Aftermarket Services
- Create Product Demand
- Repair & Maintain Product
- Sell Product
- Diagnose & Manage Incidents

Manage Supply Chain
- Develop Supply Base
- Manage Warehouse & Distribution
- Identify Sourcing
- Conduct Supplier After Market
- Manage Production Support & Material
Enabling the Agile Enterprise

An agile enterprise reacts quickly and transforms based on changing customer demands and market dynamics. Agility must permeate the enterprise's business processes and information technology.

- Enterprises must become agile to respond to market dynamics.
- EDS is committed to building an agile enterprise platform.
- EDS has a defined roadmap to guide you to agility.
- EDS and its partners are uniquely qualified to help organizations become agile.
EDS Core Market Beliefs

Our agile enterprise vision is based on these fundamental beliefs:

1. We believe globalization will continue and innovation at the edge (mobile intelligent devices, embedded smart chips, RFID) will accelerate, changing competitive landscapes.
   In response, EDS is building global delivery consistency with a secure networked infrastructure, "always on" resiliency, scalability/surge capacity, highly distributed data, and event-enabled operations.

2. We believe 40 years of legacy environments won't support the "global/edge."
   In response, EDS is approaching this as the decade for legacy modernization.

3. We believe no single company can do it alone.
   In response, EDS is working with best-in-class partners who have a global footprint and are focused on innovation.

4. We believe where and how work is performed will change.
   In response, EDS is leveraging transformational BPO.

5. We believe our clients and prospects agree with our first four beliefs... and want us to provide them a higher-speed, lower-risk transformational journey.
   In response, EDS is helping businesses and governments on the journey to agility.