Recurring problems

- What is the best way to organize software development project?
- How to speed up development, reduce costs and improve software quality?
- How to achieve the quickest development effort, lowest effective development cost, and best available product quality?
Possible solutions

- Get best people to practice standards-based development process supported by IDEs
- Attain and improve maturity of software development capabilities
- (Re)Design your software production architecture to optimize use of development resources and processes

Overview

- Goals
- Definitions and differences
- Software production strategies
- Software production architectures
- Optimizing software production
- Tools and techniques for optimization
- Conclusions
Goals

- Present an approach for how to optimize software production
- Identify key concepts, techniques, and tools that enable better optimization
- Describe optimization transformations from business process redesign studies
- Describe opportunity areas for exploitation and use

Definitions and Differences

- **Software production**: enterprise processes and resources that produce software
- **Production strategies**: business strategies guiding overall approach to building software
- **Production architecture**: configuration of enterprise capabilities to enact strategies
- **Optimizing production**: minimizing enterprise configuration to maximize strategic options
Software Production Strategies

- Reduce costs
- Reduce cycle time
- Improve cash flow
- Customer satisfaction
- Increase sales
- Improve customer service
- Increase productivity
- Open new markets
- Open new "channels"
- Be innovation leader
- Increase market share
- Enable just-in-time service delivery

Software Production Architecture

- A composite model that interrelates
  - software system architecture
  - software process architecture
  - development organization architecture
  - network infrastructure and development tools/environment configuration
  - documentation architecture
  - customer-support knowledge base architecture

- Cf. http://www.usc.edu/dept/ATRIUM/Papers/Process_Meta_Model.ps
Optimizing Software Production

- Strategies provide global constraints or opportunities for optimizing software production
- Constraints and opportunities realized in software production enterprise
- Constraints and opportunities must be distributed across the software production architecture

Optimizing Software Production

- Optimization must address composite architecture of software production
- Local optimization of any component architecture does not guarantee global optimality of software production
- Diagnostic analyses and transformation heuristics applied to composite architectural models lead to optimization opportunities
Optimizing Software Production

• Transformation heuristics classified taxonomically
• Taxonomy classifies domain-independent and domain-specific heuristics
• DI transformations applied in any software production setting
• DS transformations applied to specific component architectures

Optimizing Software Production

• DI transformation classes (sample):
  – Job scope
  – Worker empowerment
  – Organization design
  – Workflow streamlining
  – Information technology (IT)
Optimizing Software Production

- IT transformation sub-classes (sample):
  - Extend IT-based *support* to manual process steps
  - Extend IT-based *communication* facilities to encourage information sharing activities
  - Extend IT-based *automation* to incorporate new kinds of application packages
  - Extend IT-based *integration* to interconnect and interrelate existing "islands of automation"

Example DI process redesign heuristics applied at ONR

<table>
<thead>
<tr>
<th>Heuristic</th>
<th>Applicable Heuristics</th>
<th>Expected ROI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Many manual steps</td>
<td>Consolidate and automate (workflow and IT support)</td>
<td>Med High</td>
</tr>
<tr>
<td>Many linear step sequences</td>
<td>Identify parallelization opportunities (workflow)</td>
<td>High</td>
</tr>
<tr>
<td>Many review steps</td>
<td>Joint evaluation reviews (job scope, organization design)</td>
<td>Med High</td>
</tr>
<tr>
<td>Many data validation steps</td>
<td>Risk-based review systems (IT automation)</td>
<td>Med High</td>
</tr>
<tr>
<td>Many data application steps</td>
<td>Push validation responsibility upstream (job scope)</td>
<td>Med High</td>
</tr>
<tr>
<td>Slow acceptance of new computing systems</td>
<td>Role-based document builders (IT automation)</td>
<td>Low Med</td>
</tr>
<tr>
<td>Complexity and uncertainty</td>
<td>Automate documentation generating (IT communication)</td>
<td>Med Very High</td>
</tr>
<tr>
<td>Repair paper documents</td>
<td>Employ electronic proposals and grant documents (IT communication)</td>
<td>High Very High</td>
</tr>
<tr>
<td>Islands of automation</td>
<td>Integrate with process support, data integration, and product navigation (IT integration)</td>
<td>Low High</td>
</tr>
<tr>
<td>Wide area workflow</td>
<td>Internet-based process environment (IT supports, IT communication, IT automation)</td>
<td>Med High</td>
</tr>
</tbody>
</table>
Tools and Techniques

- Process-driven intranets:
  - Model and enact software production architectures
- Business process redesign case web
- Knowledge web for software production:
  - Software production ontology
  - Taxonomy for as-is diagnosis, redesign heuristics
  - Best practices and lessons learned cross linked

Process-driven intranets

- Enable rapid configuration of *virtual enterprises* across multiple organizational domains
- Virtual enterprises for wide-area software development have been demonstrated
- Software production in VEs supported and enacted via process navigation (“process surfing”)
Process-driven intranets

- Accommodate organizational autonomy and computer-supported cooperative work
- Accommodate heterogeneous repositories
- Accommodate use of local tools and development environments

See http://www.usc.edu/dept/ATRIUM/Papers/DHT-VE97.html
See http://www.usc.edu/dept/ATRIUM/Papers/DHT-SCM7.ps
See http://www.usc.edu/dept/ATRIUM/Papers/PDI.pdf
(Also appears in IEEE Internet Computing, 1(3):42-49, 1997)
Process-driven intranets

Conclusions

- Software production can be optimized
- Optimizing software production is a strategic option/choice that can be realized
- Software production architectures and supporting technologies enable optimization
- Process improvement and production optimization are complementary efforts