**Evolving Postmortems as Teams Evolve Through TxP**

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**Approved for public release; distribution unlimited**

**Same as Report (SAR)**

<table>
<thead>
<tr>
<th>a. REPORT</th>
<th>b. ABSTRACT</th>
<th>c. THIS PAGE</th>
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<tbody>
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**unclassified**
Agenda

• NAVAIR

• Team Process Integration (TPI)

• Team “X” Process (TxP)

• Time-Based Postmortem

• Size-Based Postmortem

• Quality-Based Postmortem
NAVAIR
What is NAVAIR?

- NAVAIR is the **Naval Air Systems Command**

- Develop, acquire, and support the **aircraft** and related **weapons** systems used by **U.S. Navy and Marine Corps**

- Our **goal is to provide the fleet with quality products** that are both **affordable** and **available** when most needed

- Our support extends across the **entire life span** of a product, including all **upgrades and modifications** to that product
Where is NAVAIR?

- NAVAIR Headquarters
- Acquisition/Test/Development Centers
- Naval Aviation Depots

- China Lake
  - WEAPONS DIVISION

- Pt Mugu
  - WEAPONS DIVISION

- North Island
  - NADEP DEPOT

- Lakehurst
  - ALRE - SUPPORT EQ
  - AIRCRAFT DIVISION

- Patuxent River
  - NAVAIRHQ, PEOs
  - AIRCRAFT DIVISION

- Cherry Point
  - NADEP DEPOT

- Jacksonville
  - NADEP DEPOT

- Orlando
  - TRAINING SYSTEMS DIVISION

- Orlando
  - TRAINING SYSTEMS DIVISION
Process Resource Team – a PI History at NAVAIR

Process Improvement Phase

Team Process Based Systems+
Team Process Based Systems
Model Based Systems
Team Process Based Software
Model Based Software

Change Management
Process Modeling
TPI Launches
TPI Research
CMMI
TSP Launches
PSP classes
CMM

Year
2011
2010
2009
2008
2007
2006
2005
2004
2003
2002
2001
2000
1999
1998
1997
1996
1995
1994
1993
Team Process Integration (TPI)
Models and Processes

**Capability Maturity Models:**
Reference for organizations building process capability

**Team Processes:**
Processes for teams building quality products on cost and schedule

**Personal Processes:**
Processes used to train individual skill and discipline
Key Team Process Framework

Customer Need

1. Plan
   - Define assignment
   - Produce conceptual design
   - Estimate size
   - Estimate effort
   - Determine Tasks
   - Produce schedule
   - Size database
   - Productivity database
   - Process Phases
   - Resources available
   - Time, Size, Mistake, EV
   - Process analysis

2. Work
   - Team members develop products/provide services
   - Individuals collect measures daily
   - Team tracks progress weekly
   - Repeat as necessary

3. Analyze
   - Goals, products & services, top-down & bottom-up planning with load balancing, risk assessment
   - Update historical data used for future planning

Customer

Deliver products & services

Develop products & services
Team Measures and Metrics

- Each team member gathers four basic measures:
  - Times
  - Sizes
  - Mistakes
  - Task completion dates

Charts and tables of project metrics are available (updated in real time)

- Direct Hours
- Earned Value
- Tasks in Progress
- many more...
NAVAIR TPI

- Success of software teams using TSP led their organizations to ask for same performance on other teams
  - Worked with the SEI to develop approach
  - Based on same TSP fundamental principles

- NAVAIR approach has become TPI for all teams
  - Teams plan all work from first launch forward
  - Work is based on all products and services defined in process modeling
  - PSP for Engineers training planned as part of project if appropriate
Just-in-Time TPI Training

**Learning**

- Personal Process (half-day)
- Personal Planning
  - Personal Quality
  - Plan Overview (half-day)
- Operational Overview
  - TPI Tool Overview (half-day)
- PSP Fundamentals (one week)

**Doing**

- Process Modeling
  - (one to four half-day sessions)
- Plan the work
  - (four days)
- Work the plan
  - (cycle 1)
  - (three to nine months)
Team [topic-name] Process (TnP)
TPI Pluses & Minuses

+ A detailed plan!
+ Ability to track progress (weekly)
+ Improved estimating (over cycles)

− No mature processes
  − “Where do we put mistake-fixing phases?”

− No defect type standards
  − “What kinds of mistakes do I make?”

− No quality planning
  − “Will our plan produce a good product?”

− No quality indicators (e.g., A/FR)
CMMI, TSP & PSP Relationship

CMMI - Builds organizational capability

TSP - Builds quality products on cost and schedule

PSP - Builds individual skill and discipline

TRP (Rqmts)  T  TTP (Sys Test)  TnP

PRP  P  PTP  PxP

TTP (Sys Test)
TPI is Only a Waypoint

• TPI teams will hit a glass ceiling

• TPI teams need to evolve to achieve TSP-like performance (become a TxP team)

• What else does a TPI team have to do in order to become a TxP team?

• **What does a TSP team do?**
What Does a TSP Team Do?

Typical TSP Cycle

<table>
<thead>
<tr>
<th>Plan the Work</th>
<th>(Work the Plan)</th>
<th>Analyze the Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Launch</td>
<td>Weekly Meetings and Day-to-Day Actions</td>
<td>Postmortem</td>
</tr>
</tbody>
</table>

TSP Activities

- Planning Activities
- Working Activities
- Analyzing Activities

And they develop software too!
## TxP Planning Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>From the Start</th>
<th>Some Time Later</th>
<th>Get To Last</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project and Management Objectives</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Team Goals and Roles</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Strategy and Support</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall Plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planned sizes and rates used to compute times</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quality Preparation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planned Defects Injected/Removed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Planned quality indicator values are acceptable</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Balanced Plan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project Risk Analysis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Launch Report Preparation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Management Review</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Launch Postmortem</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
 TxP Working Activities

- Logging time
- Logging defects
- Tracking EV
- Using PROBE in Planning phase
- Entering actual sizes in Postmortem phase
- Defining Defect Types
- Using Review checklists
- Holding periodic team meetings
- Following an agenda during team meetings
- Performing/reporting on assigned roles
- Reviewing action items
- Reviewing assigned goals and risks
- Maintaining project plan and workbook
# TxFP Analyzing Activities

<table>
<thead>
<tr>
<th>Activity</th>
<th>From The Start</th>
<th>Some Time Later</th>
<th>Get To Last</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evaluate plan vs. actual schedule hours</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate plan vs. actual component hours</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluate plan vs. actual component sizes</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Evaluate team performance vs. goals and quality plan</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Evaluate plan vs. actual quality of components</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Update planning data for schedule hours</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Update planning data for lifecycle time-in-phase %s</td>
<td>✔</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Update planning data for productivity rates</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Update planning data for defect densities</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Update planning data for defect rates and yields</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
<tr>
<td>Update planning data for quality indicator thresholds</td>
<td></td>
<td></td>
<td>✔</td>
</tr>
</tbody>
</table>
Training & First Launch
- 3-part TPI Training
- Process Modeling
- First Launch

Product Size Definition
- Define size measures
- Add Planning and Postmortem phases
- Begin use of PROBE

Defect Removal
- Define Defect Types
- Refine Processes with Defect Removal Phases

Quality Indicators
- Define Product Quality Indicators
- Define Process Quality Indicators

Transitions

Stages
- TIME-Based
- SIZE-Based
- QUALITY-Based
- TxP

Planning Activities

Working Activities

Analyzing Activities

3-part TPI Training
- Add Planning and Postmortem phases
- Begin use of PROBE

Defect Removal Phases
- Define Defect Types
- Refine Processes with Defect Removal Phases

Quality Indicators
- Define Product Quality Indicators
- Define Process Quality Indicators

Training & First Launch
- Process Modeling
- First Launch

Product Size Definition
- Define size measures
- Add Planning and Postmortem phases
- Begin use of PROBE

Defect Removal
- Define Defect Types
- Refine Processes with Defect Removal Phases

Quality Indicators
- Define Product Quality Indicators
- Define Process Quality Indicators
Time-Based Postmortem

• The team’s most consistent data at first is time
  – Time on Task by Team Member
  – Planned vs. Actual Time by Component
  – Planned vs. Actual Time by Product/Service Type
  – Planned vs. Actual Time by Workflow

• Sample Time Log

<table>
<thead>
<tr>
<th>Logged To</th>
<th>Start Time</th>
<th>Delta</th>
</tr>
</thead>
<tbody>
<tr>
<td>/Project/PRT FY2014/Common/Monthlies/Oct 2013/TPI Coaching/AV-8B SW/Do</td>
<td>Tue Oct 08 08:00:52 PDT 2013</td>
<td>0:10</td>
</tr>
<tr>
<td>/Project/PRT FY2014/TPI/Checkpoints/H-1 SIT - Aug 2013 part 2/Follow-up</td>
<td>Tue Oct 08 08:20:49 PDT 2013</td>
<td>0:17</td>
</tr>
<tr>
<td>/Project/PRT FY2014/TPI/Checkpoints/H-1 SIT - Aug 2013 part 2/Follow-up</td>
<td>Tue Oct 08 08:45:47 PDT 2013</td>
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<td>Tue Oct 08 10:00:13 PDT 2013</td>
<td>0:05</td>
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<tr>
<td>/Project/PRT FY2014/Common/Monthlies/Oct 2013/TPI Coaching/Informal/Do</td>
<td>Tue Oct 08 10:17:40 PDT 2013</td>
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<td>Wed Oct 09 08:00:06 PDT 2013</td>
<td>0:48</td>
</tr>
</tbody>
</table>
Time on Task by Team Member

- Time Log analysis
  - Accuracy & precision of estimates
  - Real-time logging vs. backfilling

\[ y = 1.0731x \]
\[ R^2 = 0.4001 \]
Time by Component

By Component

- Study any points in red regions
- Adjust team productivity rates for next cycle

By Component Type

+18%
-3%
+29%

\[ y = 0.5018x \]
\[ R^2 = 0.4022 \]
**Time by Workflow**

<table>
<thead>
<tr>
<th>Activity</th>
<th>Plan Time</th>
<th>Actual Time</th>
<th>Plan %</th>
<th>Actual %</th>
<th>Act - Plan</th>
<th>Next Plan</th>
<th>Normalized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning</td>
<td>68:06</td>
<td>41:03</td>
<td>2.4%</td>
<td>1.4%</td>
<td>-1.1%</td>
<td>2.4%</td>
<td>2.3%</td>
</tr>
<tr>
<td>High-Level Design</td>
<td>248:01</td>
<td>251:46</td>
<td>8.8%</td>
<td>8.4%</td>
<td>-0.4%</td>
<td>8.8%</td>
<td>8.4%</td>
</tr>
<tr>
<td>HLD Inspection</td>
<td>103:07</td>
<td>65:44</td>
<td>3.7%</td>
<td>2.2%</td>
<td>-1.5%</td>
<td>3.7%</td>
<td>3.5%</td>
</tr>
<tr>
<td>Detailed Design</td>
<td>356:52</td>
<td>339:32</td>
<td>12.7%</td>
<td>11.3%</td>
<td>-1.4%</td>
<td>12.7%</td>
<td>12.2%</td>
</tr>
<tr>
<td>Detailed Design Review</td>
<td>129:06</td>
<td>90:59</td>
<td>4.6%</td>
<td>3.0%</td>
<td>-1.6%</td>
<td>4.6%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Test Development</td>
<td>61:44</td>
<td>34:58</td>
<td>2.2%</td>
<td>1.2%</td>
<td>-1.0%</td>
<td>2.2%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Detailed Design Inspection</td>
<td>294:44</td>
<td>220:51</td>
<td>10.5%</td>
<td>7.4%</td>
<td>-3.1%</td>
<td>7.4%</td>
<td>7.1%</td>
</tr>
<tr>
<td>Code</td>
<td>435:48</td>
<td>575:10</td>
<td>15.5%</td>
<td>19.2%</td>
<td>3.7%</td>
<td>19.2%</td>
<td>18.4%</td>
</tr>
<tr>
<td>Code Review</td>
<td>143:08</td>
<td>112:39</td>
<td>5.1%</td>
<td>3.8%</td>
<td>-1.3%</td>
<td>5.1%</td>
<td>4.9%</td>
</tr>
<tr>
<td>Compile</td>
<td>21:04</td>
<td>16:06</td>
<td>0.7%</td>
<td>0.5%</td>
<td>-0.2%</td>
<td>0.7%</td>
<td>0.7%</td>
</tr>
<tr>
<td>Unit Test</td>
<td>349:58</td>
<td>485:12</td>
<td>12.4%</td>
<td>16.2%</td>
<td>3.7%</td>
<td>16.2%</td>
<td>15.5%</td>
</tr>
<tr>
<td>Code Inspection</td>
<td>365:50</td>
<td>444:37</td>
<td>13.0%</td>
<td>14.8%</td>
<td>1.8%</td>
<td>13.0%</td>
<td>12.5%</td>
</tr>
<tr>
<td>Build and Integration Test</td>
<td>189:47</td>
<td>290:05</td>
<td>6.7%</td>
<td>9.7%</td>
<td>2.9%</td>
<td>6.7%</td>
<td>6.5%</td>
</tr>
<tr>
<td>Postmortem</td>
<td>46:48</td>
<td>29:26</td>
<td>1.7%</td>
<td>1.0%</td>
<td>-0.7%</td>
<td>1.7%</td>
<td>1.6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>2814:03</td>
<td>2998:08</td>
<td>100.0%</td>
<td>100.0%</td>
<td>104.3%</td>
<td>100.0%</td>
<td></td>
</tr>
</tbody>
</table>

- Isolate times for one kind of activity
  - Analyze & discuss big differences
  - Proposed planned %s for next cycle
Size-Based Postmortem

- Once the team has consistent size data...
  - Productivity Rates by Team Member
  - Planned vs. Actual Size by Component
- Example of Size Documentation

<table>
<thead>
<tr>
<th>BASE PROGRAM SIZE</th>
<th>Estimated</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>BASE SIZE (B)</td>
<td>150</td>
<td>150</td>
</tr>
<tr>
<td>DELETED SIZE (D)</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>MODIFIED SIZE (M)</td>
<td>8</td>
<td>8</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>BASE ADDITIONS</th>
<th>Estimated</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>Report Altitude</td>
<td></td>
<td></td>
</tr>
<tr>
<td>add more rows for base additions...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PARTS ADDITIONS</th>
<th>Estimated</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>GUI</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Altimeter Referencing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>add more rows for parts additions...</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>TYPE</th>
<th>ITEMS</th>
<th>REL. SIZE</th>
<th>SIZE</th>
<th>NR.</th>
</tr>
</thead>
<tbody>
<tr>
<td>I/O</td>
<td>1</td>
<td>Medium</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>Logic</td>
<td>1</td>
<td>Large</td>
<td>23</td>
<td></td>
</tr>
</tbody>
</table>

Total: [39] [55]
Productivity Rates by Team Member

- All individuals have their own rates...per product type

Beta1 (minutes/LOC) = 1.587

PSP Productivity Rate (LOCs/Hr) = 38
Size by Component

Previous Cycle Components

Current Cycle Components

Size Diff ([A-P]/P)

Productivity

Both

Size

OK
Quality-Based Postmortem

- Getting a handle on defects usually happens last
  - Defect Injection Rate by Phase
  - Defect Measures by Defect Type
  - Defects Injected by Phase
  - Defects Removed by Phase

- Sample Defect Log

<table>
<thead>
<tr>
<th>Project</th>
<th>ID</th>
<th>Type</th>
<th>Injected Environment</th>
<th>Injected Test</th>
<th>Removed Environment</th>
<th>Removed Test</th>
<th>Time (M)</th>
<th>Count</th>
<th>Description</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non Project/PSP for Engineers/Program 5</td>
<td>1</td>
<td>Interface</td>
<td>Design</td>
<td>Design Review</td>
<td>5.3</td>
<td>1</td>
<td></td>
<td>did not configure wires properly during board test</td>
<td>09/03/2009</td>
<td></td>
</tr>
<tr>
<td>Non Project/dev/FMPT/JDAM Cross Range</td>
<td>2</td>
<td>Assignment</td>
<td>Design</td>
<td>Design Review</td>
<td>10.8</td>
<td>15</td>
<td></td>
<td>forgot to consider general architecture classes in my...</td>
<td>08/25/2010</td>
<td></td>
</tr>
<tr>
<td>Non Project/dev/FMPT/JDAM Cross Range</td>
<td>3</td>
<td>Documentation</td>
<td>Design</td>
<td>Design Review</td>
<td>6.1</td>
<td>1</td>
<td></td>
<td>didn’t initialize parameters</td>
<td>09/10/2010</td>
<td></td>
</tr>
<tr>
<td>Non Project/dev/FMPT/JDAM Cross Range</td>
<td>4</td>
<td>Interface</td>
<td>Design</td>
<td>Design Review</td>
<td>0.6</td>
<td>1</td>
<td></td>
<td>did not draw data flow arrows in correct direction between...</td>
<td>10/13/2010</td>
<td></td>
</tr>
<tr>
<td>Non Project/dev/FMPT/JDAM Cross Range</td>
<td>5</td>
<td>Interface</td>
<td>Design</td>
<td>Design Review</td>
<td>1.2</td>
<td>1</td>
<td></td>
<td>forgot to flush out paras for func Compute Angle</td>
<td>11/17/2010</td>
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<tr>
<td>Non Project/sw history/Prod A Reqt 3</td>
<td>1</td>
<td>Function</td>
<td>Code</td>
<td>Test</td>
<td>1.1</td>
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<td>inverted to variables</td>
<td>01/29/2009</td>
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<td>Non Project/sw history/Prod A Reqt 3</td>
<td>2</td>
<td>Unclear</td>
<td>Design</td>
<td>Design Review</td>
<td>0.9</td>
<td>3</td>
<td></td>
<td>did not give vars initial values...</td>
<td>10/11/2011</td>
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</tr>
</tbody>
</table>
Defect Injection Rate by Phase
Defect Measures by Defect Type

- Sorted by Fix Time

Defect Fix Times

How many doesn’t always matter

Defect Counts
Defects Injected/Removed by Phase

Height of Red above Green indicates how many mistakes were in the product at that phase of development.

<200 remaining

>600 remaining

Cumulative Defects Injected and Removed

Planned vs. Actual Phase Yields
TxP Postmortem

- Only after the team knows what level of process performance results in a quality product, then they can set goals and compare planned values to actual values.

### RATIOS

<table>
<thead>
<tr>
<th>Plan</th>
<th>Actual</th>
<th>Phase</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.36</td>
<td>0.27</td>
<td>DLD Review/DLD Ratio</td>
</tr>
<tr>
<td>0.82</td>
<td>0.59</td>
<td>DLD/Code ratio</td>
</tr>
<tr>
<td>0.33</td>
<td>0.20</td>
<td>Code Review/Code</td>
</tr>
<tr>
<td>0.00</td>
<td>3.15</td>
<td>Compile Defect Density</td>
</tr>
<tr>
<td>8.86</td>
<td>7.81</td>
<td>Unit Test Defect Density</td>
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</tbody>
</table>

### REVIEW RATES (LOCs/hr)

<table>
<thead>
<tr>
<th>Plan</th>
<th>Actual</th>
<th>Phase</th>
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</thead>
<tbody>
<tr>
<td>336</td>
<td>829</td>
<td>DLD review</td>
</tr>
<tr>
<td>71</td>
<td>136</td>
<td>DLD inspection</td>
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<tr>
<td>147</td>
<td>266</td>
<td>CODE review</td>
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<tr>
<td>60</td>
<td>62</td>
<td>CODE inspection</td>
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### Cost of Quality (COQ)

<table>
<thead>
<tr>
<th>Topic</th>
<th>Plan</th>
<th>Actual</th>
</tr>
</thead>
<tbody>
<tr>
<td>% Appraisal COQ</td>
<td>36.8%</td>
<td>30.8%</td>
</tr>
<tr>
<td>% Failure COQ</td>
<td>19.9%</td>
<td>26.1%</td>
</tr>
<tr>
<td>Appraisal / Failure Ratio (AFR)</td>
<td>1.85</td>
<td>1.18</td>
</tr>
</tbody>
</table>
Things to Remember

• As a team’s process evolves from TPI to TxP, the analysis of their data needs to evolve too.

• Focus on what is value-added to the team and they will strive to collect the data.

• This analysis gives them insight into the quality of their processes used to produce their products and provide their services.
Questions?

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Brad Hodgins

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(760) 939-0666
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  - CMM®
  - Capability Maturity Model Integration®
  - CMMI®
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Acronym List

- A/FR – Appraisal Failure Ratio
- CMM – Capability Maturity Model
- CMMI – Capability Maturity Model Integration
- COQ – Cost of Quality
- DLD – Detailed-Level Design
- EV – Earned Value
- HLD – High-Level Design
- LOC – Line of Code
- NAVAIR - Naval Air Systems Command
- PI – Process Improvement
- PROBE – PROxy-Based Estimating
- PRT – Process Resource Team
- PSP – Personal Software Process
- SEI – Software Engineering Institute
- TSP – Team Software Process
- TPI – Team Process Integration
- TnP – Team [topic name] Process