From Integration to Composition: On the Impact of Software Product Lines, Global Development and Ecosystems
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Complexity of Large-Scale Software Development:

- Software Product Lines
- Global Development
- Software Ecosystem

For most software systems companies, large scale software development is complicated, expensive, slow and unpredictable.
Software Product Lines

- A software product line consists of a software platform shared by a set of products.
- Each product can typically select and configure components in the platform for its own purposes and extend the platform with product-specific functionality.

Organizational teams exist for each of the products as well as for the platform.

Benefits:
- Reducing Development Expenses (50% to 75%)
- Decrease Defect Density (50% to 75%)
- Increases the size of product portfolio

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Global Development

For many companies, software development is going global

Benefits:
- Reduction of Cycle Time
- Reduction of Travel Cost
- Use of Expertise When Needed
- etc.

Challenges:
- Different Culture
- Different Time Zone
- Different Technical Skills
- Different SE Maturity
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A software ecosystem consists of a software platform, a set of internal and external developers and a community of domain experts in service to a community of users that compose relevant solution elements to satisfy their needs.

The scope of a software product line is intra-organizational, the scope of a software ecosystem is much broader, including external developers and the extensions that they provide as well as other parties providing contributions.
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3 Case Companies

**Company A**
- Fortune 100
- The size of software range is between 7-15 million lines
- Several new products per year
- Using product line
- Using global development
- Using software ecosystem

**Company B**
- Fortune 500
- The size of software range is between multi- to tens of millions lines
- Several new products per year
- Using product-centric
- Using global development

**Company C**
- Fortune 100
- The size of software range is mostly consist of several million lines of code
- Minimizing software product line principles
- Using global development
Company A

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Problems Observed at Case Study Companies

- **Software Architecture**
  - Falling to keep it simple
  - Lock-step evaluation
  - Insufficient quality attributes management

- **R&D Organization**
  - Globalization
  - Tacit knowledge
  - Mismatch between architectural and organizational structure.

- **Engineering Processes**
  - Supply chain management
  - Agile and Scrum processes
  - Identifiable product
  - End-to-end process analysis
  - Automated engineering processes
  - Alignment between business and engineering processes
Software Architecture

- Failing to keep it simple
- Lock-step evaluation
- Insufficient quality attribute management
Engineering Processes

- Insufficient pre-iteration cycle work
- Unintended resource allocation
- High and unpredictable product integration cost
- Lack of process discipline
- Mismatched engineering processes
- Disconnected business and engineering processes
R&D Organization

- Globalization
- Tacit knowledge
- Mismatch between architectural and organizational structure.
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<table>
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<tr>
<th>Approaches</th>
<th>Integration-centric</th>
<th>Release grouping</th>
<th>Release trains</th>
<th>Independent deployment</th>
<th>Open (eco-) system development</th>
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</thead>
<tbody>
<tr>
<td>1. Architecture</td>
<td>Strongly interconnected architecture</td>
<td>High integration within release grouping, high decoupling between groupings</td>
<td>High decoupling between components</td>
<td>Highly decoupled with sand boxes for third party functionality</td>
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<tr>
<td>2. Process</td>
<td>Continuous coordination between teams</td>
<td>Continuous coordination within grouping</td>
<td>Short iteration cycles; only coordination at start/end of cycle</td>
<td>Each team selects length of iteration cycle</td>
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<tr>
<td>3. Organization</td>
<td>High interdependency teams</td>
<td>Teams responsible for different release groupings can be distributed</td>
<td>Distributed teams within organization</td>
<td>Distributed teams within organization</td>
<td>Distributed teams across organizational boundaries</td>
</tr>
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Thank You