Baselines and Models for Tailoring

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Northrop Grumman Corporation
• Typical vs Mature Organizations
• Value of Tailoring Metrics
• Example of Tailoring Baselines and Models
• Baselines and models are only possible if your tailoring approach was designed for higher levels of maturity

• In other words,... you have tailoring METRICS
Storyboard of a Typical Organization

1. Create Standard Processes
   - Develop policies and standard processes in Word

2. Post Standard Processes
   - Provide Word files to projects

3. Go Into Hibernation
   - Wait for the next process initiative

4. Update Years Later
   - Update policies and standard processes years later
Storyboard of a Mature Organization

1. Create Standard Processes
   - Develop policies and standard processes in a tool

2. Post Standard Processes
   - Provide the tool to projects

3. Let the Tool Gather Metrics
   - Walk away knowing the tool will automatically gather metrics

4. Improve Standard Processes
   - Use the metrics, to improve the policies and standard processes regularly

CMMI Level
Storyboard of a Typical Organization
Trying to Become More Mature

Collect Defined Processes
Collect Word files from projects

Figure Out What Was Tailored
Analyze red revision bars in every Word file

Waste Resources
Waste an enormous amount of money and time

Improve Standard Processes
Use the error-prone method to improve the policies and standard processes regularly

CMII Level
The 3 “P”s and CMMI Maturity Levels

- **Process**
  - Metrics to monitor the process, e.g., process effectiveness

- **Product**
  - Metrics to monitor the product, e.g., peer reviews and test

- **Project**
  - Metrics to monitor the project, e.g., cost and schedule
Let’s just beef up the baselines and models from Levels 2-3 and add more variables. Just make it fancier with more bells and whistles.

What happened to “Process”? 

Baselines and models to predict defects from peer reviews and test

Baselines and models to predict cost and schedule
Baselines and Models for Mature Organizations

Don’t give up on “Process”.

Think about baselines and models for OPD, OPF, OT, etc.

Expand your thinking.
### Create a Tailoring Tool that Collects Metrics

#### Microsoft Excel - dm-355 Rev 08 10-01-04.xls

<table>
<thead>
<tr>
<th>A</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>I</th>
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<tbody>
<tr>
<td>924</td>
<td>Risk Management</td>
<td>Selection</td>
<td>Rationale</td>
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<table>
<thead>
<tr>
<th>4.5</th>
<th>Handle Risks</th>
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<td>Handle Risks</td>
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</tr>
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</table>

#### Use any tool that can collect metrics

**Applicable**

**Original**

**Modified**

**Risk handling options are defined in the Risk Management Plan.**

**Compliant**

**Modified**

**Plans must be written. Action items are not allowed.**

**Deleted**

**Results of mitigation actions are not known when the plan is being written.**

**Applicable**

**Applicable**

**Applicable**

**Applicable**

**Applicable**

**Applicable**

**Applicable**

**Applicable**

**Applicable**

**Applicable**
Example 1 of Tailoring Metrics’ Value
Analyze Policy Tailoring

Project Tailoring of Policies

Test for Equal Variance (F-Test)

<table>
<thead>
<tr>
<th>Project Tailoring of Policies</th>
</tr>
</thead>
<tbody>
<tr>
<td>921 Project Planning</td>
</tr>
<tr>
<td>922 Project Monitoring and Control</td>
</tr>
<tr>
<td>923 Supplier Agreement Management</td>
</tr>
<tr>
<td>924 Risk Management</td>
</tr>
<tr>
<td>925 Quantitative Project Management</td>
</tr>
<tr>
<td>926 Project Review Authority</td>
</tr>
</tbody>
</table>

**Actions:** Improved the list of metrics in 926 Project Review Authority.

*Project tailoring varies more since some projects do not have suppliers*

*Project tailoring varies the most on the policy unique to Mission Systems*
Example 2 of Tailoring Metrics’ Value
Analyze Standard Process Additions

Actions: Identified potential improvements to the standard processes.
A stretch of process steps in the Risk Management (924) standard process was being tailored frequently. After investigating, it was discovered the process steps were way too detailed and not really “standard” practice. As a result, the standard process was changed to have projects define the details in their project plans.

A process step in the Integration (934) standard process was being tailored frequently. After investigating, it was discovered the process step was not what is normally done on projects, i.e., it wasn’t “standard” practice. The process step was deleted.
Baselines and Models Always Need a Goal

My goal,...

Stop the Complaining
Stop the Excuses
Stop the Wasted Hours
Stop the Bad Decisions

Goals should be related to your pain and what you care about.
One project spent 8,000 hours (4 years) to tailor the standard process. Each process area was assigned to a team of people who had several meetings to discuss each process step.
Decided to Create a Model for Hours to Tailor

Questions People Ask

Why didn’t you create a model for the amount of tailoring?

Why didn’t you create a model for waivers and deviations?

Why didn’t you create a model for the number of additions?

Why didn’t you create a model for my next raise?
You create more and more and don’t know why, except that you want to pass CMMI Level 5. The only model needed was the one to heal my pain (goal-driven).
Controllable vs Non-Controllable Factors

**Controllable Factors**
- Method (Blank, Pre-Tailor, Reused, Pre-Populated)
- Effort for Tailoring (Heads Assigned to Tailoring)

**Non-Controllable Factors**
- Development Type (Development, Maintenance, Services, Other)
- Project Type (Software, Hardware, Systems)
- Project Size (Heads)

*A model is not a model unless there are controllable factors (“what-if”)**
## Tailoring Baselines

### Non-Controllable Factors

<table>
<thead>
<tr>
<th>Project Type Baselines</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Med</th>
<th>Mean</th>
<th>Q1</th>
<th>Q3</th>
<th>StDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Development</td>
<td>109</td>
<td>0.3</td>
<td>8000.0</td>
<td>97.0</td>
<td>273.2</td>
<td>46.5</td>
<td>230.0</td>
<td>831.2</td>
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<tr>
<td>Maintenance</td>
<td>69</td>
<td>7.0</td>
<td>2654.0</td>
<td>100.0</td>
<td>231.8</td>
<td>55.0</td>
<td>242.5</td>
<td>432.2</td>
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<td>Services</td>
<td>61</td>
<td>4.0</td>
<td>8000.0</td>
<td>60.0</td>
<td>320.0</td>
<td>32.0</td>
<td>121.0</td>
<td>1147.0</td>
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<tr>
<td>Other</td>
<td>27</td>
<td>11.0</td>
<td>640.0</td>
<td>56.0</td>
<td>91.3</td>
<td>24.0</td>
<td>100.0</td>
<td>127.6</td>
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</table>

<table>
<thead>
<tr>
<th>Development Type Baselines</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Med</th>
<th>Mean</th>
<th>Q1</th>
<th>Q3</th>
<th>StDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Software</td>
<td>128</td>
<td>0.3</td>
<td>8000.0</td>
<td>98.5</td>
<td>256.7</td>
<td>45.1</td>
<td>227.5</td>
<td>770.1</td>
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<tr>
<td>Hardware</td>
<td>37</td>
<td>0.3</td>
<td>2654.0</td>
<td>140.0</td>
<td>239.1</td>
<td>60.0</td>
<td>270.5</td>
<td>434.5</td>
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<tr>
<td>Systems</td>
<td>75</td>
<td>0.0</td>
<td>8000.0</td>
<td>8.5</td>
<td>296.0</td>
<td>36.0</td>
<td>208.0</td>
<td>1038.0</td>
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<table>
<thead>
<tr>
<th>Project Size Baselines</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Med</th>
<th>Mean</th>
<th>Q1</th>
<th>Q3</th>
<th>StDev</th>
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<tbody>
<tr>
<td>Micro Project (&lt; 10 FTEs)</td>
<td>20</td>
<td>10.0</td>
<td>200.0</td>
<td>73.0</td>
<td>79.9</td>
<td>24.0</td>
<td>102.0</td>
<td>60.3</td>
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<td>Small Project (&lt; 20 FTEs)</td>
<td>38</td>
<td>3.0</td>
<td>542.0</td>
<td>49.0</td>
<td>78.7</td>
<td>24.5</td>
<td>104.6</td>
<td>101.9</td>
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<tr>
<td>Medium Project (&lt; 100 FTEs)</td>
<td>89</td>
<td>0.3</td>
<td>1220.0</td>
<td>97.0</td>
<td>170.1</td>
<td>53.3</td>
<td>239.5</td>
<td>197.5</td>
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<tr>
<td>Large Project (&gt;= 100 FTEs)</td>
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<td>7.0</td>
<td>8000.0</td>
<td>100.0</td>
<td>579.0</td>
<td>46.0</td>
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### Controllable Factors

<table>
<thead>
<tr>
<th>Method Baselines</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Med</th>
<th>Mean</th>
<th>Q1</th>
<th>Q3</th>
<th>StDev</th>
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</thead>
<tbody>
<tr>
<td>a. Blank</td>
<td>92</td>
<td>0.3</td>
<td>8000.0</td>
<td>86.0</td>
<td>290.7</td>
<td>51.3</td>
<td>220.0</td>
<td>900.0</td>
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<tr>
<td>b. Pre-tailor</td>
<td>14</td>
<td>12.0</td>
<td>400.0</td>
<td>120.5</td>
<td>137.7</td>
<td>39.5</td>
<td>218.5</td>
<td>113.0</td>
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<tr>
<td>c. Reused</td>
<td>25</td>
<td>7.0</td>
<td>430.0</td>
<td>69.0</td>
<td>99.2</td>
<td>22.0</td>
<td>153.5</td>
<td>104.5</td>
</tr>
<tr>
<td>d. Pre-populated</td>
<td>19</td>
<td>11.0</td>
<td>1053.0</td>
<td>90.0</td>
<td>175.7</td>
<td>31.0</td>
<td>280.0</td>
<td>239.2</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Heads for Tailoring Baselines</th>
<th>N</th>
<th>Min</th>
<th>Max</th>
<th>Med</th>
<th>Mean</th>
<th>Q1</th>
<th>Q3</th>
<th>StDev</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 1</td>
<td>41</td>
<td>0.3</td>
<td>230.0</td>
<td>63.0</td>
<td>76.7</td>
<td>25.5</td>
<td>98.5</td>
<td>67.5</td>
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<tr>
<td>b. 1 to 2</td>
<td>35</td>
<td>8.0</td>
<td>315.0</td>
<td>60.0</td>
<td>84.4</td>
<td>24.0</td>
<td>130.0</td>
<td>83.0</td>
</tr>
<tr>
<td>c. 2</td>
<td>25</td>
<td>17.0</td>
<td>2654.0</td>
<td>84.0</td>
<td>219.0</td>
<td>45.0</td>
<td>161.0</td>
<td>519.0</td>
</tr>
<tr>
<td>d. 3 or more</td>
<td>23</td>
<td>20.0</td>
<td>8000.0</td>
<td>252.0</td>
<td>669.0</td>
<td>92.0</td>
<td>300.0</td>
<td>1670.0</td>
</tr>
</tbody>
</table>

- Collected metrics from 184 projects
- These baselines are provided to projects
- Per the CMMI, baselines have distribution (StDev) and range (Min Max)
Hours for Tailoring are **WILD**

Our metrics,...

*Lesson learned,*... you better have a very specific operational definition (directions for the metrics you want) or you get this! We had to redo the definition.
Tailoring “Rough” Estimation Model

- The “rough” model uses the baselines to provide a range of estimated hours
- Users select from the blue pulldown menus
- The model is “rough” because the factors are not correlated with one another, i.e., some factors have a greater influence on the estimated hours
- An accurate model correlates the factors and uses a regression equation

<table>
<thead>
<tr>
<th></th>
<th>Q1</th>
<th>Q3</th>
<th>Median</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Project type is primarily:</td>
<td>Development</td>
<td>46.5</td>
</tr>
<tr>
<td>2</td>
<td>Development type is primarily:</td>
<td>Software</td>
<td>45.1</td>
</tr>
<tr>
<td>3</td>
<td>Project size:</td>
<td>Small Project (&lt; 20 FTEs)</td>
<td>24.5</td>
</tr>
<tr>
<td>4</td>
<td>Method to complete the tailoring:</td>
<td>c. Reused</td>
<td>22.0</td>
</tr>
<tr>
<td>5</td>
<td>Heads to complete the tailoring:</td>
<td>c. 2</td>
<td>45.0</td>
</tr>
</tbody>
</table>

Estimated Hours: 37 to 80  
36.62  175.32  79.5
Tailoring Regression Estimation Model

- The regression equation was developed using Minitab
- Unlike the previous model, which used pulldown menus (discrete data), this model uses continuous data for Project Size and Heads for Tailoring, which is more accurate
- This model accounts for multiple Project Types and Development Types
- This model accounts for normal vs. lognormal data, which is also more accurate

### Tailoring Hours: Regression Model

1. **Project Type:**
   - Development: Yes
   - Maintenance: Yes
   - Services: No
   - Other: No

2. **Development Type:**
   - Software: Yes
   - Hardware: Yes
   - Systems: Yes

3. **Project Size (Number of FTE Heads):**
   - 20

4. **Number of heads to complete the tailoring:**
   - 1

5. **Method to complete the tailoring:**
   - Reused

**Estimated Hours:** 38
Monte Carlos Can Also Be Used

- The Monte Carlo was done using Crystal Ball
- The Monte Carlo range is more accurate than the “rough” model presented earlier
- Monte Carlo provides fields where the user can enter percentages. In the example to the left, there is 80% certainty that tailoring will take between 32.79 and 91.51 hours
Did it Help My Pain to Achieve My Goal?  

YES
Projects Can See the Effect of Their Decisions

1 Person Completes the Tailoring

Tailoring Hours: Regression Model

1 Project Type:
- Development: Yes
- Maintenance: No
- Services: No
- Other: No

2 Development Type:
- Software: Yes
- Hardware: No
- Systems: No

3 Project Size (Number of FTE Heads): 50

4 Number of heads to complete the tailoring: 1

5 Method to complete the tailoring: Blank

Estimated Hours: 65

8 People Complete the Tailoring

Tailoring Hours: Regression Model

1 Project Type:
- Development: Yes
- Maintenance: No
- Services: No
- Other: No

2 Development Type:
- Software: Yes
- Hardware: No
- Systems: No

3 Project Size (Number of FTE Heads): 50

4 Number of heads to complete the tailoring: 8

5 Method to complete the tailoring: Blank

Estimated Hours: 6348

65 vs. 6,348 hours
Summary

- Mature organizations create baselines and models for “Process”, not just “Project” and “Product”
- Have goals before creating any baselines and models or you end up with non value-added baselines and models
- Models are powerful tools that allow users to make better choices, i.e., “what-if” analysis

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Stop the Guessing