Manufacturing System Evolution based on Life Cycle Simulation

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Product vs. System Life Cycle

- Product Life Cycle
- System Life Cycle

\{ Incompatibility \}

- Different Inertia
  - System/Facility
  - Product
  - Environment
Manufacturing System Evolution: Case Study

• Evolution of Manufacturing Systems
  – Short Product Life Cycle ⇒ Product Family
  – Demand Variations ⇒ System Evolution

• Manufacturing System Evolution
  – High Flexibility
  – Evolutonal Approach ⇒ Lean Approach

• Simulation-based Evaluation
  – Adaptability to Change
  – Initial Investment and Operational Cost

• Case Study
  – Machining Lines of Automotive Components
Life Cycle Simulation of Manufacturing Systems

**Variable Pattern**

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
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<tbody>
<tr>
<td>2004.4</td>
<td>864</td>
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<tr>
<td>2004.5</td>
<td>967</td>
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<td>2004.6</td>
<td>954</td>
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<td>2004.9</td>
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<td>2004.10</td>
<td>611</td>
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<td>2004.11</td>
<td>620</td>
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<td>2004.12</td>
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**Operation Scenario**

**Modification Plan and Timing for Production Line**

**Simulation**

**Evaluation**

- **Demand Forecasting**
- **Electricity Consumption**
- **Operation Cost**
- **Equation Models for Rough Simulation**

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Demand Scenarios (256 Cases)
Sensitivity Curves with Mass Production Effect

Cost

Max. Capacity

Volume/Day

Re-configuration

TR Re-configuration

CELL Line

Volume
Examples of Demand Scenarios
Detailed Simulation of Production
Life Cycle Simulation Results

Profit

Delivery

Line Number

Cell Line

Transfer Line
Life Cycle Simulation Results

Profit Distribution after 70 Months

Cumulative Profit Distribution after 70 Months
Summary

• System Evolution
  – Cell Type vs. Line Type
  – Adaptability to Demand Changes

• Incompatibility Resolution
  – Integration of Product and System View

• Operational Efficiency
  – Excess Capability/Flexibility

• Life Cycle Consideration
  – Reusing Disposed Systems/Components