Product Lifecycle Management Strategic Initiative

(initial focus on Discrete Manufacturing)

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Siemens Product Lifecycle Software
Contributing Sources

• MESA PLM MSI team
  – Balasubramanian, K - TCS
  – Khoshoo, Raj - Siemens PLM
  – Kulkarni, Prashant TCS
  – Miller, John – Siemens PLM
  – Ohnemus, Thomas - SAP
  – Thalbauer, Hans - SAP
  – Wines, Eric - Cap Gemini

• Sources
  – Aberdeen
  – AMR
  – Capgemini
  – Cimdata
  – Daratech
  – Gartner
  – PDMA
  – MESA
  – U of M
  – John Stark
  – James Morgan
  – Jeff Liker
  – SAP
  – Siemens
  – TCS
  – Volvo
Focus on MESA PLM Guidebook

- Discrete manufacturing initially
- Can extend to other domains based on member interest
- Implementation focus
- Management focus
- The work is by no means done
- Specific detailed topics like DFSS, DFx, Closed Loop, PLM/MES integration, PLM and Quality/Compliance integration could also be good topics for MESA
PLM and MES integration potential

- Extending PLM backbone to integrate with MES
  - Build to package
  - Changes
  - Corrective actions
  - Critical characteristics management
- Design anywhere Build anywhere
- Virtual prove out of the Plant
- Evolve from Emulation to Simulation
- Real time validation of change (any location)
- Front loading process capacity in Product design is essential for design for Six Sigma (DFSS), Dfx
- Stochastic product design
Building a synchronized digital model in parallel to the running plant operations is on its way to become reality.

Synchronized Digital Manufacturing closes the gap between product design and product delivery (manufacturing processes).
Detailed workflows between PLM and MES in an enterprise IT ecosystem lay a foundation of the vision.

Connecting design and production allows upfront simulation still in the engineering phase: Engineering phase.

Within the supply chain, MES is responsible for the deliver-as-promised.

Optimizing design time via a new advanced scheduling paradigm based on the digital plant model.

Realizing the closed-loop solution for an immediate build-in of changes – for highest competitiveness and profitability.
Introduction

– The transformation into lean enterprise requires a second step;

– moving upstream to the development of products and processes.

– As many companies have discovered, there is only so much waste that you can squeeze out of production before the engineering of the products and processes become a critical constraint.

– Indeed, product and process development can have an even bigger impact on lean enterprise than lean manufacturing....

• James Morgan & Jeff Liker (Productivity Press)
PLM has evolved as an Enterprise IT System

A strategic business approach that applies a consistent set of business solutions in support of the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise from concept to end of life – integrating people, processes, business systems, and information.

CIMdata
Aberdeen: The three major functional threads

Manufacturing Framework

- Business/Commerce
  - Order to Cash
  - Procure to Pay
  - Plan to Produce (business level)
  - Manage the Enterprise
  - Human Capital Management
- Production/Execution
  - Commissioning
  - Detailed Scheduling
  - Manufacturing Execution
  - Process Control
  - Production Reporting
  - Data History
- Product Innovation/Development
  - Projects/Portfolios
  - Product Design
  - Design Analysis
  - Process Design
  - Production Simulation

Execution Experience

PLM MSI
• Enterprise technologies are very much top-down; they are purchased and imposed on organizations by senior management. Companies can’t adopt EIT without introducing new interdependencies, processes, and decision rights. Executives need to stop looking at IT projects as technology installations and start looking at them as periods of organizational change that they have a responsibility to manage.

  - Mastering the Three Worlds of Information Technology
  - Harvard business review November 2006
Implementing PLM
Applying Lean Principles to Product Development

- A thirty-month research study by The University of Michigan identified seven fundamental principles that account for Toyota's speed-to-market. These principles form the foundation for, and optimize, Toyota's product development and production systems.

- A holistic, systems approach to product development.

- An imbedded customer first approach to product development.

- A front-loaded process.

- Built-in learning and continuous improvement.

- Synchronize processes for simultaneous execution.

- Use rigorous standardization to create strategic flexibility.

- Go to the source engineering.

• By James Morgan, Vice President, Troy Design and Manufacturing

http://www.sae.org/topics/leanfeb02.html

Key strategic initiatives that drive product Development

SIEMENS SAP Capgemini TATA CONSULTANCY SERVICES
Implementing PLM
... Initiatives drive cross process /practice coordination

- Initiatives must drive “cross process and cross practice” coordination to achieve simultaneous development
- Information must be shared across processes and practices without duplication
- The physical processes must influence the virtual process for continuous improvement (closed loop)
PLM touches every part of the value chain
....sub processes / practices

<table>
<thead>
<tr>
<th>PROCESS / PRACTICE</th>
<th>SUB PROCESSES / PRACTICES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program Management</td>
<td>Innovation, Portfolio, Process, Project, Risk and Performance Management, Target Cost</td>
</tr>
<tr>
<td>Early Integrated Design</td>
<td>Functional and Systems Design; Validation; Compliance; DFSS; Macro Make/Buy; IP Management</td>
</tr>
<tr>
<td>Mechanical Design Development</td>
<td>Layout; Packaging/Industrial design; Product Design and Validation; Part Design and Validation;</td>
</tr>
<tr>
<td>Electronics Design Development</td>
<td>Logic Design, IC Design, PCB Design; Simulation and Validation; Packaging</td>
</tr>
<tr>
<td>SW Design and Development</td>
<td>System Design, Source authoring and Executable Management; Testing and Integration</td>
</tr>
<tr>
<td>ME/EE/SW Integration</td>
<td>Mechatronics; BOM; Doc. &amp; Release; Configuration Mgmt.; Should Cost; Make/Buy</td>
</tr>
<tr>
<td>Manufacturing Engineering</td>
<td>Process Planning; Factory Layout &amp; Design; Tool and Fixture Design; Quality; Automation Design &amp; Simulation</td>
</tr>
<tr>
<td>Procurement</td>
<td>Supplier Management; Negotiation; Risk Management; Category Management;</td>
</tr>
<tr>
<td>Manufacture</td>
<td>Production Operations; Quality Management; Asset Management; Factory Commissioning</td>
</tr>
<tr>
<td>Sell</td>
<td>Build to Stock; configure to order; assemble to order; Engineer to order;</td>
</tr>
<tr>
<td>Service</td>
<td>Asset Mgmt.; Service Knowledge Mgmt.; Maintenance planning &amp; Execution; Material Mgmt.</td>
</tr>
<tr>
<td>Recycle</td>
<td>Environmental, Government, Compliance</td>
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</tbody>
</table>
1. Start with a cross functional team with an executive owner
2. Link PLM Initiatives to corporate strategy
3. Assess current state of maturity
4. Develop technology roadmap to best and next practices
5. Coordinated planning for people, process, technology and Governance
6. Determine the value and investment required to improve
7. Prioritize the improvements
8. Create the final implementation master plan
9. Ensure that continuous improvement is the cornerstone of the whole framework
### Assess current state of digital process maturity

<table>
<thead>
<tr>
<th>Maturity</th>
<th>Definition</th>
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<tbody>
<tr>
<td><strong>Closed Loop</strong></td>
<td>Process adjusts according to needs</td>
</tr>
<tr>
<td><strong>Integrated</strong></td>
<td>integrated with the whole value chain</td>
</tr>
<tr>
<td><strong>Defined</strong></td>
<td>Digital process is fully implemented</td>
</tr>
<tr>
<td><strong>Partially Digitized</strong></td>
<td>Digital process is partially implemented</td>
</tr>
<tr>
<td><strong>Manual</strong></td>
<td>Manual Process is defined</td>
</tr>
<tr>
<td><strong>Ad hoc</strong></td>
<td>One off</td>
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An assessment of Process/Practice maturity is the starting point... Illustrative

- .....and compare them to best practices

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<tr>
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<td>X</td>
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<td>Software Design and Development</td>
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</table>

X current state
X best practice
An assessment of barriers and articulation of the end state creates gaps to be filled.
Roadmap to best and next practices
... an illustrative

**SUB PROCESS/PRACTICES**
- Physical and Virtual prototypes;
- System level validation;
- Released Product Structure with options and variants;
- Effectivity;
- Build to package;
- Make/Buy analysis;
- Procure to package

**BARRIERS**
- Multiple representations and formats
- Multiple Locations and time zones
- Reconciling version and configurations
- Change Management

**END STATE**
- Single lifecycle representation
- Publish and subscribe from all locations
- Work in process configuration management

<table>
<thead>
<tr>
<th>ACCEPTED PRACTICE</th>
<th>BEST PRACTICE</th>
<th>NEXT PRACTICE</th>
<th>FUTURE</th>
</tr>
</thead>
<tbody>
<tr>
<td>many interfaced representations: designed, as planned, as sourced, as services, EBOM, MBOM,...</td>
<td>as designed and EBOM integration; as designed and as planned integration; connected EBOM and MBOM; commonality between as planned and as sourced integration</td>
<td>External rules models driving as designed representations; EBOM and MBOM integration; early coarse to fine integration; CRM integration</td>
<td>Common lifecycle representation</td>
</tr>
</tbody>
</table>
Development of roadmaps and phases

...Illustrative
A holistic approach that encompasses people, process, technology and governance is required to implement PLM and mitigate risks.
A key step in the process to determine the potential value for investment in PLM
A measurement system lined to the corporate strategy is one of the basis of priorities and continuous improvement.
A framework of measurement system is one of the basis of priorities and continuous improvement
ROI = Benefits / Cost
...generally difficult to measure, most of the time it is calculated to suit

- Best Practices
  - IT projects are very visible it is essential to get money back
  - Avoid systems that don’t communicate with each other
  - Focus on 'value creation,' which is a combination of bottom- and top-line ROI.
  - Use same methodology for all projects
  - Assess projects based on potential
    - Solid operational return
    - Satisfy regulatory requirement
    - Stay competitive
    - Concurrent engineering of several business processes
  - Project improvements in all areas
  - Compare vs. status quo
  - Link ROI to shareholder value

When times are tough it is Cost, when times are good it is the Customer...65% of the respondents said they don't have the knowledge or tools needed to do ROI calculations. Nearly 75% said their companies don't have formal processes or budgets in place for measuring the ROI of IT projects. (Computerworld)
A multi-year, multi-phase analysis is key to success... Illustrative
A decision matrix that elaborates value and ease of implementation (from people, process governance and technology) perspective lays a groundwork for effective decision making.
Each project needs to be assess for risks

<table>
<thead>
<tr>
<th>Practice</th>
<th>“Current”</th>
<th>“Best”</th>
<th>“Next”</th>
<th>“Future”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Adoption</td>
<td>Mass Adoption</td>
<td>Early Adoption</td>
<td>Leading Edge Usage</td>
<td>Development Areas</td>
</tr>
<tr>
<td>Adoption Timing</td>
<td>Accepted</td>
<td>“Accepted” In 2 Years</td>
<td>“Best” In 2 Years</td>
<td>“Next” In 2 Years</td>
</tr>
<tr>
<td>Implementation</td>
<td>Most processes that are institutionalized</td>
<td>Mission Critical Processes that provide leadership</td>
<td>Few Processes that can provide breakthrough's, focused and controlled implementations</td>
<td>Staging next paradigms; research areas;</td>
</tr>
<tr>
<td>Adoption By</td>
<td>“bulk of the market”</td>
<td>“Industry Leaders”</td>
<td>“Thought Leaders”</td>
<td>“Strategic Leaders”</td>
</tr>
<tr>
<td>Risk</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
<td>Very High</td>
</tr>
<tr>
<td>Process Change</td>
<td>Incremental</td>
<td>Process Redesign</td>
<td>End To End Process</td>
<td>Change Model</td>
</tr>
</tbody>
</table>
Iterate between Priorities, ROI and Ease of implementation
Success comes from having a measurement framework that provides a closed loop for continuous improvement and knowledge management.
Implementation Overview

Continuous Improvement

Plan | Define | Develop | Deploy

People
- High Level Objectives
- PLM Vision
- Readiness Assessment
- User Requirement
- Proof of Concept
- User Training

Process
- ROI & Bus Case
- Business Requirement
- Roadmap Definition
- As Is Process
- TO-BE Process
- Functional Specification
- System Integration Testing
- System Integration
- Data and Process Migration

Technology
- As Is System Landscape
- Migration & Integration Strategy
- Technical Design
- Solution Development
- Solution Realization
- Production Rollout
- Post Migration Reconciliation
- System Administration

Governance
Define who will “own” and control the information and processes; Need to reflect the company’s organization and culture; Need to support the company’s vision for its future; Executive sponsorship is key; Resources as proactive proponents of integration providing guidance, support, and resources

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Success cases

- Customer cases from:
  - PLM system suppliers
  - PLM System Integrators
- Cross Industry
- Wide spectrum of coverage
Thank you

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