Standardization of Product Development Processes in Multi-Project Organizations

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Product Development Organization

Project

Project

Project

Project

Project

How does process standardization influence organizational performance?
What is the impact of process standardization on organizational performance?

**Process Standardization**

**Organizational Performance**
- Efficiency
- Knowledge Transfer
- Decision making / Resource Allocation
- Project performance
- Innovation
- Adaptation/ Learning over time
- Employee Satisfaction

+ Adler et. al 1999; Morgan, Liker 2006
  - Argote 1999; Adler and Cole 1993

- Krubasik 1988; Shenhar 2001
  - Benner & Tushman 2002; Tilcsik 2008
  - March 1991; Levinthal and March 1993
  - Adler et al. 1999
Field Research

- 5 large companies ($5B+ annual sales)
- Develop electromechanical assembled products
- Different industries
- Different approaches to process standardization
- Data: Interviews, Project Documents, Central Process Documents

- Theory-building from case studies (*Eisenhardt and Graebner 2007*). Selected Cases form theoretical Sample
Lessons from Case Studies - 1

Process Standardization

+

Organizational Performance
- Efficiency
- Knowledge Transfer
- Decision making / Resource Allocation

- Project performance
- Innovation/ Creativity
- Adaptation/ Learning over time
- Employee Satisfaction
“The biggest benefit is that because of the standard deliverables at the reviews, we all talk the same language and expect to see the same things in the same format. It’s easy for the Senior Management Team to know when a red flag comes up or when a project is moving into exception.”

Process Manager at Company E

“One good thing was that since we started using the same tools, it allows us to easily move between projects. We didn’t have to retrain every time we switched.”

Engineer at Company E

“Because of the tools, we can get engineers from other projects in crunch time and they don’t spend too much time ramping up. They can be integrated relatively seamlessly.”

Project Manager at Company E
Process Design
- Activities/Tasks
- Order, Flow, and Dependencies
- Timing
- Roles/Agents
- Tools/Methods
- Deliverables/Outputs

Process Standardization
- Activities/Tasks
- Order, Flow, and Dependencies
- Timing
- Roles/Agents
- Tools/Methods
- Deliverables/Outputs

Project Performance
- Product Cost
- Product Quality
- Development Time
- Development Cost

Organizational Performance
- Efficiency
- Knowledge Transfer
- Creativity/Innovation
- Decision making/Resource Allocation
- Adaptation/Learning over time
- Employee Satisfaction
Lessons from Case Studies - 2

☐ All companies
  - Acknowledged and controlled some amount of process variation, left some free to the discretion of project team

☐ Companies differed on:
  - What project characteristics they took into consideration to customize their process
  - Process Dimensions that are centrally specified and others left to vary
## Company A

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Algorithm</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Hardware/Software</td>
<td>Table - each product archetype column, activities as rows. yes/no indicated.</td>
<td>• Activities</td>
</tr>
<tr>
<td>• Extent of In-House Development</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8 Product ‘Archetypes’</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
# Company A - Project Archetypes

## Product Type

<table>
<thead>
<tr>
<th>Hardware</th>
<th>Software (not MNL, not ABC)</th>
<th>Hardware &amp; Software</th>
<th>Software OEM-in</th>
<th>Hardware OEM-in</th>
<th>Hardware Reseller</th>
<th>ABC Software</th>
<th>ABC XYZ Software</th>
</tr>
</thead>
<tbody>
<tr>
<td>Examples: AB4000, AB5000, some Tape</td>
<td>none, except RST going to PQR</td>
<td>SVC</td>
<td>AB3000, Brokeman 20</td>
<td>Sysco PQR</td>
<td>Note: These are special in that are closely tied to system software of which ABC is a part</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Development

| Accessibility Checklist(s) | | | | | | | |
|---------------------------|-----------------------------|---------------------|----------------|------------------|--------------|--------------|
| Anti-Smoke - HW only      | NA - not HW                 | NA - not HW         | NA - handled by pDA | NA - not HW | NA - not HW |
| Cost of Originality (COO & VO0) | | | | | | |
| Chemical Emissions Data   | | | | | | |

### Finance
## Company B

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Algorithm</th>
<th>Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Complexity</td>
<td>Logic Table – each activity decision made by referring to answers for pertinent questions</td>
<td>• Activities (required and suggested)</td>
</tr>
<tr>
<td>• Newness</td>
<td></td>
<td>• <em>Deliverables</em></td>
</tr>
<tr>
<td>• Cost</td>
<td></td>
<td>• <em>Templates</em></td>
</tr>
<tr>
<td>• Certifications</td>
<td></td>
<td>~80 technical activities</td>
</tr>
<tr>
<td>• Technology Readiness</td>
<td></td>
<td>~50 management activities</td>
</tr>
<tr>
<td>• Business Unit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Testing Requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Support Requirements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Hardware/Software</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Extent of Outsourcing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Supplier Quality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Production Needs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>32 questions</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

~80 technical activities
~50 management activities
## Company B

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Q1</td>
<td>What is the projected cost of this project?</td>
<td>Select one.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a</td>
<td>At or Above $ABC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>✗</td>
<td>Below $ABC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Q2</td>
<td>Please indicate maturity of technology on the project</td>
<td>Select one.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>a</td>
<td>Risky technology - unproven or limited application;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>emerging within market</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>✗</td>
<td>Mature technology - proven and applied in similar applications;</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>established within market</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>B</td>
<td>C</td>
<td>D</td>
<td>E</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>'X'=YES</td>
<td>Req/Audit</td>
<td>Cust Reqd</td>
<td>ACTIVITIES AND TASKS</td>
<td>DELIVERABLE</td>
</tr>
<tr>
<td>☒</td>
<td></td>
<td></td>
<td>Capture Originating Requirements</td>
<td></td>
</tr>
<tr>
<td>☒</td>
<td></td>
<td></td>
<td>1. Capture stakeholders needs</td>
<td>stakeholder needs</td>
</tr>
<tr>
<td>☒</td>
<td></td>
<td></td>
<td>2. Capture source requirements.</td>
<td>source requirements</td>
</tr>
<tr>
<td>☒</td>
<td></td>
<td></td>
<td>3. Capture architectural context.</td>
<td>architectural context(s)</td>
</tr>
<tr>
<td>☒</td>
<td></td>
<td></td>
<td>4. Define most important</td>
<td>most important requirements</td>
</tr>
<tr>
<td>☒</td>
<td></td>
<td></td>
<td>5. Define technical performance</td>
<td>technical performance measures (TPMs)</td>
</tr>
<tr>
<td>☐</td>
<td></td>
<td></td>
<td>Define Concepts</td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td></td>
<td></td>
<td>1. Define concept.</td>
<td>concept</td>
</tr>
<tr>
<td>☐</td>
<td></td>
<td></td>
<td>2. Perform conceptual analysis.</td>
<td>conceptual analysis document</td>
</tr>
<tr>
<td>☒</td>
<td>✓</td>
<td></td>
<td>Define Requirements</td>
<td></td>
</tr>
<tr>
<td>☐</td>
<td></td>
<td></td>
<td>1. Perform requirements trade</td>
<td>trade studies</td>
</tr>
<tr>
<td>☒</td>
<td>✓</td>
<td></td>
<td>2. Define product requirements.</td>
<td>product requirements</td>
</tr>
<tr>
<td>☒</td>
<td>✓</td>
<td></td>
<td>3. Conduct traceability analysis from</td>
<td>requirements trace/analysis</td>
</tr>
<tr>
<td>☒</td>
<td></td>
<td></td>
<td>4. Perform functional hazard</td>
<td>functional hazard assessment</td>
</tr>
</tbody>
</table>
## Company C

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Algorithm</th>
<th>Outputs</th>
</tr>
</thead>
</table>
| “Degree of Product Change” in three key subsystems | Three digit code maps to a “timing template” | • Activities  
• Sequence  
• Timing  
• (Reviews)  
• Deliverables  
• Templates  
• Roles |
| Rated from 1-6                             |                                        |                    |
Company C

Global - 542 Timing Template

1) All Timing Templates <PS> to <J1> timing is based on current Global Capability.
2) All Process Documents (Process Sheets, Process Flow Chart and Workplanning Template) are based on 664 Scale and desired state <PS> to <J1> timing (e.g. Process Documents <PS> to <J1> timing 40 months vs. 542 Timing Template <PS> to <J1> timing 44 months).
Note: Not all GPDS Deliverables are accounted for on the timing templates.
Portfolio Characteristics

Process Dimensions to Standardize and Centrally Control

Strategic Priorities in Performance Outcomes
Summary

- Individual Process Dimensions

- Which process dimensions should your company be controlling centrally? Consider:
  - Variation in Project Characteristics across portfolio
  - Strategic Priorities across Performance Outcomes
Thank You!

Questions? Comments?
Supplementary Slides
Data Collection

- Visits to companies – each visit 3 days to a week.
- Interviews (40+) with project managers, process managers, engineers, business-unit managers, functional managers
- Process documentation (corporate and project level), Project information
- Examples of Project-level process data
  - Documentation from Gates/Reviews
  - “Engineering Plan”, Project Information Repositories and Checklists
  - Process Customization Declarations (PCD) and Rationales for Deviation (RfD)
- Questions Driving Data Collection and Analysis
  - How do product development processes for different projects in an organization differ?
  - What factors drive these differences?
  - How do differences or standardization across processes impact performance on project-level and organization level outcomes?
Benefits of Standardization

- Process standardization enables true concurrent engineering and provides a structure for synchronizing cross-functional processes that enables unmatched vehicle development speed...

- Standard development processes are the only conceivable way to run a multi-project development factory and gauge the performance and progress of any individual program.”

  Morgan and Liker, Toyota Product Development System, 2006

- The standardization increased the relevance of knowledge acquired in one part of the establishment for another and the documentation served as a conduit for knowledge to flow from one part of the organization to the other.

However...

- Projects are different!
  PD projects differ in factors like scale, complexity, technology uncertainty, schedule, environments, goals, domain, available resources, and project team capability.
  
  *MacCormack and Vergnanti, 2003; Dvir, Shenhar, and Alkaher, 2003; Cockburn, 2000; Glass, 2000; Lindvall and Rus, 2000.*

- A ‘one-size-fits-all’ approach is difficult to work in product development.
  
  *MacCormack and Vergnanti, 2003; Glass, 2000; Lindvall and Rus, 2000.*

- “…process diversity offers one big advantage: it allows different kinds of [projects] to be managed in different ways”
  
  *Hammer and Stanton, 1999*
The standardization extreme

- “…many organizations’ standard processes tend to be detached from the way work is actually done. Many of those doing so-called ‘real work’ may see the standard process as irrelevant, too generic to be helpful”

  Browning, Fricke, and Negele 2006

- Standard process is often bureaucratic and cumbersome, lacks buy-in from employees, and project teams often circumvent the process or only pay lip-service to it.

  Cooper 2005

- GM example: “the more they attempt to define the process of product development, the less the organization is able to carry out that process properly.”

  Sobek, Liker, and Ward 1998
Standardization and Innovation

- Routinization creates a risk: when organizations are guided by old knowledge, they do not create new knowledge.
  
  *Brunner, Staats, Tushman 2009*

- In a 20-year longitudinal study of patenting activity and ISO 9000 quality program certifications in the paint and photography industries, we found that increased routinization associated with process management activities increases the salience of short term measures and triggers selection effects that lead to increases in exploitative technological innovation, at the expense of exploratory innovation.

  *Benner and Tushman, 2002, 2003*