Organizational Theory Perspective on Process Capability Measurement Scales

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SPICE 2009
Process capability scales should stand on firm theoretical grounds and not depend on subjective judgment of “better process”

Is there such theoretical support for the widely accepted capability scale?

What consequences would such theory have on capability scales?
<table>
<thead>
<tr>
<th>Rating</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Optimizing</td>
</tr>
<tr>
<td>4</td>
<td>Quantitatively managed</td>
</tr>
<tr>
<td>3</td>
<td>Defined</td>
</tr>
<tr>
<td>2</td>
<td>Managed</td>
</tr>
<tr>
<td>1</td>
<td>Performed</td>
</tr>
<tr>
<td>0</td>
<td>Incomplete</td>
</tr>
</tbody>
</table>
The basic structure of capability models is widely accepted but not consistent.

- The 5 (or 6) level capability model is widely accepted. CMMI, SPICE, COBIT, OPM3, Baldrige Award

- Acceptance is not matched by consistency of each level

- Difference matters when an organization adopts multiple models, e.g. ISO 20000 and COBIT
Can the differences be resolved?

- Are there reasons for the differences or are there underlying principles that can be used to develop a universal capability model?
- Consider two factors of organizations
  - Structure
  - Control
“Every organized human activity – from making pots to the placing of a man on the moon – gives rise to two fundamental and opposing requirements: the division of labour into various tasks to be performed and the coordination of these tasks to accomplish the activity.”
As an organization grows…

- Small organization can divide the tasks and coordinate among themselves by mutual adjustment. They just talk to each other.
- Medium organization needs to use direct supervision.
  - Project management is a form of direct supervision
  - A hierarchical bureaucracy is a form of direct supervision
Divisionalised organization needs more than direct supervision
## Process control and coordination

<table>
<thead>
<tr>
<th>Organization size</th>
<th>Coordination mechanism</th>
<th>Capability level description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Level 1</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Very small (single process)</td>
<td>Mutual adjustment</td>
<td>Performed - The implemented process achieves its process purpose.</td>
</tr>
<tr>
<td><strong>Level 2</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small to medium (single project)</td>
<td>Direct supervision</td>
<td>Managed – the process is planned, work allocated and coordinated.</td>
</tr>
<tr>
<td><strong>Level 3</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Large (distributed project, multiple projects)</td>
<td>Standardization</td>
<td>Defined – the process for performing the work is defined and standardized</td>
</tr>
</tbody>
</table>
Standardization comes in different forms

- **Standardization of work**
  - Work processes are standardized by describing the sequence of tasks to be performed and the techniques to be used in performing them.
  - ISO 9001 and ISO 20000 support such standardization.

- **Standardization of outputs**
  - The results of the work are specified but not the means of achieving those results.
  - Directing a taxi by giving the destination but not the route

- **Standardization of skills.**
  - When the outputs are difficult to specify and the work cannot be fully specified in advance, standardized skills are used.
  - A surgical team assigns responsibilities to each team member who discharges those responsibilities within an expected range of behaviours.
  - The anaesthetist does not wield the scalpel, the surgeon does not fetch instruments.
When to use which form of standardization?

- When are the different forms of standardization appropriate
- How is organizational control exercised
- How does that affect process capability
Control Theory can tell more about when to use the different forms of standardization

- Control Theory proposed by William Ouchi
  - How does an organization control obtain cooperation among a collection of individuals when they share only partially congruent objectives.
  - Efforts will adjust to the distribution of rewards

- Parts supply division
  - 22 (3 managers) employees of the purchasing division buy 100,000 parts each year from among 3000 suppliers and manufacturers
  - 1400 employees (150 managers) store those parts
  - Why is there a significant difference in the number of employees required for the two tasks
Agency Theory tells more about organization control

- Agency Theory originated in accounting.
  - One party (the principal) delegates work to another party (the agent) who performs that work.
  - The desires and goals of the principal and the agent conflict
  - It is difficult and expensive for the principal to verify what the agent is doing
  - Principal and agent may have differing attitudes toward risk
Control and Agency Theory come to the same conclusion

- Three forms of control
  - Output control
    - Control is exercised by rewarding results, with no concern for how those results are obtained
    - Depends on ability to specify and measure the outputs (products or services)
    - Favoured when it is hard to specify how to perform the task. E.g. selling on commission
  - Behaviour control
    - Control is exercised through rewarding behaviour without concern for the results of that behaviour
    - Depends on being able to specify how the task is to be performed
    - Does not depend on ability to specify and measure outputs
    - Most common control
  - Clan control
    - Control is exercised through subscriptions to common values
    - Control is achieved through the threat of exclusion from the clan
    - Professional societies are clans

- Seldom use only one control mechanism
Different circumstances favour different control mechanisms

### Ouchi’s choices of control mechanism

<table>
<thead>
<tr>
<th>Ability to measure outputs</th>
<th>Knowledge of the transformation process</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Perfect</td>
</tr>
<tr>
<td>High</td>
<td>Behavior or output measurement</td>
</tr>
<tr>
<td>Low</td>
<td>Behaviour control</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Imperfect</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Output measurement</td>
</tr>
<tr>
<td></td>
<td>Ritual and ceremony, “Clan” control</td>
</tr>
</tbody>
</table>

### Eisenhardt's model of choosing a control mechanism

**Task Characteristics**
- Task programmability

**Information systems**
- Behaviour measurement
- Outcome measurement

**Uncertainty** (of the outcome)

**Control strategy**
- Behaviour-based vs. Outcome-based

Influence the choice of:
- June 2009

Organizational Theory perspective on Capability Measurement Scale
Most process capability models emphasize behaviour control
- Extensive description of activities and tasks
- Little descriptions of work product requirements or validation criteria
- Little, if any, description of skills and experience required by the process
How is software developed or services delivered

- Seldom entirely under the control of the one organization
  - Prime contractor may do much of the work
  - Buy some components
  - Engage consultants
  - Outsource some work

- Unlikely to use only behaviour control
  - Too difficult to get everyone to use the same processes
  - Improved ability to specify work and measure outputs
  - Improving ability to communicate values and beliefs (vision statements)

- Process activities and tasks are insufficient to assess whether or not the process is adequately controlled
Generalised capability model

- Capability levels 1 and 2 remain unchanged
- Different approaches to standardization and coordination at level 3
  - Main concern is distributed development and outsourcing
  - Microsoft reduce the amount of process and documentation to “just enough” and implement a contract between the parties
  - Service level agreements are a form of contract between parties
Process definition attribute gains a new outcome

PA 3.1 The process definition attribute is a measure of the extent to which a standard process is maintained to support the deployment of the defined process. As a result of full achievement of this attribute:

<table>
<thead>
<tr>
<th>Process Outcome</th>
<th>Behaviour Control</th>
<th>Outcome control</th>
<th>Clan control</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) a standard process, including appropriate tailoring guidelines, is defined that describes the fundamental elements that must be incorporated into a defined process;</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>b) the sequence and interaction of the standard process with other processes is determined;</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>c) required competencies and roles for performing a process are identified as part of the standard process;</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>d) required infrastructure and work environment for performing a process are identified as part of the standard process;</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>e) suitable methods for monitoring the effectiveness and suitability of the process are determined.</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>f) Suitable methods for determining the fulfilment of requirements and responsibilities are determined</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
PA 3.2 The process deployment attribute is a measure of the extent to which the standard process is effectively deployed as a defined process to achieve its process outcomes. As a result of full achievement of this attribute:

<table>
<thead>
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<th>Clan control</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) a defined process is deployed based upon an appropriately selected and/or tailored standard process;</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>b) required roles, responsibilities and authorities for performing the defined process are assigned and communicated;</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>c) personnel performing the defined process are competent on the basis of appropriate education, training, and experience;</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>d) required resources and information necessary for performing the defined process are made available, allocated and used;</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>e) required infrastructure and work environment for performing the defined process are made available, managed and maintained;</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>f) appropriate data are, collected and analysed as a basis for understanding the behaviour of, and to demonstrate the suitability and effectiveness of the process, and to evaluate where continuous improvement of the process can be made.</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>g) <strong>Fulfilment of requirements and responsibilities are determined.</strong></td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>h) <strong>A fallback position is defined and agreed between parties.</strong></td>
<td></td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
It’s all in the implementation

- Process outcomes don’t necessarily change
- Assessment of the process outcomes will change depending on circumstances
  - It is difficult to assess how globally distributed software development is done.
  - However, the outputs of those tasks can be assessed
  - When clan control is appropriate, roles, responsibilities, competencies and training become more important
- Implies a more complex assessment method
The current capability measurement scale reflects the dominant form of organization control – behaviour control.

The ISO 15504 capability measurement scale can accommodate other forms of control.

To do so would require a more sophisticated, and significantly larger, process assessment model.
Questions

- Questions
- Questions
- Questions