"I'd rather have it wrong than have it late. We can always fix it later."
- A senior software manager (industry)

"The bottom line is schedule. My promotions and raises are based on meeting schedule first and foremost."
- A program manager (government)

Standish Group – the Chaos Report
* 24% of software projects failures (2009)
  - from 31% failures (1994)
* 44% of software projects challenged (2009)
  - from 53% challenged (1994)

"By regularly putting the development process under extreme time pressure and then accepting poor-quality products, the software user community has shown its true quality standard."
- DeMarco and Lister (Peopleware)
Process Management Premise

The quality of a (software) system is largely governed by the quality of the process used to develop and maintain it.

This premise implies focus on process as well as product.

The value of this premise is visible world-wide in the Total Quality Management movements in the manufacturing and service industries.
- performance excellence against business objectives
- doing more with less
- increasing customer satisfaction (and delight)
- improving shareholder equity

Implications of Maturity

Better predictability... Less variability... Improved performance...

<table>
<thead>
<tr>
<th>Level</th>
<th>Process Characteristics</th>
<th>Predicted Performance</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Optimizing</td>
<td>Process improvement is institutionalized</td>
</tr>
<tr>
<td>4</td>
<td>Managed</td>
<td>Product and process are quantitatively controlled</td>
</tr>
<tr>
<td>3</td>
<td>Defined</td>
<td>Software engineering and management processes defined and integrated</td>
</tr>
<tr>
<td>2</td>
<td>Repeateable</td>
<td>Project management system in place; performance is repeatable</td>
</tr>
<tr>
<td>1</td>
<td>Initial</td>
<td>Process is informal and unpredictable</td>
</tr>
</tbody>
</table>
## Trends in Software Quality

<table>
<thead>
<tr>
<th>Maturity Level</th>
<th>Design Faults / KSLOC (Keene)</th>
<th>Delivered Defects / FP (Jones)</th>
<th>Shipped Defects / KSLOC (Krasner)</th>
<th>Relative Defect Density (Williams)</th>
<th>Shipped Defects (Rifkin)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>0.5</td>
<td>0.05</td>
<td>0.5</td>
<td>0.05</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>0.14</td>
<td>2.5</td>
<td>0.1</td>
<td>5</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>0.27</td>
<td>3.5</td>
<td>0.2</td>
<td>7</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>0.44</td>
<td>6</td>
<td>0.4</td>
<td>12</td>
</tr>
<tr>
<td>1</td>
<td>5-6</td>
<td>0.75</td>
<td>30</td>
<td>1.0</td>
<td>61</td>
</tr>
</tbody>
</table>

Karl D. Williams, “The Value of Software Improvement… Results! Results! Results!” SPIRE97, June 1997.

## Trends in Productivity

<table>
<thead>
<tr>
<th>Maturity Level</th>
<th>Business Systems PI</th>
<th>Engineering Systems PI</th>
<th>Real-Time Systems PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>17</td>
<td>15</td>
<td>9</td>
</tr>
<tr>
<td>3</td>
<td>19.5</td>
<td>18</td>
<td>11.5</td>
</tr>
<tr>
<td>4</td>
<td>22</td>
<td>20.5</td>
<td>14</td>
</tr>
<tr>
<td>5</td>
<td>25</td>
<td>23</td>
<td>16.5</td>
</tr>
</tbody>
</table>

## CMMI-DEV v1.3

<table>
<thead>
<tr>
<th>Level</th>
<th>Process Characteristics</th>
<th>Process Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>Optimizing</td>
<td>Causal Analysis &amp; Resolution</td>
</tr>
<tr>
<td></td>
<td>Focus is on quantitative continuous process improvement</td>
<td>Organizational Performance Management</td>
</tr>
<tr>
<td>4</td>
<td>Quantitatively Managed</td>
<td>Process is measured and controlled</td>
</tr>
<tr>
<td></td>
<td>Process is measured and controlled</td>
<td>Organizational Process Performance</td>
</tr>
<tr>
<td></td>
<td>Process is characterized for the organization and is proactive</td>
<td>Quantitative Project Management</td>
</tr>
<tr>
<td>3</td>
<td>Defined</td>
<td>Requirements Development</td>
</tr>
<tr>
<td></td>
<td>Process is characterized for projects and is often reactive</td>
<td>Technical Solution</td>
</tr>
<tr>
<td></td>
<td>Requirements Management</td>
<td>Product Verification</td>
</tr>
<tr>
<td>2</td>
<td>Managed</td>
<td>Verification</td>
</tr>
<tr>
<td></td>
<td>Process is characterized for projects and is often reactive</td>
<td>Validation</td>
</tr>
<tr>
<td>1</td>
<td>Initial</td>
<td>Requirements Development</td>
</tr>
<tr>
<td></td>
<td>Process is unpredictable, poorly controlled, and reactive</td>
<td>Project Planning</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Project Monitoring &amp; Control</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supplier Agreement Management</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Verification</td>
</tr>
</tbody>
</table>

### Comparing Capability and Maturity Levels

<table>
<thead>
<tr>
<th>Level</th>
<th>Continuous Representation Capability Levels</th>
<th>Staged Representation Maturity Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Incomplete</td>
<td>---</td>
</tr>
<tr>
<td>1</td>
<td>Performed</td>
<td>Initial</td>
</tr>
<tr>
<td>2</td>
<td>Managed</td>
<td>Managed</td>
</tr>
<tr>
<td>3</td>
<td>Defined</td>
<td>Defined</td>
</tr>
<tr>
<td>4</td>
<td>---</td>
<td>Quantitatively Managed</td>
</tr>
<tr>
<td>5</td>
<td>---</td>
<td>Optimizing</td>
</tr>
</tbody>
</table>
**A Performed Process and the Level 1 Generic Practice**

A performed process is a process that accomplishes the work necessary to satisfy the specific goals of a process area.

*GG 1 Achieve Specific Goals  
GP 1.1 Perform Specific Practices*

---

**A Managed Process**

A managed process is a performed process that is

- planned and executed in accordance with policy;
- employs skilled people having adequate resources to produce controlled outputs;
- involves relevant stakeholders;
- is monitored, controlled, and reviewed; and
- is evaluated for adherence to its process description.
Level 2 Generic Practices

GG 2 Institutionalize a Managed Process
   GP 2.1 Establish an Organizational Policy
   GP 2.2 Plan the Process
   GP 2.3 Provide Resources
   GP 2.4 Assign Responsibility
   GP 2.5 Train People
   GP 2.6 Control Work Products
   GP 2.7 Identify and Involve Relevant Stakeholders
   GP 2.8 Monitor and Control the Process
   GP 2.9 Objectively Evaluate Adherence
   GP 2.10 Review Status with Higher Level Management

CMMI-DEV v1.3 ML2

Requirements Management       REQM
Project Planning                PP
Project Monitoring & Control    PMC
Supplier Agreement Management   SAM
Process & Product Quality Assurance PPQA
Configuration Management       CM
Measurement & Analysis          MA
**Project Planning**

Establish and maintain plans that define project activities.

**Specific Goals**
1) Establish estimates.
2) Develop a project plan.
3) Obtain commitment to the plan.

---

**Process & Product Quality Assurance**

Provide staff and management with objective insight into processes and associated work products.

**Specific Goals**
1) Objectively evaluate processes and work products.
2) Provide objective insight.

*Note that product quality assurance, as described in PPQA, is against applicable process descriptions, standards, and procedures. It is not against requirements. Practices in the Verification process area ensure that specified requirements are satisfied.*
A Defined Process and the Level 3 Generic Practices

A defined process is a managed process that is
• tailored from the organization’s set of standard processes according to the organization’s tailoring guidelines;
• has a maintained process description; and
• contributes process related experiences to the organizational process assets.

GG 3 Institutionalize a Defined Process
   GP 3.1 Establish a Defined Process
   GP 3.2 Collect Process Related Experiences

CMMI-DEV v1.3 ML3

Requirements Development  RD
Technical Solution        TS
Product Integration       PI
Verification              VER
Validation                VAL
Organizational Process Definition OPD
Organizational Process Focus OPF
Organizational Training   OT
Integrated Project Management IPM
Risk Management           RSKM
Decision Analysis & Resolution DAR
Verification

Ensure that selected work products meet their specified requirements.

Specific Goals
1) Prepare for verification.
2) Perform peer reviews.
3) Verify selected work products.

Note that IEEE 610-1990 defined verification as “The process of evaluating a system or component to determine whether the products of a given development phase satisfy the conditions imposed at the start of that phase.”

Validation

Demonstrate that a product or product component fulfills its intended use when placed in its intended environment.

Specific Goals
1) Prepare for validation.
2) Validate product or product components.

Note that validation is against “intended use.. in its intended environment” rather than against the requirements. IEEE 610-1990 defined validation as “The process of evaluating a system or component during or at the end of the development process to determine whether it satisfies specified requirements.”
IEEE 610-1990 defined V&V as “The process of determining whether the requirements for a system or component are complete and correct, the products of each development phase fulfill the requirements or conditions imposed by the previous phase, and the final system or component complies with specified requirements.”

This seems to fit the CMMI definitions of V&V better than the individual definitions do. Caveat emptor!
Causal Analysis & Resolution (CAR)

Organizational Performance Management (OPM)

Identify causes of selected outcomes and take action to improve process performance.

Specific Goals
1) Determine causes of selected outcomes.
2) Address causes of selected outcomes.

“Defects” in CMMI v1.2 became “selected outcomes” in CMMI v1.3.
**IPPD**

Integrated Process & Product Development disappeared between CMMI-DEV v1.2 and v1.3.
   - Replaced by teaming practices OPD SP 1.7 and IPM SP 1.6

“IPPD” and “integrated process and product development” do not appear in v1.3.

Teaming and IPPD are arguably not synonyms.

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**CMMI Complexity**


“One thing the book unintentionally reveals is the enormous complexity of the CMMI. The number of process areas, goals, and practices is truly staggering. One can’t help but wonder if the CMMI is in danger of collapsing under its own weight. But this is all the more reason to add a book like this to one’s reference shelf.”
Questions and Answers

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