Supporting the CMMI Metrics Framework thru Level 5

EDS-Electronic Data Systems do Brasil Ltda.

Márcio Silveira
Agenda

- Objective
- EDS Overall Process Improvement Strategy
- Measurement Elements of the CMMI Model
- M&A and High-Maturity Practices
- Processes and Procedures for M&A and High-Maturity
- Lessons Learned
- Q&A
Objective

This presentation shows the Software Engineering Framework that EDS utilizes at its Applications Development and Maintenance Centers in Brazil that supports the measurement requirements of the CMMI® model thru level 5. During the presentation you will learn the basics and advanced measurement requirements from the CMMI® model and see how EDS implemented the processes and procedures to support these requirements.
Corporate Objectives
Business Drivers
Technology Drivers
PI Opportunities
Voice of Customer
Voice of Management

Inputs/Drivers

Strategic Business Plan (SBP)

Strategies/Initiatives
Measurement (Monitor & Control)

Organization Improvement Strategy

Governance Council (Board)
Edge (Work-types, Processes, Activities)

Iterative Development v5

Edge (Work-types, Processes, Activities)

Process - Estimate Project Work - Application Development

Alternate Name
Use other detailed tasks are needed for generating estimates for development or enhancement projects.

Purpose

Diagram

Components

<table>
<thead>
<tr>
<th>Name, Description, Responsibilities</th>
<th>Inputs/Outputs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Plan and Prepare for Estimates</td>
<td>Inputs:</td>
</tr>
<tr>
<td></td>
<td>- Issue-Assumptions-Risks Log</td>
</tr>
<tr>
<td></td>
<td>- Project Plan</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Gather Historical Information</td>
<td>Outputs:</td>
</tr>
<tr>
<td></td>
<td>- Estimate Package</td>
</tr>
<tr>
<td></td>
<td>- Issue-Assumptions-Risks Log</td>
</tr>
</tbody>
</table>

Responsibilities:
- Project Manager (R)
- Project Technical Leader (S)

Using the selected estimating procedure(s), obtain whatever historical data may be available from the Metrics Repository or local records that can be leveraged. Review the output from these sources. If necessary, refine the search criteria and perform further research to improve the estimate.
Tailoring the Project ...

- OSSP-Org. Plans Tailoring Criteria
- Requirements and Approach Documentation
- Project's Defined Process File
- Tailoring Tool
- Project’s Defined Process File (PDP)
- Starting Point Schedule
- Project Workbook Structure
- Tailoring Execution
- Waivers
- Tailoring Decisions
- Amendment History

Supporting the CMMI Metrics Framework thru Level 5
### M&A e High-Maturity (CMMI-Dev 1.2)

<table>
<thead>
<tr>
<th>LEVEL</th>
<th>FOCUS</th>
<th>NAME</th>
<th>PROCESS AREAS</th>
</tr>
</thead>
</table>
| 5     | Continuously Improving Process | OPTIMIZING | - Organizational Innovation & Deployment  
- Causal Analysis and Resolution |
| 4     | Predictable Process | QUANTIT. MANAGED | - Organizational Process Performance  
- Quantitative Project Management |
| 3     | Standard and Consistent Process | DEFINED | - Requirements Development  
- Technical Solution  
- Product Integration  
- Verification  
- Validation  
- Integrated Project Management  
- Risk Mgmt.  
- Decision Analysis and Resolution  
- Organizational Process Focus  
- Organizational Process Definition  
- Organizational Training |
| 2     | Disciplined Process | MANAGED | - Requirements Mgmt.  
- Project Planning  
- Project Monitoring and Control  
**Measurement and Analysis**  
- Process and Product Quality Assurance  
- Configuration Mgmt.  
- Supplier Agreement Mgmt. |
| 1     | Ad Hoc | PERFORMED | (None) |
M&A Objectives

The purpose of Measurement and Analysis is to develop and sustain a measurement capability that is used to support management information needs by:

- Specifying the objectives of measurement and analysis such that they are aligned with identified information needs and objectives
- Specifying the measures, analysis techniques, and mechanism for data collection, data storage, reporting, and feedback
- Implementing the collection, storage, analysis, and reporting of the data
- Providing objective results that can be used in making informed decisions, and taking appropriate corrective actions
Supporting M&A Goal 1

- SPs Goal 1: Align Measurement and Analysis Activities

**SP 1.1 Establish Measurement Objectives**
- Strategic Business Plan
- Performance and Quality Goals and Objectives
- Service Level Agreement

**SP 1.2 Specify Measures to Address Measurement Object**
- SP 1.3 Specify data collection and storage procedures
- SP 1.4 Specify analysis procedures

**OPP/QPM**
- Organization
- Project

**Organizational Quantitative Management Approach**
- Project Quantitative Management Plan

**Organizational Measurement Plans**
- Project Measurement Plans
Supporting M&A Goal 2

- SPs Goal 2: Provide Measurement Results
OPP & QPM Objectives

• The purpose of Organizational Process Performance (OPP) is to establish and maintain a quantitative understanding of the performance of the organization’s set of standard processes in support of quality and process-performance objectives by:
  - Selecting processes to be managed quantitatively
  - Establishing process performance measurements and quality and process performance objectives
  - Creating and maintaining Process performance baselines and models

• The purpose of Quantitative Project Management (QPM) is to quantitatively manage the project’s defined process to achieve the project’s established quality and process-performance objectives by:
  - Establishing and maintaining the project’s quality and process-performance objectives
  - Identifying suitable sub-processes that compose the project’s defined process based on historical stability and capability data found in process-performance baselines or models
  - Selecting the sub-processes of the project’s defined process to be statistically managed
  - Monitoring the project to determine whether the project’s objectives for quality and process performance are being satisfied, and identifying appropriate corrective action
  - Selecting the measures and analytic techniques to be used in statistically managing the selected sub-processes
  - Establishing and maintaining an understanding of the variation of the selected sub-processes using the selected measures and analytic techniques
  - Monitoring the performance of the selected sub-processes to determine whether they are capable of satisfying their quality and process-performance objectives, and identifying corrective action
  - Recording statistical and quality management data in the organization’s measurement repository
Supporting OPP Goal 1

- SPs Goal 1: Establish Performance Baselines and Models

M&A - SP 1.1 Establish Measurement Objectives

SP 1.1 Select Processes
SP 1.2 Establish Process-Performance Measures
SP 1.3 Establish Quality and Process-Performance Objectives

M&A - SP 1.1 Establish Measurement Objectives

SP 1.4 Establish Process-Performance Baselines (PPBs)

SP 1.5 Establish Process-Performance Models (PPMs)

Organizational Metrics Repository → PPBs

Statistical & Simulation Tools → PPMs
Supporting QPM Goal 1

- SPs Goal 1: Quantitatively Manage the Project

SP 1.1 Establish the Project’s Objectives
SP 1.2 Compose the Defined Process
SP 1.3 Select the Sub-processes that will be Statistically Managed

SP 1.4 Manage Project Performance (more in Goal 2)

- Project Defined Process (PDP)
- Project Tracking Reports (Local Repository)
- Project Metrics Analysis Report
- Project Quantitative Management Plan

Organization

Performance and Quality Goals and Objectives

Project

Supporting the CMMI Metrics Framework thru Level 5
Supporting QPM Goal 2

- SPs Goal 2: Statistically Manage Sub-process Performance

**SP 2.1 Select Measures and Analytic Techniques**

**SP 2.2 Apply Statistical Methods to Understand Variation**

**SP 2.3 Monitor Performance of the Selected Sub-processes**

**SP 2.4 Record Statistical Management Data**

Project Tracking Reports (Local Repository)

Project Metrics Analysis Report

PPBs & PPMs

Project Storyboard
Strategic Business Planning - Key element

Strategic Planning

Business Objectives

Market Drivers, Improvement Opportunities

Customer’s expectations

Performance and Quality - Goals and Objectives
Performance and Quality Goals and Objectives

- Defines the process-performance and quality goals and objectives from the organization. It is a key output of the SBP activities. It defines:

  ✔ Suggested measurements and objectives at organizational level and project level.
  ✔ High-level measurement plan
  ✔ Reporting mechanism
Organizational Measurement Plans (Pattern)

- Defines the process to collect, store, analyze and report the measurements collected by the organization and projects. Basically contains:
  - ✔ Linkage between the measurements and the performance and quality goals objectives
  - ✔ Detailed information about the metrics that will be collected, stored and analyzed.
  - ✔ Analysis and reporting procedures
  - ✔ Triggers
  - ✔ Roles & responsibilities
  - ✔ Organizational Metrics Repository information
Project Measurement Plans

- It is an instantiation of the “Organizational Measurement Plans (Pattern)“.
- Projects reuse the pattern and:
  ✓ Justify what doesn’t apply to the project.
  ✓ Add project specific needs
Organizational Quantitative Management Approach

- It addresses establishment of process-performance and quality objectives for the organization. These objectives will be used by projects to establish project-level process-performance and quality objectives, and determine the measurements that will be used to support these objectives. Basically contains:
  - Quality goals and process-performance objectives
    - Common Organizational Objectives
    - Common Project Objectives (Project Type)
  - Organizational Baselines locations (PPBs)
  - Organizational Performance Models (PPMs) Performance
  - Quantitative Management General Procedures
    - Organizational Procedures (PPBs, PPMs, Tools, etc.)
    - Project Procedures
Project Quantitative Management Plan

- It is an instantiation of the “Organizational Quantitative Management Approach”.
- Projects follow the organizational approach by:
  - Selecting the common objectives that are applicable to the project.
  - Identifying project specific objectives.
  - Identifying processes and sub-processes affected by the objectives.
  - Creating a plan to collect, store, analyze and report on quantitative management data. (DMAIC)
  - Identifying Baselines and Models that will be created and/or reused.
  - Documenting all specific procedures that must be followed.
Supporting the CMMI Metrics Framework thru Level 5

Tasks Assignments

MSPS

Effort

Consolidation & Upload
# Project Tracking Reports (PTR) - Local Repository

## Effort by Production Support Process

<table>
<thead>
<tr>
<th></th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
<th>M</th>
<th>N</th>
<th>O</th>
<th>P</th>
<th>Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td><strong>Total Project Effort</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>PCS - Provide Client Support</td>
<td>3018.35</td>
<td>2920.75</td>
<td>1563.34</td>
<td>1293.98</td>
<td>2653.83</td>
<td>19962.50</td>
<td>28%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>MSO - Monitor System Operations</td>
<td>47.67</td>
<td>20.59</td>
<td>20.59</td>
<td>20.59</td>
<td>620.59</td>
<td>350.00</td>
<td>77%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>CORCT - Perform Minor Changes - Corrective</td>
<td>96.17</td>
<td>54.33</td>
<td>33.83</td>
<td>52.00</td>
<td>626.57</td>
<td>480.00</td>
<td>31%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>PERFCT - Perform Minor Changes - Perfective</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>ADAPT - Perform Minor Changes - Adaptive</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>MINENV - Perform Minor Changes - Enhancement</td>
<td>1595.75</td>
<td>1153.92</td>
<td>520.67</td>
<td>102.50</td>
<td>1110.34</td>
<td>10300.00</td>
<td>9%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>OSG - Ongoing Support - Perform Temporary Fix</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>0.50</td>
<td>2.50</td>
<td>10.00</td>
<td>75%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>RL - Release Application</td>
<td>281.25</td>
<td>28.83</td>
<td>12.50</td>
<td>4.83</td>
<td>927.58</td>
<td>266.00</td>
<td>249%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>RELAT - Release Application - FAT</td>
<td>139.75</td>
<td>35.00</td>
<td>5.50</td>
<td>11.00</td>
<td>225.75</td>
<td>222.00</td>
<td>2%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>PI - Impl Appl - Monitor Prod Appl (Post Imp)</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>IM - Implement Application</td>
<td>8.00</td>
<td>357.83</td>
<td>15.00</td>
<td>41.00</td>
<td>882.83</td>
<td>460.00</td>
<td>92%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>TR - Project-Related Travel</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>TH - Project-Related Training</td>
<td>149.08</td>
<td>340.07</td>
<td>330.00</td>
<td>352.00</td>
<td>3505.17</td>
<td>1614.00</td>
<td>114%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td><strong>Work Management (WM)</strong></td>
<td>496.42</td>
<td>537.00</td>
<td>505.92</td>
<td>514.75</td>
<td>5559.01</td>
<td>4064.50</td>
<td>38%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>% WM Effort</td>
<td>16%</td>
<td>18%</td>
<td>32%</td>
<td>40%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>PL - Plan Project Work</td>
<td>0.00</td>
<td>3.00</td>
<td>1.00</td>
<td>0.50</td>
<td>104.00</td>
<td>473.50</td>
<td>70%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>PLRS - Plan Project Work - Retine Scope &amp; Approach</td>
<td>5.00</td>
<td>20.00</td>
<td>75%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>EX - Execute Project Plan</td>
<td>496.42</td>
<td>534.00</td>
<td>504.92</td>
<td>514.25</td>
<td>5487.01</td>
<td>3571.00</td>
<td>54%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>MS - Manage Suppliers</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>26</td>
<td><strong>Total Review Effort</strong></td>
<td>135.84</td>
<td>213.00</td>
<td>60.42</td>
<td>5.91</td>
<td>731.25</td>
<td>1505.00</td>
<td>51%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>27</td>
<td>WM Review Effort</td>
<td>6.50</td>
<td>0.58</td>
<td>0.00</td>
<td>0.66</td>
<td>19.16</td>
<td>51.00</td>
<td>62%</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Supporting the CMMI Metrics Framework thru Level 5**

September 2009
Supporting the CMMI Metrics Framework thru Level 5

Project Tracking Reports (PTR) - Analysis Procedures
Supporting the CMMI Metrics Framework thru Level 5

Project Tracking Reports (PTR) - Consolidation

- Effort Data
- Change Request data
- Size data...

Consolidation Process

Organizational Metrics Repository

- Project Tracking Reports - Project 1
- Project Tracking Reports - Project 2
- Project Tracking Reports - Project N
Organizational Metrics Analysis Report

- Some examples:
  - **Productivity:**
    - Hours per FP per platform
    - KLOC per resource per month per platform
  - **Quality Assurance:**
    - Average number of non-conformances per audit
    - Average days for non-conformances closing
  - **Defects:**
    - Defect density (#defects / size * 100)
    - Defect containment (#defeitos detected in peer reviews/ados em revisões/#total defects) by deliverable/phase.
  - **Estimates:**
    - Effort variation by project/Service Request by platform/language
    - Duration variation by project/Service Request by platform/language
  - **OPP Baselines and Models**
  - **Customer Satisfaction Index**
Supporting the CMMI Metrics Framework thru Level 5

Statistical & Simulation Tools - Minitab/Crystal Ball

I-MR Chart of Effort
Tickets from 2007

X = 2.14

UCL = 7.67
LCL = 0

Tickets from 2007

Approval value:

UCL = 4.79
LCL = 0
### Process Performance Baselines (PPBs)

<table>
<thead>
<tr>
<th>Name</th>
<th>Description</th>
<th>Main Characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Design Defect Density</strong></td>
<td>It shows the expected range of Defect Density (number of Defects by Pages of Documentation * 100) for the External Reviews.</td>
<td>- Design Phase&lt;br&gt;- Health Care&lt;br&gt;- Design Work Products&lt;br&gt;- Minor Enhancement</td>
</tr>
<tr>
<td><strong>Testing Productivity</strong></td>
<td>It shows the range of expected Appl.CR productivity when a Test Case is created.</td>
<td>- Produce Phase&lt;br&gt;- Health Care, Transportation&lt;br&gt;- Test Case&lt;br&gt;- Minor Enhancement</td>
</tr>
<tr>
<td><strong>Effort Variation</strong></td>
<td>It shows the range of expected effort variation that would normally be achieved by a Application CR following the minor modification process with similar characteristics.</td>
<td>- Main Phases (Design, Produce and Testing).&lt;br&gt;- Health Care, Transportation&lt;br&gt;- Primary Language (Cobol, Cool:Gen, Java, Shell Script)&lt;br&gt;- Minor Enhancement</td>
</tr>
<tr>
<td><strong>Ticket Effort Resolution</strong></td>
<td>It shows the behaviour of the ticket resolution process.</td>
<td>- On-going support&lt;br&gt;- Ticket category&lt;br&gt;- Effort ticket resolution</td>
</tr>
</tbody>
</table>
## Process Performance Models (PPMs)

### Life Cycle | GAD QMS | Predictability | Productivity | Quality
--- | --- | --- | --- | ---
Produce | ![Standard Process] | ![Business Skill] | ![Test Case Creation] | ![Test Case Creation]
Non Dev Ticket | ![Standard Process] | ![Knowledge Base] | ![Knowledge Base] | ![Knowledge Base]

---

### Effort Variation Model per Primary Language

<table>
<thead>
<tr>
<th>Project Data</th>
<th>Limits for Effort Variation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project</td>
<td>c</td>
</tr>
<tr>
<td>Developer</td>
<td>c</td>
</tr>
</tbody>
</table>

Regression Equation:

- \( Fitted \ Line \ Plot \):
  \[ \text{Coding} = 10.86 - 0.4746 \times \text{Code line Qty _avg} + 0.007352 \times (\text{Code line Qty _avg})^2 \]

- \( \text{Apr/2007 to Apr/2008} \)

Productivity & Quality

**Life Cycle**

- **GAD QMS**: Standard Process
- **Predictability**: Business Skill
- **Productivity**: Test Case Creation
- **Quality**: Test Case Creation

**Effort Variation**

<table>
<thead>
<tr>
<th>Current Perspective</th>
<th>Estimated Effort</th>
<th>Actual Effort</th>
<th>Forecasted Effort</th>
<th>Current Effort Variability</th>
<th>Unadjusted Business Skill</th>
<th>Simulated Effort</th>
<th>Simulated Effort Variability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Design</td>
<td>40.00</td>
<td>80.00</td>
<td>100%</td>
<td>25.52</td>
<td>1.00</td>
<td>60.00</td>
<td>100.00%</td>
</tr>
<tr>
<td>Produce</td>
<td>40.00</td>
<td>40.00</td>
<td>0%</td>
<td>25.52</td>
<td>3.00</td>
<td>23.32</td>
<td>-40.45%</td>
</tr>
<tr>
<td>Testing</td>
<td>40.00</td>
<td>40.00</td>
<td>0%</td>
<td>25.52</td>
<td>3.00</td>
<td>23.32</td>
<td>-40.45%</td>
</tr>
<tr>
<td>Total</td>
<td>120.00</td>
<td>160.00</td>
<td>33%</td>
<td>127.64</td>
<td>0%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Project Specific Limits**

- **Current Perspective**: Effort Variation
- **Simulated Perspective**: Effort Variation

- **Min UB**: 30%
- **Average**: 20%
- **Max UB**: 40%

**Confidence Intervals for Effort Variation**

- **Current Perspective**: Effort Variation
- **Simulated Perspective**: Effort Variation
**DMAIC Initiatives – Quality**

*Client:*

The Business Need

- Increase the quality of the final product;
- Reduce the bottleneck on the application US SME.

*Results:*

- The Health Care industry detects 98.5% of defects;
- Design phase is the origin of 68.9% of defects;
- Developer role injects 88.0% of defects.

*Simulation:*

- In order to evaluate the alternatives a simulation was performed, evaluating the impact on External Defect Density and Cost. Cristal Ball, a Monte Carlo simulator, was the tool used.

*Analysis:*

- The analysis of defects raised at ASFOA Rio External Reviews showed that:
- The Simulation Health Care industry detects 98.5% of defects;
- Design phase is the origin of 68.9% of defects;
- Developer role injects 88.0% of defects.

*Regression:*

- A model was developed and deployed on Health Care projects. The Project Manager will use it to analyze the benefits of perform an internal review to retain defects.

*Supporting the CMMI Metrics Framework thru Level 5*
1. M&A/OPP/QPM will force you to create a structured process for Strategic Business Planning. If you don’t have it will be very difficult to implement M&A/OPP/QPM practices.

2. Have a long-term strategy to store measurement data, not only M&A but also SPC data.

3. Have an integrated set of tools supporting your Software Engineering projects, otherwise metrics collection will be a nightmare.

4. Reduce the effort, as much as you can, for metrics collection process, if possible, collect at the same time that the task is being performed.

5. Do specialize people on SPC, Six Sigma otherwise levels 4 and 5 will be a very hard journey. Consider to have statisticians around.

6. Excel will not be sufficient in many cases for QPM/OPP.

7. Do start with few performance indicators and then sophisticate and add additional ones, please remember, they must be aligned to companies’ goals/objectives. 100 performance indicators will not allow you to take any conclusion.

8. Keep these indicators stable, as much as possible, so that you can analyze them periodically.

9. Do not individualize data at personal level, particularly on QPM/OPP analysis where sub-process analysis may lead you to see detailed data on people.