Understanding High Maturity Organizations

Donna K. Dunaway, Charles V. Weber, Mark C. Paulk, Will Hayes, and Mary Beth Chrissis

Software Engineering Institute
Carnegie Mellon University
Pittsburgh, PA 15213-3890

Topics

Introduction

Maturity Levels 2 and 3 as Foundations

What Is Level 4 All About?

What Is Level 5 All About?

Conclusion

The Problem

When CMM for Software was written, there were few high-maturity software organizations to use as exemplars

Concepts underlying maturity levels 4 and 5 are based on statistical process control.

- **Levels 4 and 5 are written as quantitative management rather than statistical control**
- **There is a wide range of interpretations of what is needed to achieve levels 4 and 5**

This Presentation

The purpose of this presentation is to clarify some of the interpretation issues associated with maturity levels 4 and 5

Establish a more uniform basis for implementing and appraising high maturity processes, so that organizations:

- **Receive more consistent appraisals**
- **Realize the intended benefits of higher maturity levels**

SEI Strategy

Provide more concise descriptions, implementation guidance, and examples of maturity level 4 and 5 practices

Communicate the practices through:

- **courses**
  - **new courses**
  - **update existing courses**
- **workshops**
- **publications**
- **conferences**

Levels 2 and 3

Maturity levels 2 and 3 build the foundation necessary for quantitative management

- **Defined processes**
  - **to achieve consistency across the organization**
  - **to provide a detailed understanding of the relationships between subprocesses**
- **Common measures to accumulate meaningful data across the organization**
- **Effective SQA to identify process areas that are the source of instability**

What is Level 4 All About? - 1

Quantitative Process Management

- **Determine linkages between critical subprocesses and their impact on business goals**
- **Identify and measure subprocesses (or process steps) within the development lifecycle**
- **Understand the natural variation of the critical subprocesses**
- **Take action for “special causes” to achieve predictable performance results**

What is Level 4 All About? - 2

Software Quality Management

- **Establish quality goals**
- **Understand the contribution of the critical subprocesses within the lifecycle to achieving the quality goals**
- **Make incremental improvements from the insight gained into the development lifecycle.**

Identify and Measure Subprocesses

Process data is collected at the "process step" level for quantitative process management

- **engineers are using the data to drive technical decision making**
- **examples: design inspections, code inspections, test cases**

Data collected at phase end or on monthly basis is too late for real-time control

[Some exceptions may exist in small projects or maintenance projects]

Monitor Subprocesses

Monitoring subprocesses requires an understanding of variation

High maturity organizations collect a lot of data (at the subprocess level)

- **to use data for control and comparison, data sources must be categorized - by product family, application domain, etc.**
- **a few important business drivers determine the vital few measures, e.g., cost, schedule, quality**

Measuring Processes

What is the need for measuring processes?

- **to understand the existing performance of the processes**
- **to know the current levels and variability of the values that are measured**

Then, we can proceed to evaluate the information from other perspectives

To attain control, a process variability must be well-bounded, or “stable” in the SPC sense

Understanding Variation

A wide range of analytic techniques are available for systematically understanding variation

- **simple graphs, such as histograms and bar charts**
- **statistical formulas, such as standard deviation and range**
- **statistical process control tools, such as XmR charts and u-charts**
- **analysis of variance techniques, such as ANOVA, ANCOVA, and test of hypotheses**

Quantitative Management

Quantitative quality goals for products and services are established

From analysis of the selected critical subprocesses, it can be determined whether the processes are capable of meeting the quality goals

The process implementation throughout the lifecycle is quantitatively managed against these goals

Evolving Definition of Quality

Quality at level 2 is "conformance to requirements"

Quality in high-maturity organizations connotes "fitness for use" and customer satisfaction

Software Quality Management **deals with**

- **product quality issues**
- **the product or system perspective**

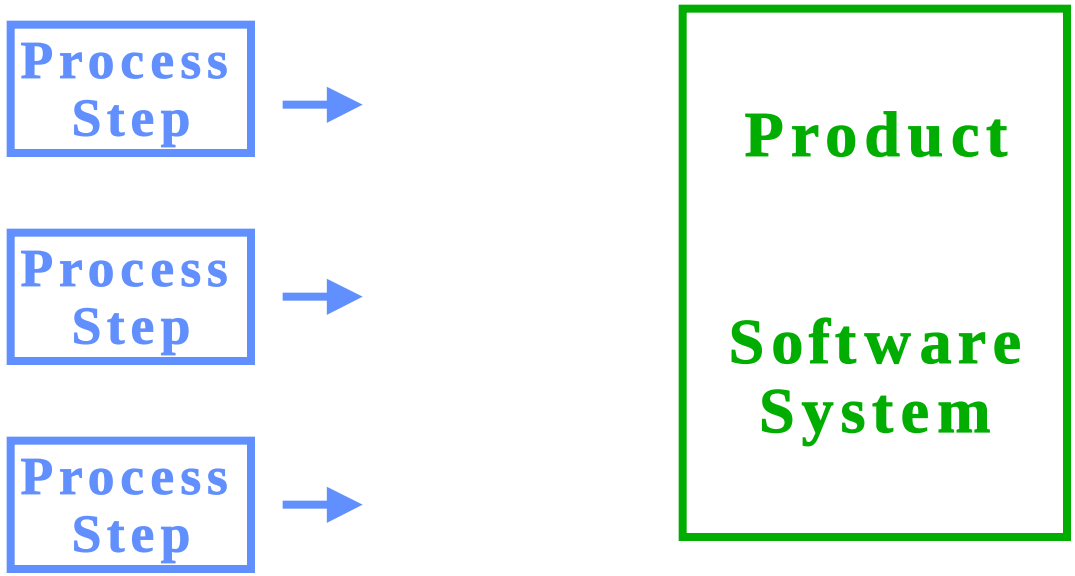
Defining Quality

There are many attributes to "quality"

- **defect density is the most commonly used**
- **mean-time-to-failure is probably more important to the customer**
- **other important quality attributes include**
  - **performance**
  - **features**
  - **functionality**
  - **safety**
  - **service**
  - **aesthetics**

A process attribute, such as defect removal efficiency, can impact multiple quality attributes: schedule, cost, and quality - a cascading effect

Product vs Process Management



Quality management depends on process management

What is Level 5 All About?

Identify criteria for evaluating new technologies and processes

Use analytical techniques to understand the impact of proposed changes

Provide feedback mechanisms to determine deployment

Provide effective and efficient deployment of process improvements

Technical Change Management and Process Change Management

Identify the criteria that are important for evaluating new technologies and processes

The criteria for evaluating change should be based on impact to business drivers

Examples of evaluation criteria:

- **number of users affected**
- **frequency of usage**
- **affected processes**
- **cost**

Defect Prevention

Continual improvement requires universal participation

Defect Prevention

- **The software project analyzes defects, identifies their causes, takes action to prevent their recurring - resulting in incremental improvement**
- **Projects provide defect information as candidates for organizational process improvement**

Implementing Change

Use sophisticated analytical techniques when they are needed to understand the impact of a proposed change

If the impact of a change is large and obvious, e.g., order of magnitude improvement, sophisticated analyses may be unnecessary

- **capture the evaluation consistently and using the pre-defined criteria**

User feedback, e.g., in the form of user surveys after pilots, should always be considered in deciding about deployment

Piloting

It may be desirable to pilot significant technology and process changes before deployment

Choosing not to pilot before deployment can be a "bet-the-business" strategy

Piloting has other benefits than gathering quantitative performance data

- **building buy-in for the change**
- **controlling the learning curve**

Long-Term Analysis

Even if piloted, some changes do not "scale up" well in full-scale deployment

Tracking of performance after deployment is important for understanding the long-term impact of a change - and verifying its value

- **data categorization is critical for dealing with confounding factors**

Process modeling, e.g., systems dynamics models, may be useful for understanding feedback and interaction effects

- **use the process step data obtained at level 4**

Pulling Maturity Levels 4 and 5 Together

Maturity Level 4:

Understanding and managing the variation in the process to achieve the quality goals

Maturity Level 5:

Use the knowledge available from quantitative management to select and deploy incremental improvements as well as innovative technological improvements

General SEI Information

SEI Customer Relations +1 (412) 268-5800
SEI FAX number +1 (412) 268-5758
Internet Address
customer-relations@sei.cmu.edu
Mailing Address
Customer Relations
Software Engineering Institute
Carnegie Mellon University
4500 Fifth Avenue
Pittsburgh, PA 15213-3890

Internet Access to SEI

SEI Web pages

- ***www.sei.cmu.edu***
- ***www.sei.cmu.edu/cmm/***
- ***www.sei.cmu.edu/cmm/cmm.articles.html***