Objective

➢ Present a new perspective on the role of manufacturing in the enterprise

➢ Offer a new concept of what it means to take lean beyond the factory floor

➢ Influence thinking on enterprise strategy in a maturing industry
What is a Manufacturing System?

➢ A manufacturing system is NOT just ...
   ➢ The product, machines, tools, materials or assembly line
   ➢ A factory floor
   ➢ A cell, FMS, composite center or a job shop
   ➢ MRP, ERP, kanban or POLCA

➢ A manufacturing system IS all of the above plus ...
   ➢ Workers
   ➢ Processes
   ➢ Suppliers
   ➢ Management
What is Manufacturing System Design?

- Manufacturing system design is NOT just ...
  - Factory floor improvements
  - Kaizen activities
  - Changes within the four walls
  - Waste elimination

- Manufacturing system design IS the above plus ...
  - A selection of a layout that meets system demands (outputs)
  - Development of an operational policy for decision making
  - Selection of the right process technology
  - Make-Buy decisions
  - Organizational structure design and interaction methods
Product Trends Affecting Manufacturing System Design

➢ Focus on affordability and life cycle support
➢ Diminishing product differentiation between competitors
➢ Reduced advantages in competing with product features or product performance
➢ Basic physical design stable
➢ Cost starting to be more important than performance improvements

Is the industry approaching a new phase?
Have other industries gone through this?
➢ Rate of product innovation highest during formative years
➢ As product matures rate of process innovation overcomes product innovation
➢ Very mature products have low levels of both product & process innovations

**Utterback’s Dynamics of Innovation Model**

- **Fluid Phase:** Rapid technology innovation, many firms founded.
- **Transition Phase:** Shakeout, competition shifts to process.
- **Emergence of the Dominant Design**
- **Specific Phase:** Stable, small number of firms; competition shifts to price.
- **Destabilizing changes in technology or process can destroy industry!**

Dominant design - that design that wins allegiance of the marketplace and meets all known user needs

Dominant designs occur through

- Refinement of product attributes
- Possession of necessary collateral assets
- Government regulations
- Strategic maneuvering
- Communication with users
### Dominant Design and the Aerospace Industry

<table>
<thead>
<tr>
<th>Dominant designs?</th>
<th></th>
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<tbody>
<tr>
<td>General aviation</td>
<td>yes</td>
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<tr>
<td>Commercial aircraft design</td>
<td>yes</td>
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<tr>
<td>Commercial aircraft interiors/systems</td>
<td>no</td>
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<tr>
<td>Military fighters flight characteristics</td>
<td>yes</td>
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<tr>
<td>Military fighters of stealth designs</td>
<td>no</td>
</tr>
<tr>
<td>Commercial/military engines</td>
<td>yes</td>
</tr>
<tr>
<td>Commercial/military space launch vehicles</td>
<td>yes</td>
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<tr>
<td>Commercial/military communication satellites</td>
<td>yes</td>
</tr>
<tr>
<td>Military specialty satellites</td>
<td>no</td>
</tr>
<tr>
<td>Industry as a whole…………………….. predominately</td>
<td>yes</td>
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</tbody>
</table>
Implications of Post Dominant Design (Transition Phase)

➢ Little product differentiation
➢ Incremental product innovation
➢ Acquisition cost becomes focus
➢ Operating costs more of a concern
➢ Mergers, acquisitions & exits
➢ Process innovation dominates
➢ Organizations become more rigid & hierarchical
➢ Less risk taking

= AEROSPACE INDUSTRY?
Utterback’s Model and the Aerospace Industry

Emergence of jet transport and multi-role jet fighter-bomber (the dominant design)

Government intervention motivated by cold war

Fluid Phase: Rapid technology innovation, many firms founded
Transition Phase: Shakeout, competition shifts to process
Specific Phase: Stable, small number of firms, competition shifts to price
Destabilizing changes in technology or process can destroy industry!

Source: Data from Weiss/Amir, 1999: plot and notations adopted by Shields/McManus, 2000

web.mit.edu/lean
Post Dominant Design
Industrial Role

➢ Product differentiation no longer wins orders
➢ Product performance enhancements best satisfied by incremental improvements
➢ Acquisition and life cycle costs predominate
➢ Insertion of process technologies has highest leverage

Use Manufacturing for Competitive Advantage
Fine’s 3-D Concurrent Engineering Model

Product
- Performance Specifications
- Recipe, Unit Process
- Product Architecture, and Make/buy

Process
- Technology and process planning
- Time, Space, and Availability
- Details, strategy
- Manufacturing System, Make/buy

Supply Chain

Source: Charles Fine, Clockspeed, Perseus Books, p. 146
Fine’s Model and the Aerospace Industry in the Transition Phase

In a post dominant design environment two relationships predominate:

➢ Process has more leverage than design on winning orders
➢ Supply chain integration & sourcing impacts enterprise strategy and product cost more than design

Design must be much more interactive with mfg & suppliers
Is Manufacturing Important?

➢ Industrial history lessons would indicate ...
  ➢ Process emphasis now has highest leverage
  ➢ Customers more interested in life cycle costs

➢ Role of manufacturing in this environment
  ➢ Value recognized by product delivery & support
  ➢ Other functions must support this value delivery
➢ Design is their bread and butter
➢ Manufacturing is the cost of doing business
➢ Outsource if not a core competency
➢ Manufacturing not viewed as strongest function
How can Manufacturing be Used for Competitive Advantage?

➢ Design is no longer the discriminating factor for competitive success therefore ...
   ➢ Design should support manufacturing goals
   ➢ Shift social regard from design to manufacturing/industrial engineering

➢ Process technology development yields most benefits
   ➢ Continual introduction of new processing capabilities
   ➢ Organizational elements to champion process developments
New Meaning for “Lean Beyond the Factory Floor”

➢ Lean beyond the factory floor is NOT just:
   ➢ Improving the requirements process
   ➢ Improving the product development process
   ➢ Developing long term supplier relationships

➢ Lean beyond the factory floor IS the above plus:
   ➢ Changing emphasis from product to process design
   ➢ Designing to ensure ease of product realization
   ➢ Making suppliers partners in product realization
Conclusions

➢ In a maturing industry product cost and life cycle attributes predominate and are best satisfied by process improvements

➢ Lean beyond the factory floor means shifting the enterprise focus to product realization from product design

➢ Enterprise strategy should change to champion a manufacturing and extended supplier partnership competitive strategy
Introduction to Rest of the Session

- Manufacturing strategy and design tools
- Lockheed Martin JSF manufacturing system design
- Space vehicle production at TRW
- Future research direction