Multi-Attribute Modeling and Practical Use

David Sobetski, PMP
Margaret Corr
November 18, 2009
Agenda

- GDLS Overview
- Peer Review Tool
- Process Performance Models (PPM)
- Software Metrics Tool
- Results & Benefits
- Challenges
- Summary
Land Systems Products
International Locations

GDLS - Canada
London, Ontario

GDLS - Australia
Adelaide, Australia
Peer Review Tool – History

- Original version created ~2000 for Software Engineering
- Updated over the years, but was always a software tool for software personnel.
- Needed a facelift for usability outside of software – Systems Engineering, Logistics, Prototype Shop, i.e. all engineering (approximately 3000 employees).
- Updated July 2007 with new look and feel.
- Approximately 5000 peer reviews per year across Systems, Software, and Logistics engineering disciplines.
Peer Review Tool – Features

Four types of peer reviews

- Desk Check (Without Meeting)
- Colleague Review (Instant)
- Formal Review (With Meeting)
- Inspection (Formal Review with a Review Lead to verify all issues properly addressed)

- Three levels of issue severity – Major, Minor, & Editorial.
- Over 100 different work product types, each with their own issue categories. Each issue category is mapped to one or more severities.
- User interface leads user through screens.
- Emails automatically sent to participants at various stages of the review.
- Reporting and query capabilities.
- Permissions-based input fields & screens.
- Project-based access to data.
- Used to coordinate peer reviews across sites.
- ITAR (International Traffic in Arms Regulations) compliant.
  - Regularly scheduled reviews with GDLS-Canada.
The following features have been added to the Peer Review Tool:

**Saving Searches**: Users now have the ability to run a search from the Search & Reports page and then save it for later use. An unlimited number of searches can be saved per user with a title and optional description. These searches may also be modified at any time to change the title and description, or change any of the criteria used in the search. These saved searches may also be deleted at any time.

**Prep Time**: Authors may now automatically fill in a value of 6 minutes of Prep Time for all participants/items in a review if those participants have not already entered their Prep Time for an item and if they have not submitted an issue against that particular item.

### Open Peer Reviews You Own or Created

<table>
<thead>
<tr>
<th>Review #</th>
<th>Family Code</th>
<th>Project</th>
<th>Author</th>
<th>Type</th>
<th>Status</th>
<th>Rev. Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>10518</td>
<td>Organizational</td>
<td>Process Improvement</td>
<td>Sobolek, David M</td>
<td>Formal (Meeting)</td>
<td>Scheduled</td>
<td>Sep 23, 2009</td>
</tr>
</tbody>
</table>

### Open Peer Reviews You Are Participating In

<table>
<thead>
<tr>
<th>Review #</th>
<th>Family Code</th>
<th>Project</th>
<th>Author</th>
<th>Type</th>
<th>Status</th>
<th>Rev. Date</th>
</tr>
</thead>
</table>
Peer Review Tool – Create Screen

Peer Review Tool

Create Peer Review

Use this form to create a new peer review. You must first select the Family Code this review belongs to. Then, select the specific Project for this Family Code as well.

- Family Code:
  - Organizational

- Project:
  - 50S - Process Improvement

- Domain:
  - Systems Engineering

- Review Type:
  - Formal Review (With Meeting)

- Author:

- Charge Number:

- Task Code:

- Cross Charge Department:

- Additional Information about the Review:
  - Review of NDIA CMMI Presentation

- Create Peer Review
- Cancel

- Desk Check
- Colleague Review
- Formal Review
- Inspection
Peer Review Tool – Add Items Screen

Add Review Item

Fill out this form to add an item to the review. Please note that browsing for a file on your local hard drive will NOT work! The Network Link now does not attach files, it simply provides a link to the location of the file on the network. You must enter a Network Link or Web Link unless this is an Instant Peer Review.

* Item Name: 
* Version: 

* Item Location (Full Path):
  - Network Link (ex: Unlinked): 
  - Web Link (ex: IDE, ACE): 

* Support Item? [ ] Yes [ ] No

* Work Product Type: [Select One] 

* Work Product Size: 
Select a Work Product Type to determine the proper Units

Add Review Item  Cancel

100+ Work Product Types.
Size Units dependent upon work product type.

List of Items to be Reviewed

Item # 1 - NDIA CMMI Presentation Abstract
Version: 1
Web Link: http://www.ndia.org/meetings/0110/Documents/Abstracts/9407.pdf
Work Product: Type: Technical Publication (Or Equivalent) Size: 1 Pages To Be Reviewed

List of Support Items (Items Not Being Reviewed)

There are currently no support items.

Viewing Review #10519
Peer Review Tool – Issues Screen

Tabs lead user through peer review steps.

Categories based upon type of work product.

Severity based upon Category.
  - Major
  - Minor
  - Editorial
Peer Review Tool – Search Screen

Search upon any field to obtain data for analysis and reports.

Multiple report types available.
PPMs Use Peer Review Data

Peer Review Tool

Search Peer Reviews

Saved Searches

PPMs Use Peer Review Data

GENERAL DYNAMICS
Land Systems

Process Performance Models Overview

- Families of models based upon
  - Program (New development & maintenance)
  - Requirements / Code
  - Meetings / No Meetings
- 24 models in total
- Baselines developed for
  - Technical defects
  - Cost (hours)
  - Efficiency (defects / hour)
- Users reference baselines to choose the appropriate peer review process and PPM.
PPM Techniques, Tools, & Data

- Techniques
  - Initial models based upon single attribute regression.
  - Current models based upon multi-attribute, stepwise regression.
  - Modeling techniques chosen based upon available data and causal correlation of inputs to outputs.

- Data
  - Data was reviewed and corrected in the development of baselines.
  - Outlier data was removed in the iterations of the model development.
  - F-Tests and T-Tests were run to determine aggregation of data. Models were separated by vehicle programs. The programs were separated by new development or maintenance.
  - F-Tests and T-Tests were run to determine if baseline changes were significant.
PPM Techniques, Tools, & Data – 2

- Tools included:
  - Mini-tab
  - SigmaZone DOE PRO XL
  - In-house developed Excel models
  - In-house developed web-based models

- Model Verification and Validation
  - Models were peer reviewed by a team of subject matter experts.
  - Models were compared to the different iterations of the models.
  - Comparison model provides additional validation of prediction models.
  - Models were piloted.
Software Metrics Tool Introduction

- Developed by Software Systems organization within GDLS.
- Metrics tool automates Software Systems organizational and project measurements.
- Peer review section contains peer review process performance baseline data and process performance models (PPM).
- Models were initiated for process improvement, specifically to improve the quality of software requirements and code, and to reduce rework.
- Models used by software developers and technical leads performing peer reviews on requirements and code to
  - Predict peer review results
  - Compare results against existing baselines
    - Mandatory use on all requirements and code peer reviews
  - Optimize time and defects for peer reviews
Users select information to determine the appropriate model from the family of PPMs:
- Program (Models are vehicle platform specific)
- Meeting | No Meeting
- Requirements | Code
- Prediction | Optimization
## Software Metrics Tool – PPM Main Page

### Software Systems Metrics

<table>
<thead>
<tr>
<th>Code Selection Criteria Averages</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>With Meeting</strong></td>
</tr>
<tr>
<td>Major/Minor Defects per Review:  n.h.h</td>
</tr>
<tr>
<td>Total Peer Review Time:          n min</td>
</tr>
<tr>
<td>Major/Minor Defects Found per Total Peer Review Time: n.h defects/hour</td>
</tr>
<tr>
<td><strong>Without Meeting</strong></td>
</tr>
<tr>
<td>Major/Minor Defects per Review:  n.h.h</td>
</tr>
<tr>
<td>Total Peer Review Time:          n min</td>
</tr>
<tr>
<td>Major/Minor Defects Found per Total Peer Review Time: n.h defects/hour</td>
</tr>
</tbody>
</table>

**Preparation Recommendations with Meeting:**
- Number of Participants Entering Issues: n

### Prediction Optimization Comparison

**Peer Review Model**
- **Action:** Prediction
- **Program:** Abrams
- **Type:** Requirements
- **Meeting:** Yes

**Abrams Requirements Selection Criteria Averages**

<table>
<thead>
<tr>
<th>With Meeting</th>
<th>Without Meeting</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major/Minor Defects per 100 Requirements per Review: n.h.h</td>
<td></td>
</tr>
<tr>
<td>Total Peer Review Time: n min</td>
<td></td>
</tr>
<tr>
<td>Major/Minor Defects Found per 100 requirements per Total Peer Review Time: n.h defects/hour</td>
<td></td>
</tr>
</tbody>
</table>

**Preparation Recommendations with Meeting:**
- Hold Overviews for all Peer Reviews
- Average Prep Time per Invited: n - n min
- Number of Reviewers Entering Issues: n

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**PPM Tool – Prediction**

### Software Systems Metrics

<table>
<thead>
<tr>
<th>Home</th>
<th>Projects</th>
<th>Manpower</th>
<th>Resources</th>
<th>Efficiency</th>
<th>Peer Reviews</th>
<th>Overtime</th>
<th>Tools</th>
<th>Training</th>
</tr>
</thead>
</table>

**Abrams Requirements with Meeting Prediction Tool**

**Estimated Number of Reviewers Invited:** [n]

**Estimated Avg. Prep Time per Invited (mins):** [n]

**Estimated Review Meeting Time (mins):** [n]

**Predict**

**Predictions**

<table>
<thead>
<tr>
<th>Number of Reviewers Attended:</th>
<th>[n]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Reviewers Participated:</td>
<td>[n]</td>
</tr>
<tr>
<td>Number of Reviewers Making Comments:</td>
<td>[n]</td>
</tr>
<tr>
<td>Avg. Prep Time per Attended (mins):</td>
<td>[n]</td>
</tr>
<tr>
<td>Avg. Prep Time per Participated (mins):</td>
<td>[n]</td>
</tr>
<tr>
<td>Technical Errors [95% CI]:</td>
<td>[n] [+/- n.n]</td>
</tr>
<tr>
<td>Total Peer Review Time (mins) [95% CI]:</td>
<td>[n] [+/- n.n]</td>
</tr>
</tbody>
</table>

User can enter the tool on their own or is automatically routed here at the start of a peer review.

User can predict peer review results based upon number of reviewers invited, preparation time spent by the reviewers, and meeting time.
PPM Tool – Optimize Defects

Software Systems Metrics

Abrams Requirements with Meeting Optimization Model

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number reviewers invited:</td>
<td>n</td>
</tr>
<tr>
<td>Avg. prep time per invited (mins):</td>
<td>n</td>
</tr>
<tr>
<td>Actual review meeting time (mins):</td>
<td>n</td>
</tr>
<tr>
<td>Target errors found:</td>
<td>n</td>
</tr>
<tr>
<td>Target total time spent (mins):</td>
<td>n</td>
</tr>
<tr>
<td>Goal:</td>
<td>Maximize errors found</td>
</tr>
</tbody>
</table>

Optimized outcome

<table>
<thead>
<tr>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended number of reviewers invited:</td>
<td>n</td>
</tr>
<tr>
<td>Expected number of reviewers attended:</td>
<td>n</td>
</tr>
<tr>
<td>Expected number of reviewers participated:</td>
<td>n,n</td>
</tr>
<tr>
<td>Expected number of reviewers making comments:</td>
<td>n,n</td>
</tr>
<tr>
<td>Recommended avg. prep time per invited (mins):</td>
<td>n</td>
</tr>
<tr>
<td>Expected avg. prep time per attended (mins):</td>
<td>n,n</td>
</tr>
<tr>
<td>Expected avg. prep time per participated (mins):</td>
<td>n</td>
</tr>
<tr>
<td>Recommended actual review meeting time (mins):</td>
<td>n</td>
</tr>
<tr>
<td>Expected technical errors [95% CI]:</td>
<td>n,n</td>
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<tr>
<td>Expected total peer review time (mins) [95% CI]:</td>
<td>n,n</td>
</tr>
</tbody>
</table>

User can optimize peer review defect detection.
# PPM Tool – Optimize Time

## Abrams Requirements with Meeting Optimization Model

<table>
<thead>
<tr>
<th></th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number Reviewers Invited:</td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td>Avg. Prep Time per Invited (mins):</td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td>Actual Review Meeting Time (mins):</td>
<td>n</td>
<td>n</td>
</tr>
<tr>
<td>Target Errors Found:</td>
<td>n</td>
<td></td>
</tr>
<tr>
<td>Target Total Time Spent (mins):</td>
<td></td>
<td>n</td>
</tr>
</tbody>
</table>

**Goal:** Minimize Cost (Total Time Spent)

### Optimized Outcome

<table>
<thead>
<tr>
<th></th>
<th>n</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommended Number of Reviewers Invited:</td>
<td>n</td>
</tr>
<tr>
<td>Expected Number of Reviewers Attended:</td>
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</table>

User can optimize peer review cost (time).
Users are directed at peer review closure from the Peer Review Tool to the Metrics Tool. Data is automatically filled in for the user from the Peer Review Tool to determine if the review was within the baseline. Users are required to provide analysis information on their results.
Results and Benefits

- Improvements were as high as 400% increase in technical defect detection
  - 70% increase in cost (time) to achieve 400% improvement.

- Acceptance and buy-in of models
  - Automation and communication were key.
  - Mandatory usage of post comparison model.

- Use of the models is a negligible additional cost based on easy access and automation.

- More knowledgeable user base
  - Model development is understood & performed by more people.
  - Model purpose and value is understood by user base.
Challenges

● Data
  ➤ Accuracy & consistency
    ■ Correctly identifying defect severities between technical and editorial.
    ■ Size data is often entered incorrectly.
  ➤ Quantity (Subject to available historical data)
● Model usage
  ➤ User-friendly and easily accessible
  ➤ Documenting usage
● Stakeholder buy-in
  ➤ Understanding the intent and purpose of the models
  ➤ Keeping it from being personal, i.e. measuring the process & product and not the person performing the work
  ➤ Trusting the data and the models
● Documenting savings / cost benefit
What Worked Well

● Multiple subject matter experts evaluating the model
  ➤ Ensure model integrity.

● Automation - ease of use
  ➤ Web-based tools.
  ➤ Integration of modeling tool with peer review tool for both planning and post comparison.
  ➤ Documenting evidence of use of models.
  ➤ Automation leads to data and process consistency.

● Communication
  ➤ Strong and repeated communication with users.
  ➤ Educating key stakeholders to help others buy-in.
  ➤ Updated processes and guidelines to identify when and how models should be used.
Summary

• Keep it simple.
  ➔ Automate as much as possible.
    ■ Data collection must be integral with the work flow.
    ■ If the models are not easy to use, they won’t be used.
  ➔ Users need to focus on finding defects in products, not spending time running models.

• Bring it to the floor.
  ➔ Communicate with users.
  ➔ Work with users to understand the model usage and benefits. (Market and sell the models.)
  ➔ Incorporate user feedback.
Contact Information

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