GENERAL DYNAMICS
Land Systems

Multi-Attribute Modeling and Practical Use

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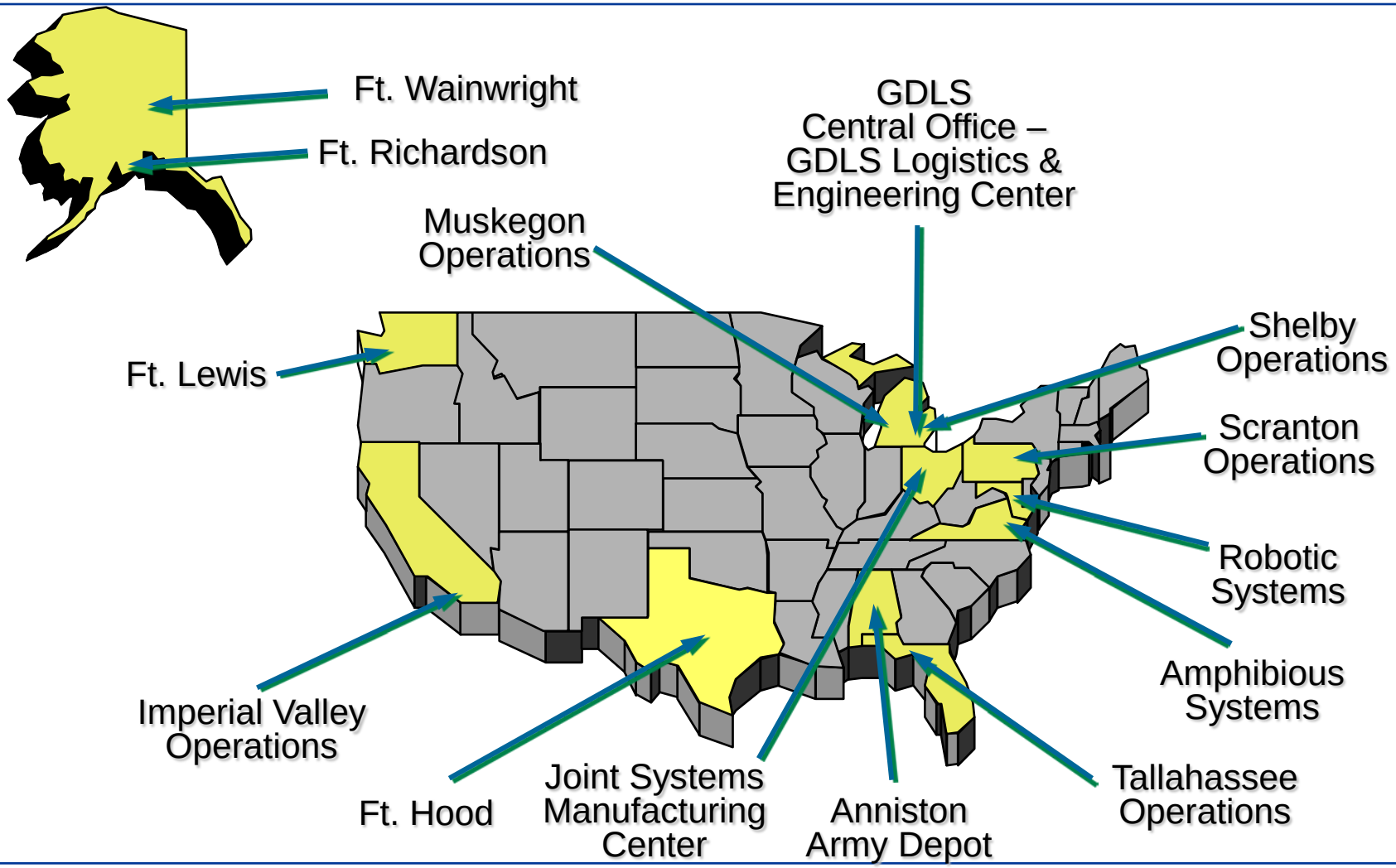
Agenda

- GDLS Overview
- Peer Review Tool
- Process Performance Models (PPM)
- Software Metrics Tool
- Results & Benefits
- Challenges
- Summary

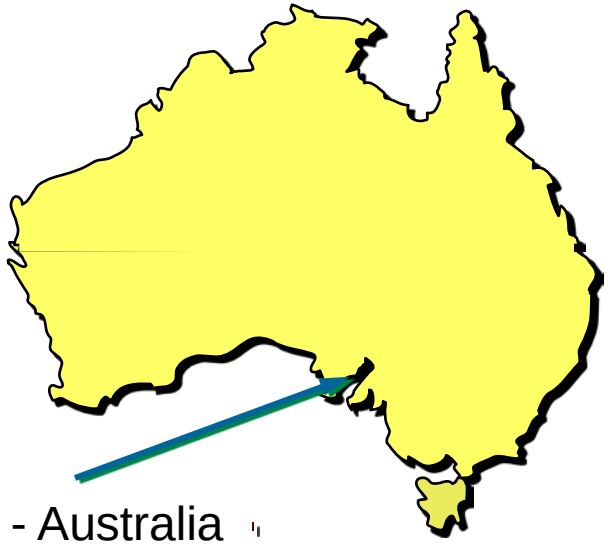
Land Systems Products

U.S. Locations



International Locations

GDLS - Canada
London, Ontario



GDLS - Australia
Adelaide, Australia

Peer Review Tool – History

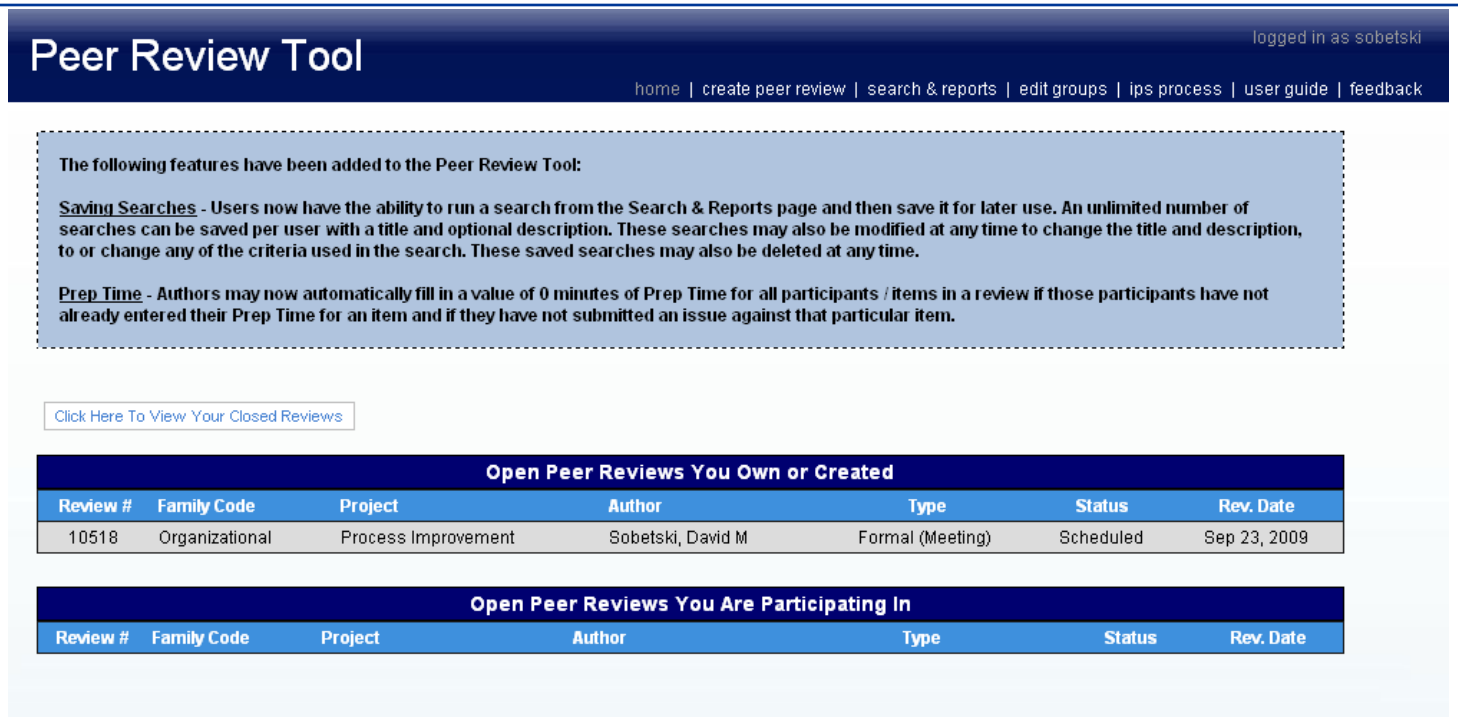
- Original version created ~2000 for Software Engineering
- Updated over the years, but was always a software tool for software personnel.
- Needed a facelift for usability outside of software – Systems Engineering, Logistics, Prototype Shop, i.e. all engineering (approximately 3000 employees).
- Updated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

Peer Review Tool – Features

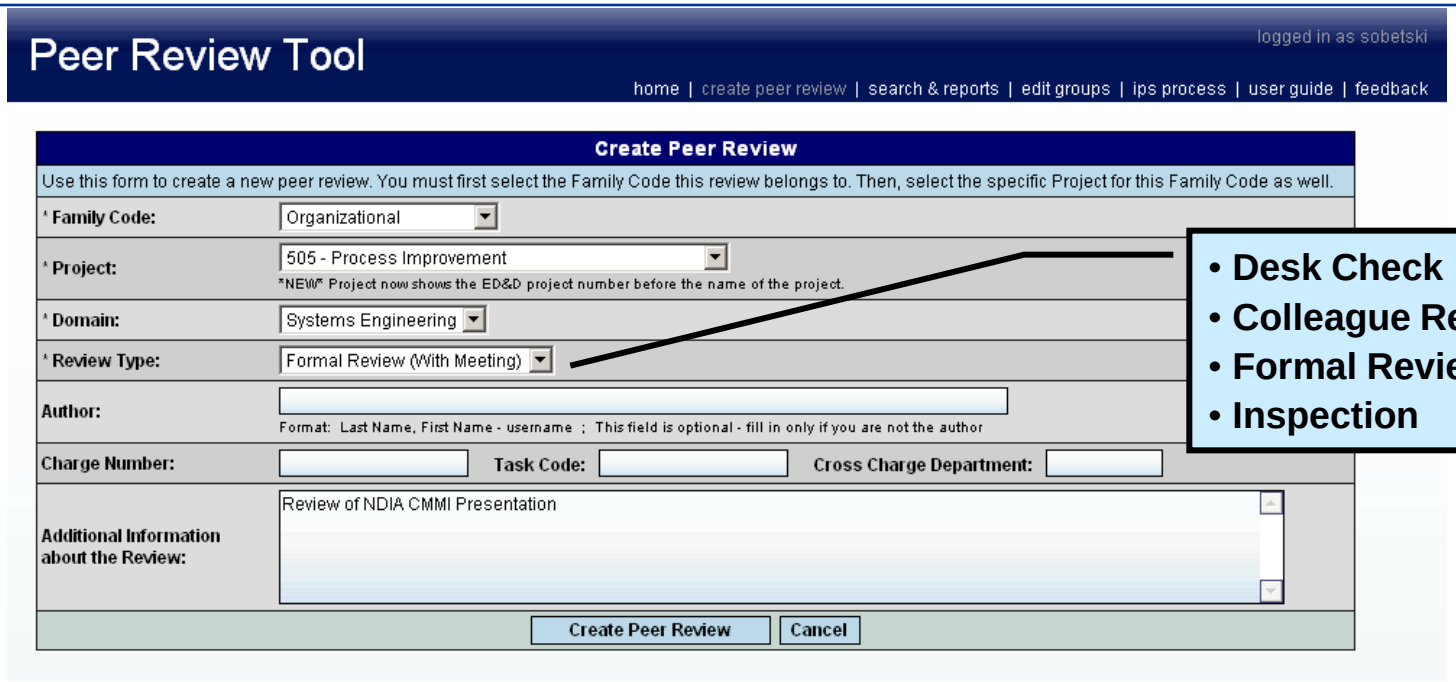
Four types of peer reviews
- Desk Check (Without Meeting)
- Colleague Review (Instant)
- Formal Review (With Meeting)
- Inspection (Formal Review with a Review Lead to verify all issues properly addressed)

- 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.

Peer Review Tool – Home Page

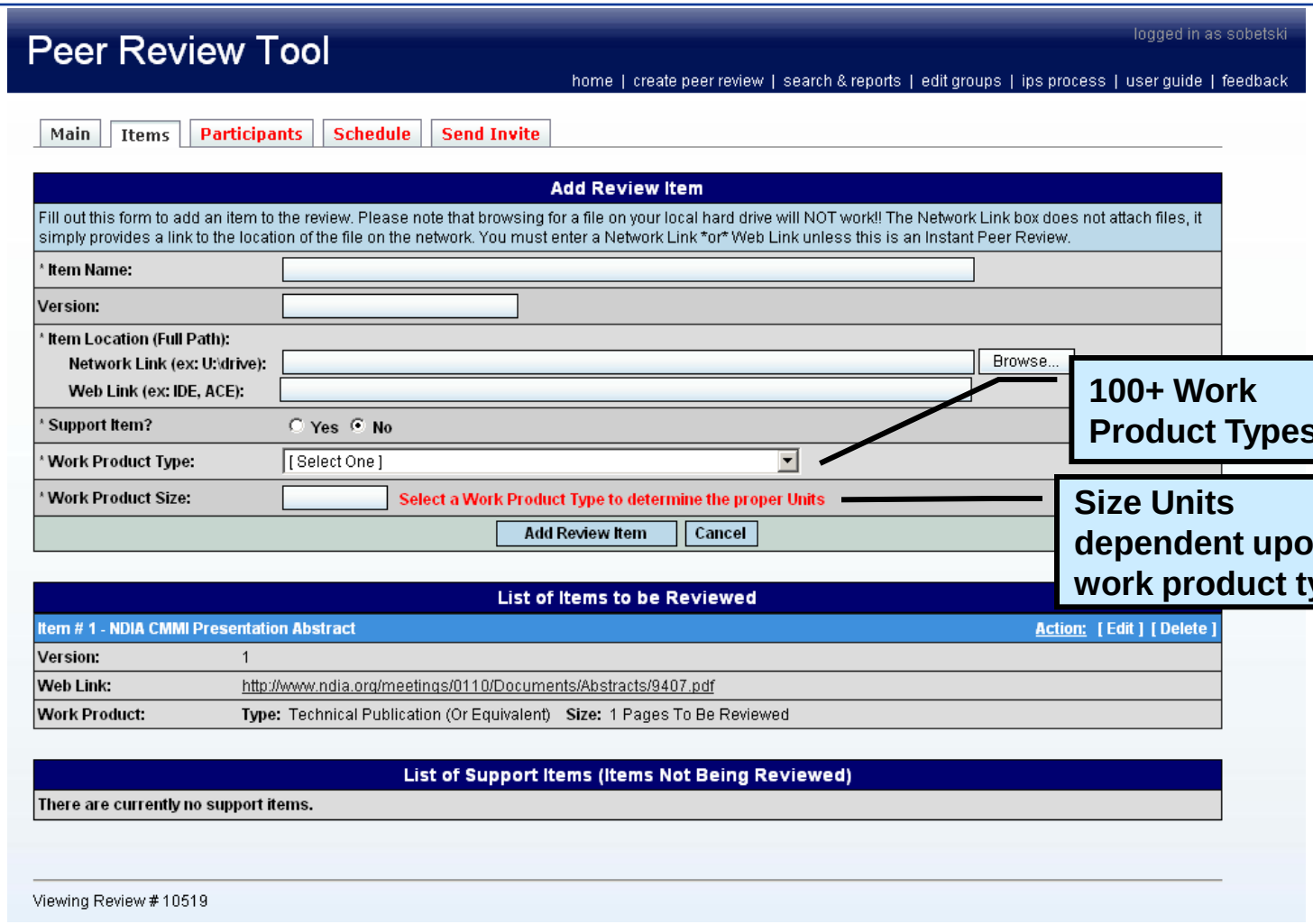


Peer Review Tool – Create Screen



- **Desk Check**
- **Colleague Review**
- **Formal Review**
- **Inspection**

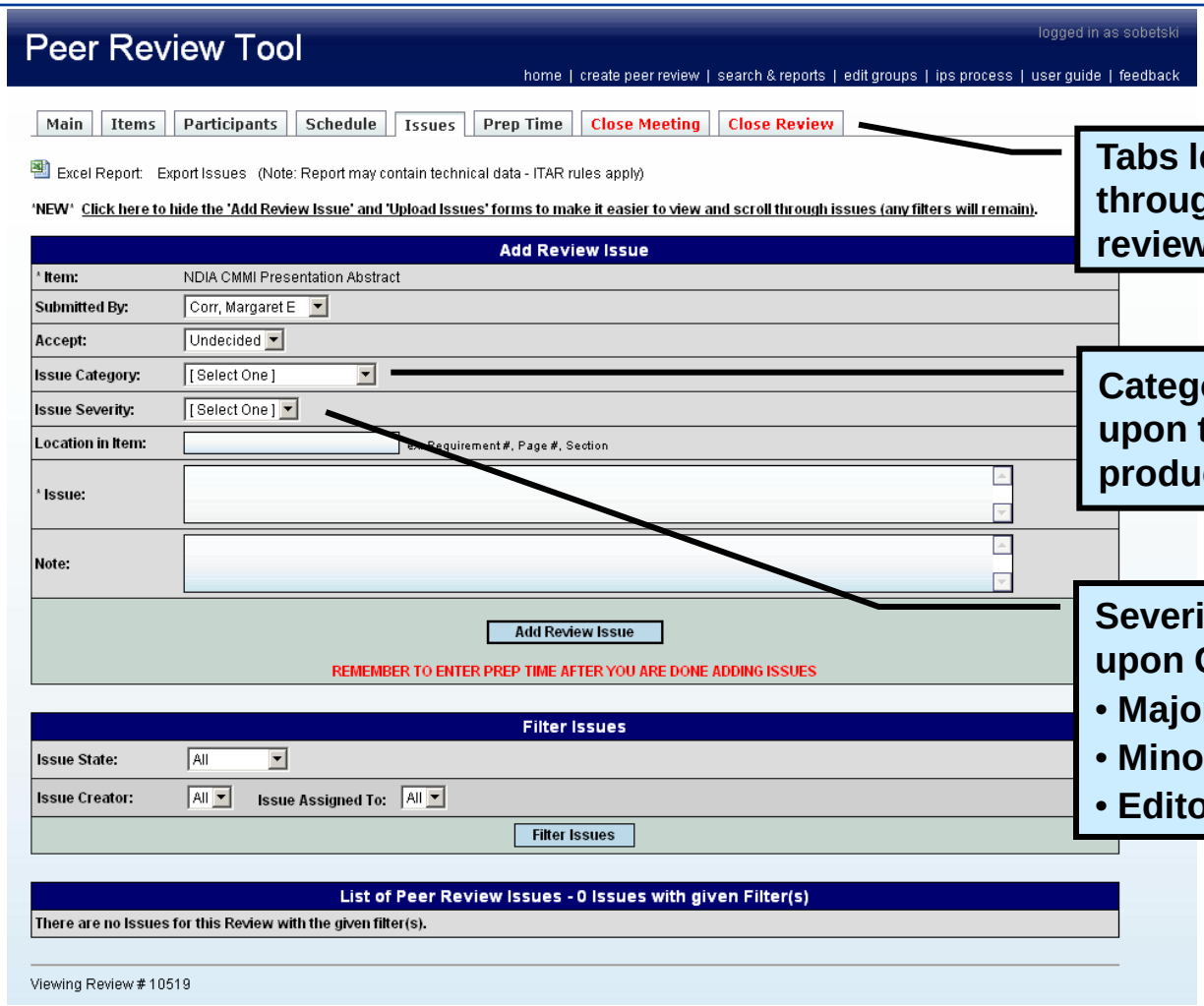
Peer Review Tool – Add Items Screen



100+ Work Product Types.

Size Units dependent upon work product type.

Peer Review Tool – Issues Screen

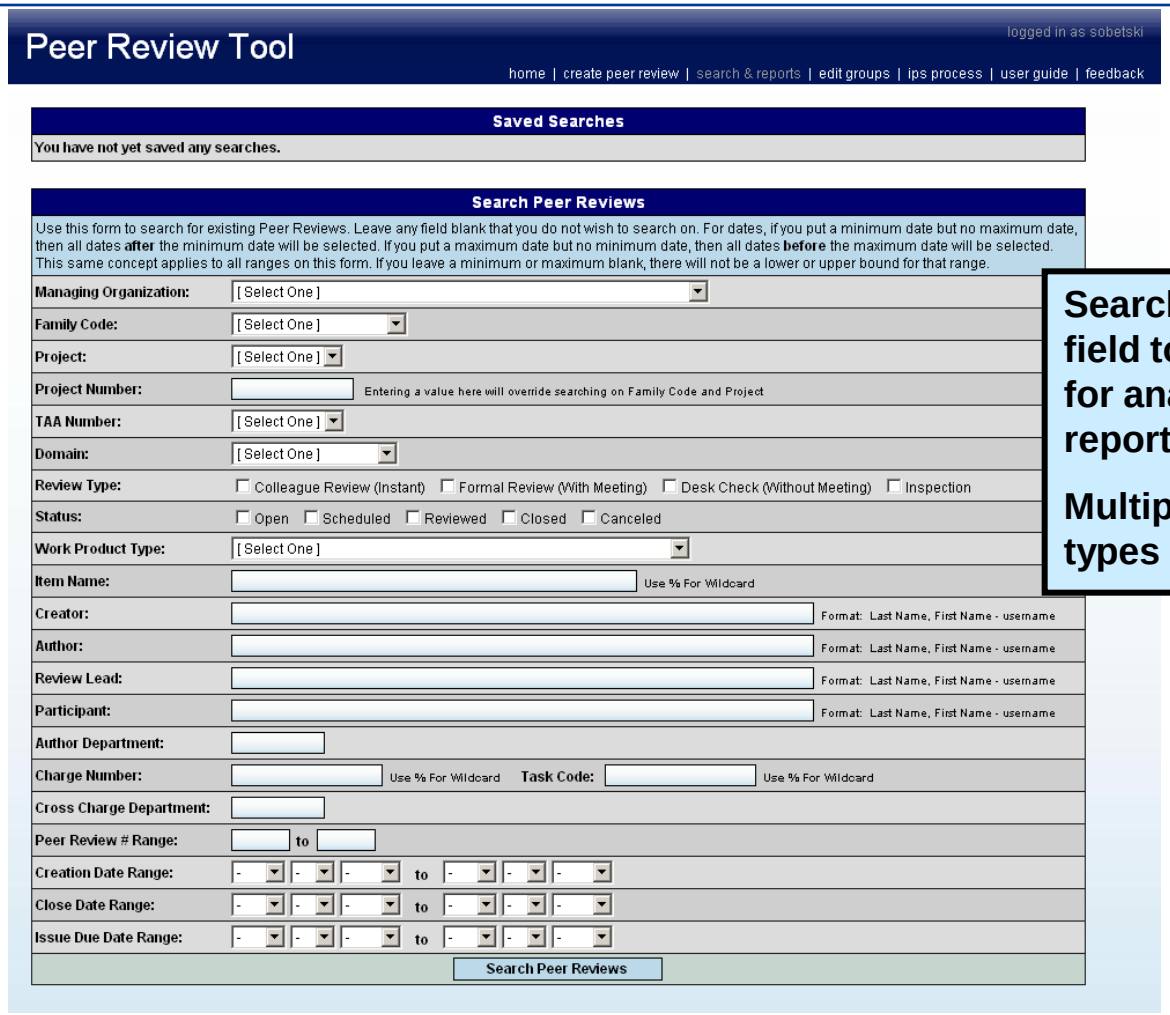


Tabs lead user through peer review steps.

Categories based upon type of work product.

Severity based upon Category.
- **Major**
- **Minor**
- **Editorial**

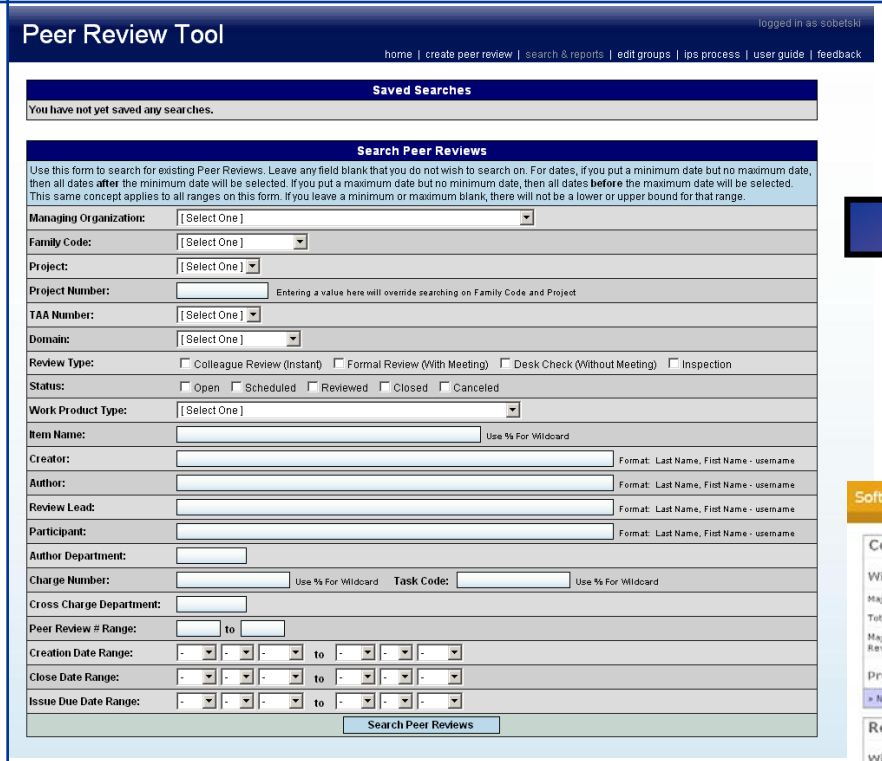
Peer Review Tool – Search Screen

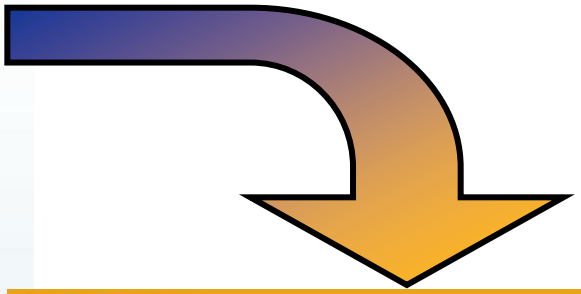


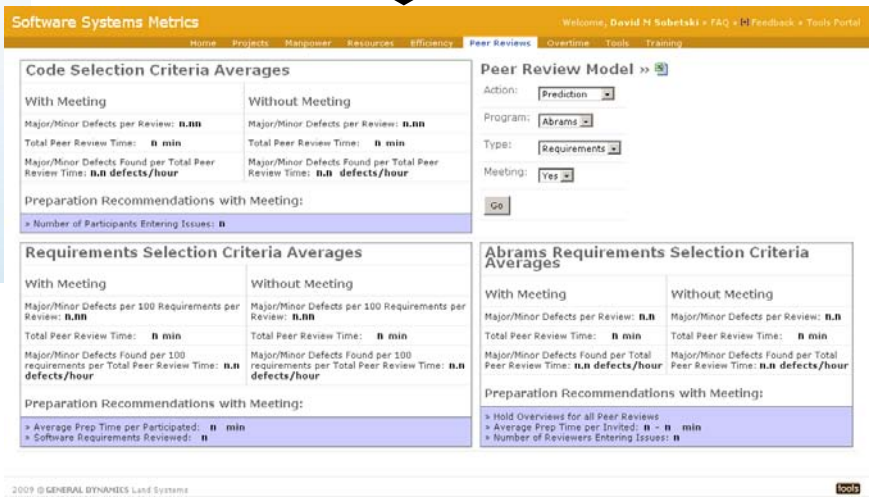
Search upon any field to obtain data for analysis and reports.

Multiple report types available.

PPMs Use Peer Review Data







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

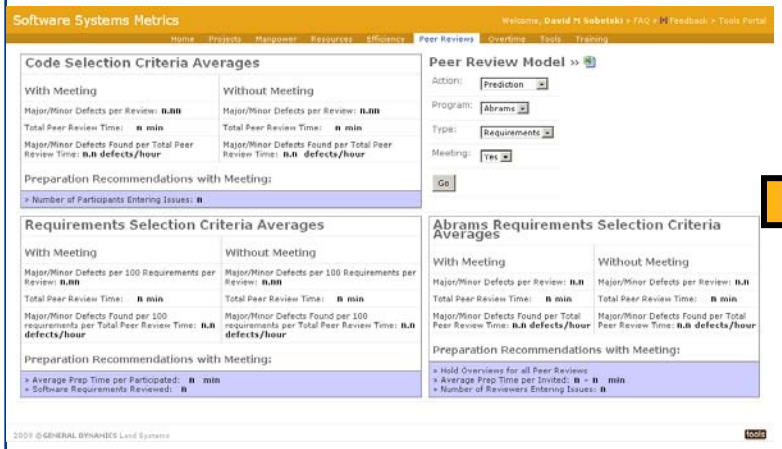
- Tools included:
  - Mini-tab
  - SigmaZone DOE PRO XL
  - In-house developed Excel models
  - In-house developed web-based models
- Model Verification and Validation
  - Models were peer reviewed by a team of subject matter experts.
  - Models were compared to the different iterations of the models.
  - Comparison model provides additional validation of prediction models.
  - Models were piloted.

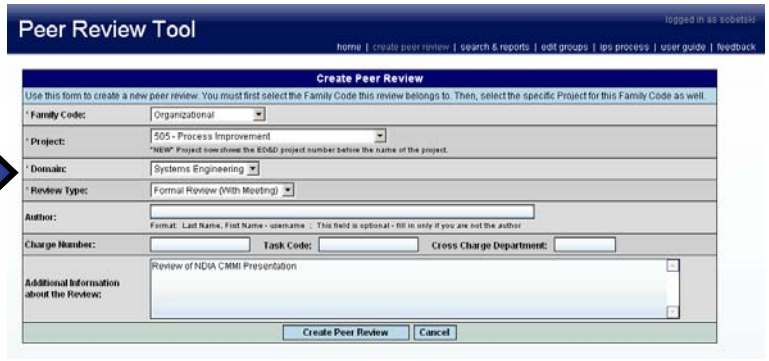
Software Metrics Tool Introduction

- 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

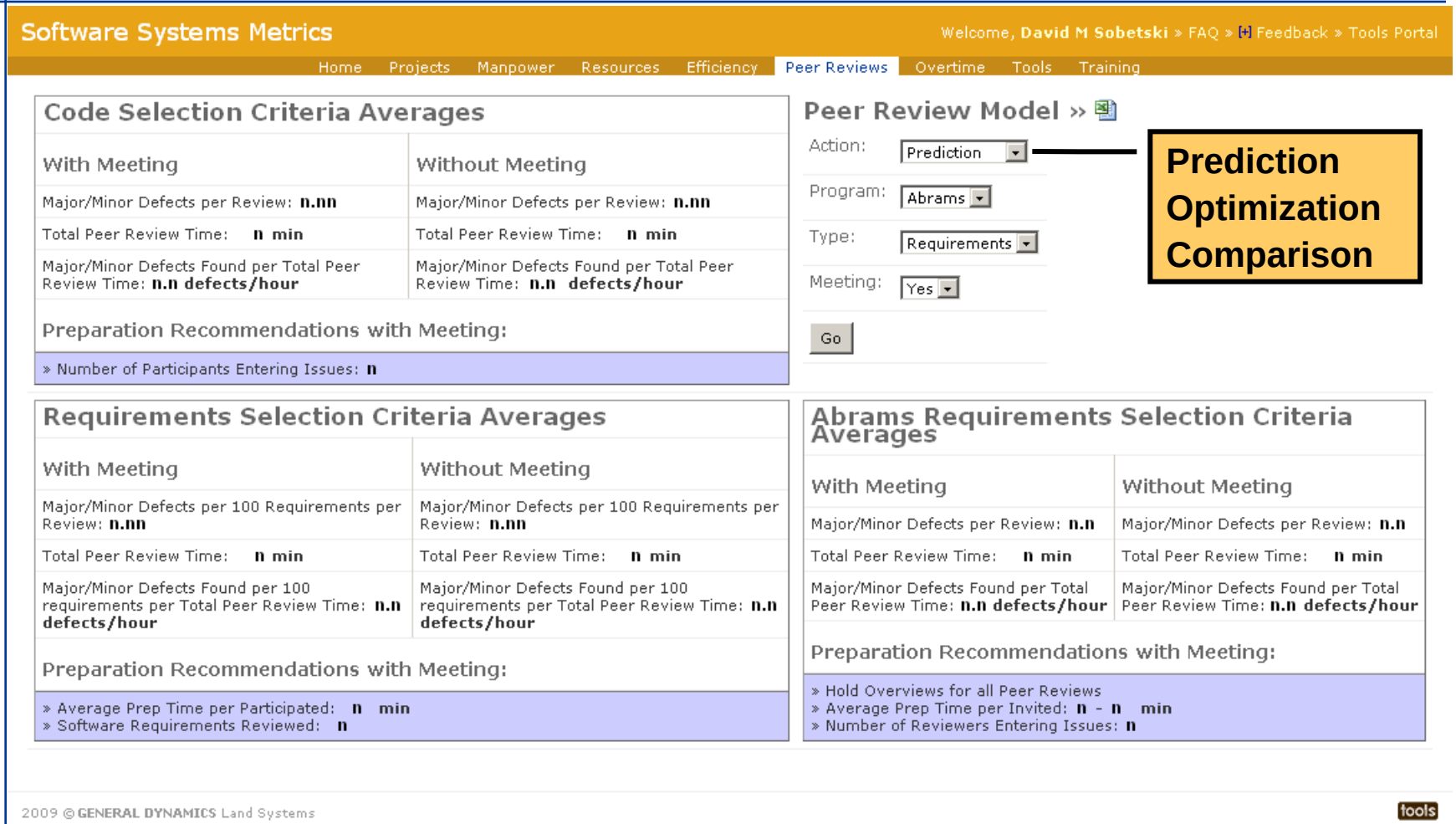
PPM Tool – Planning Peer Reviews

- 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

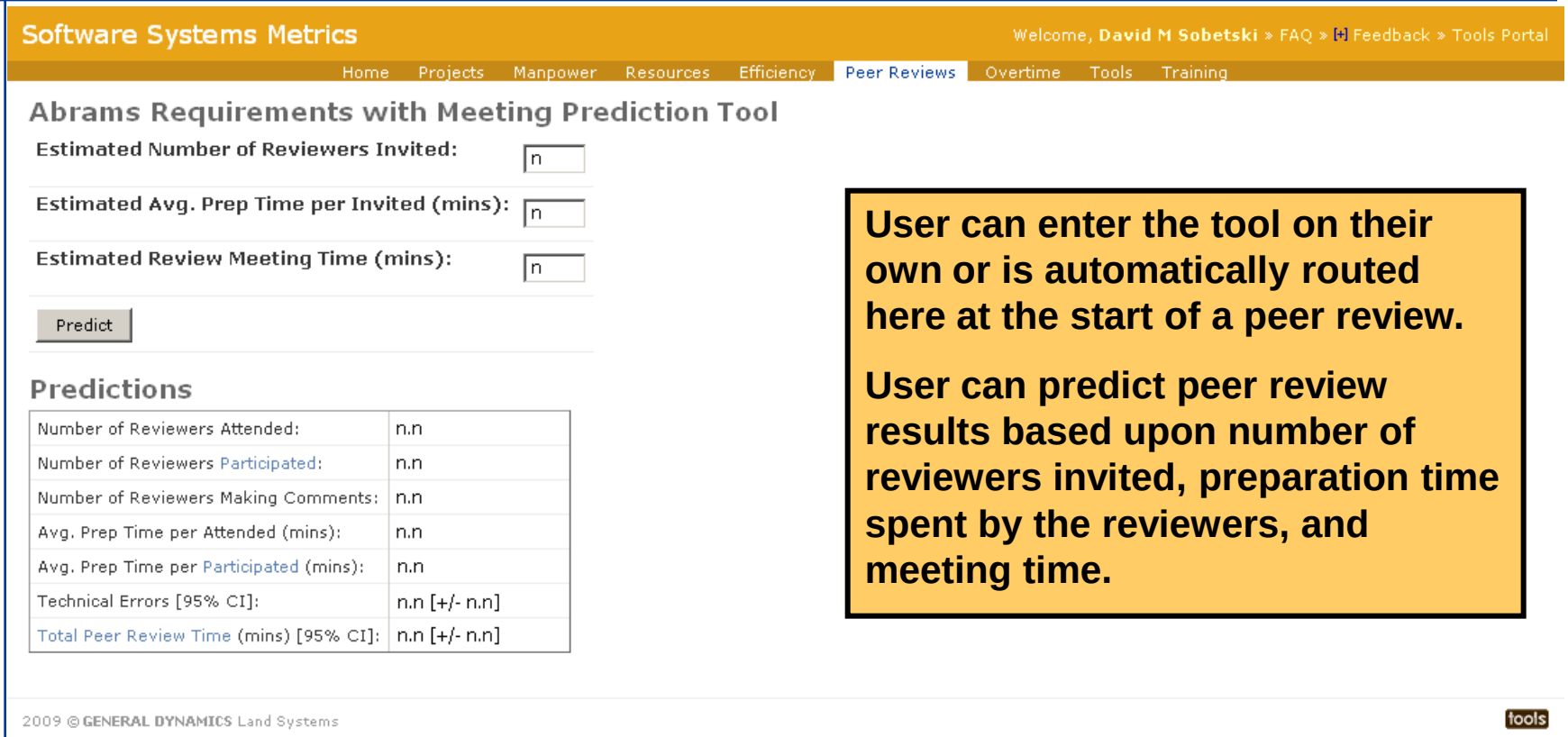




Software Metrics Tool – PPM Main Page



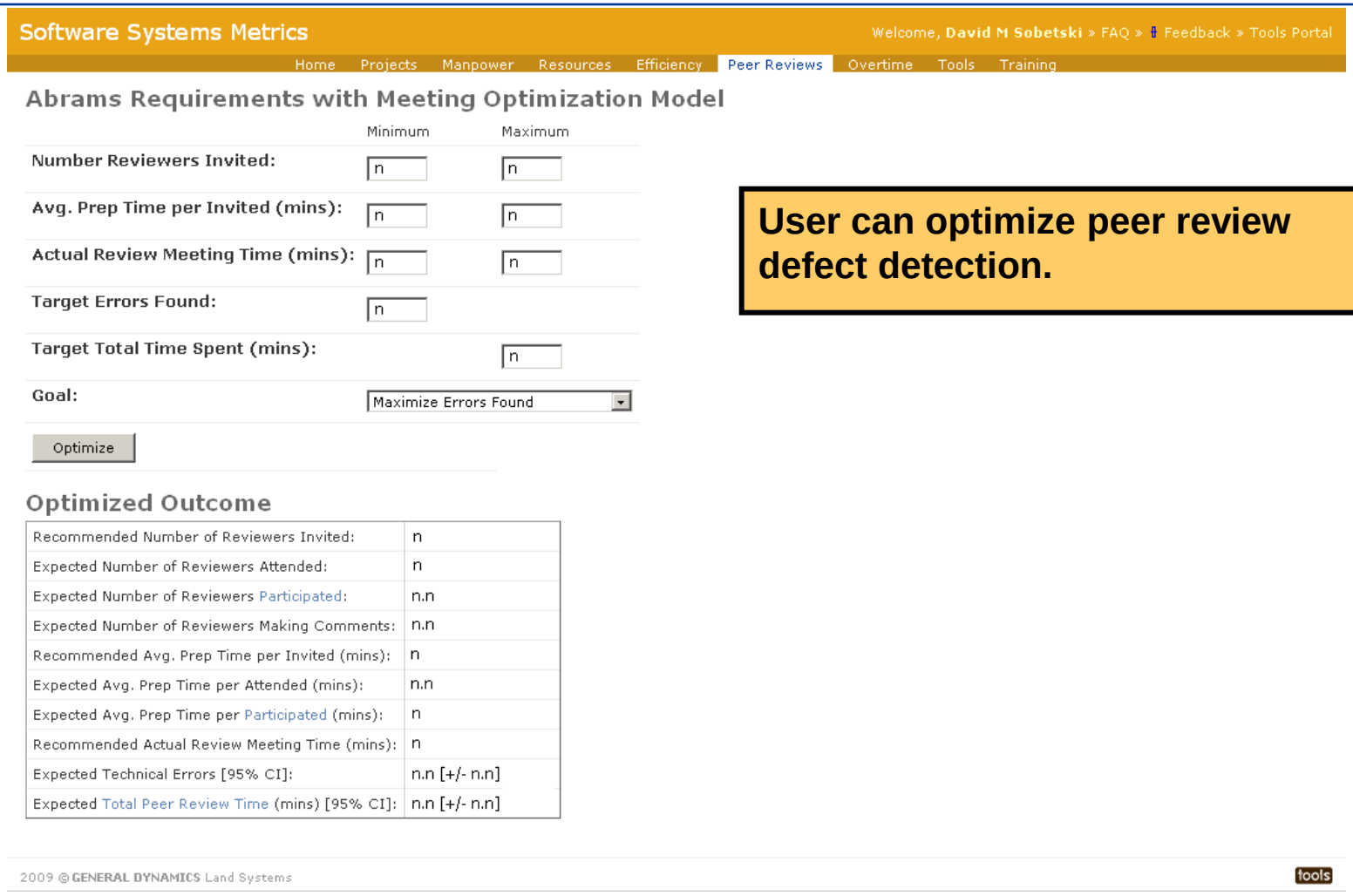
PPM Tool – Prediction



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

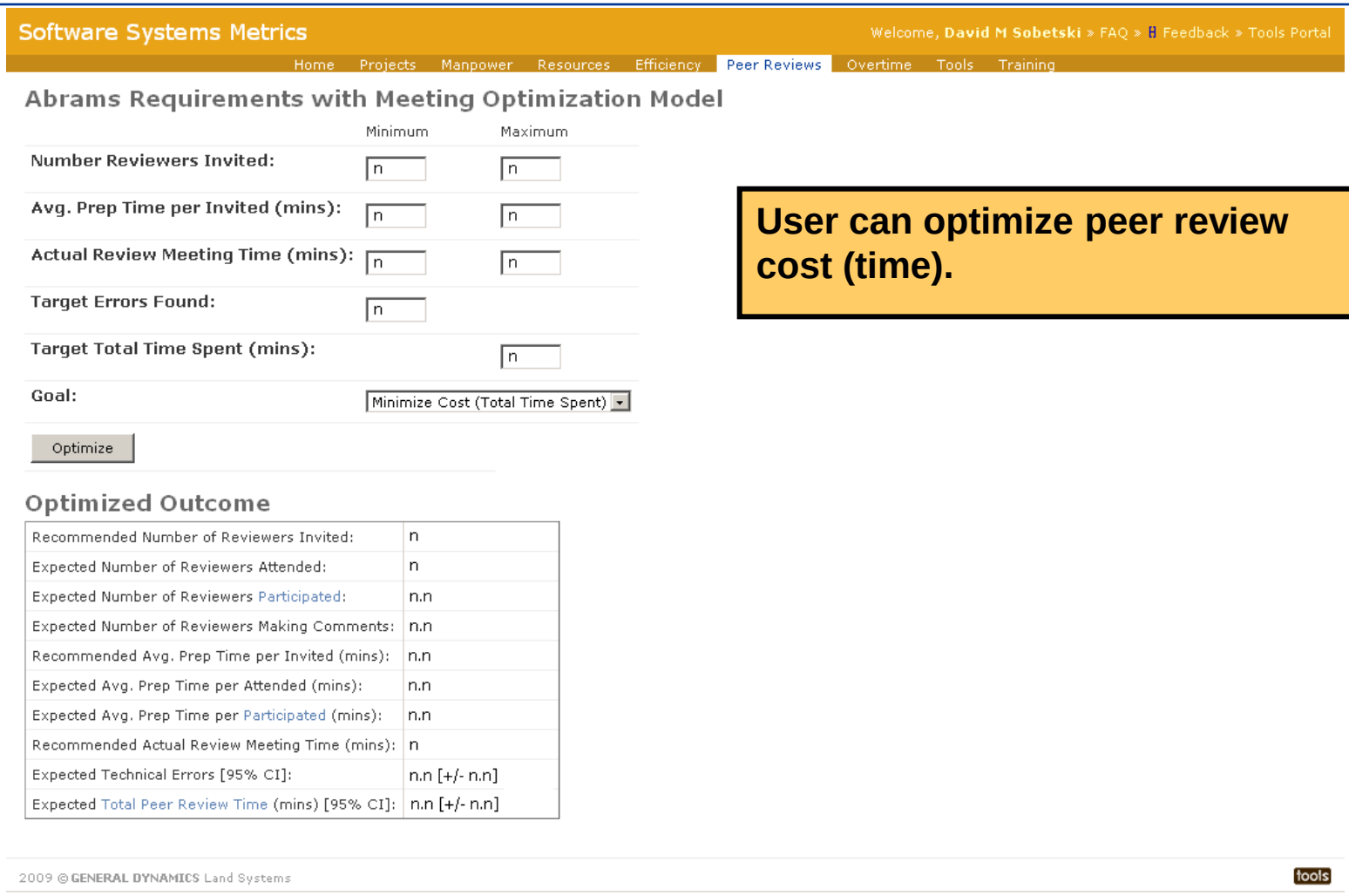
User can predict peer review results based upon number of reviewers invited, preparation time spent by the reviewers, and meeting time.

PPM Tool – Optimize Defects



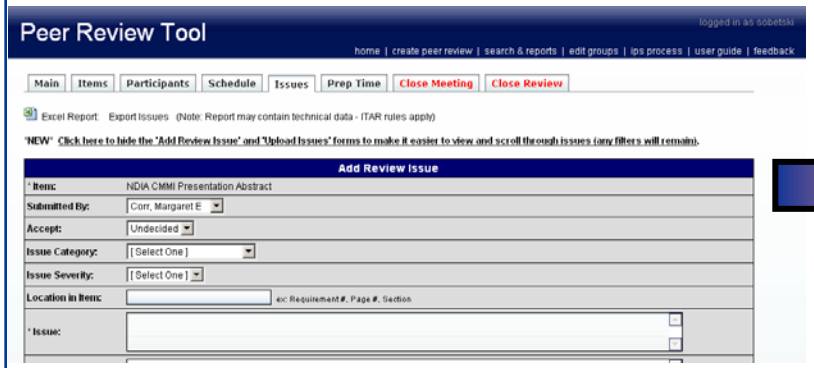
User can optimize peer review defect detection.

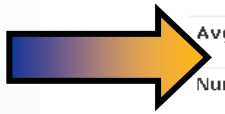
PPM Tool – Optimize Time

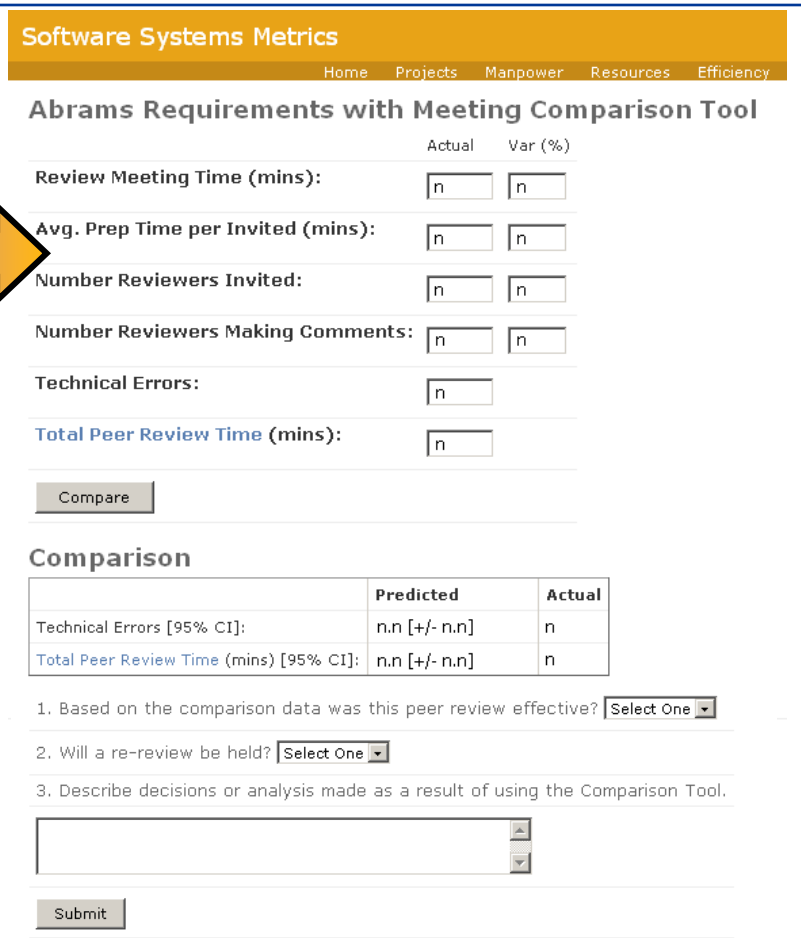


User can optimize peer review cost (time).

PPM Tool – Post Peer Review Comparison







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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