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TOR-2015-02541

Design Review Improvements Product Overview

May 7, 2015

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Design Review Improvements

Product Overview

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May 7, 2015

Agenda

- Motivation for Design Review Improvement Topic
- Charter
- Product Overview
- Topic Details
- Product Implementation Recommendations
- Topic Follow-on Recommendations
- Team Membership and Recognition

Motivation for Design Review Improvements Topic

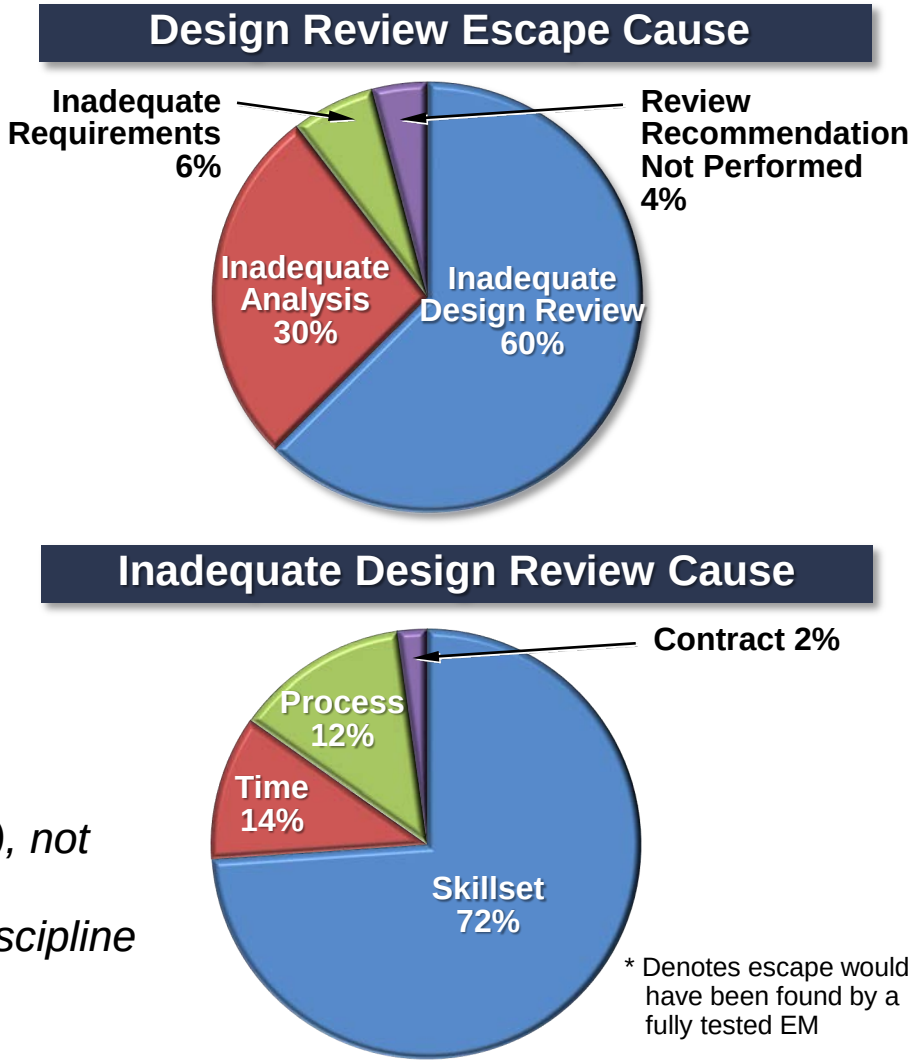
- Design escapes continue to impact program cost, schedule and mission performance
- Our design review and development test programs have failed to identify issues early enough to mitigate program or mission impacts
- Detecting and correcting design defects early in a product life cycle is becoming increasingly difficult as space systems become more complex
- In hindsight, many design escapes were deemed to be preventable
  - *Hypothesis: Late design escapes could be an indicator of a process gap*
    - Need to assess if process changes are needed to address any identified gaps
- Effects of late design escapes can be impactful to a company in many ways:
  - *Costly, damages reputations, strains customer relations, embarrassing*
    - E.g., RF cross talk in a unit resulted in an 18-month impact to the program
  - *Preventable with the right set of reviewers at the right time*

Design Review Improvement Charter

- Identify the deficiencies or weaknesses in the existing design review process that allowed design escapes to take place by leveraging existing case studies and escapes
- Identify design review process improvements
- Survey and assess the practices utilized across industry and government agencies to prepare for and conduct design reviews
  - *Surveyed team member companies – 49 test cases*
  - *Reviewed Aerospace on-orbit anomaly data (Classified) – 121 test cases*

Escape Analysis (1 of 2)

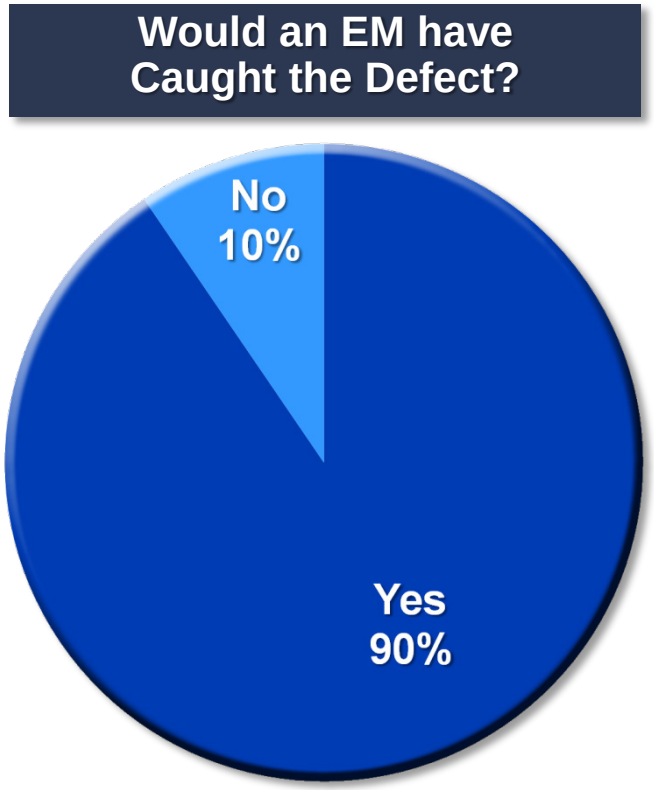
- Majority due to inadequate design review (60%)
  - RF crosstalk in unit*
  - *Other causes include:*
    - Inadequate analysis (30%)
      - *Gyro life test failure **
    - Inadequate requirements (6%)
      - *No coupling requirement for military earth coverage (MEC) signals to earth coverage signals (EC)**
    - Review recommendation not performed (4%)
      - *Power-on reset circuit**
- Reviewer skillset (72%) implicated in cause of inadequate reviews
  - *Not getting help, not the right person(s), not raising issues*
  - *Mixed technology units require multi-discipline SME reviewers*



* Denotes escape would have been found by a fully tested EM

Escape Analysis (2 of 2)

- 21 of 49 escapes did not have a fully tested EM prior to CDR
- 19 of 21 escapes noted above could have been detected with a fully tested EM
  - *Designers indicated that the escapes would have been found had they utilized a fully tested EM prior to CDR*
  - *An EM provides*
    - Opportunity to discover design defects
    - Analytical model validation
    - Requirements validation
    - Build process validation
    - Demonstrate interface compatibility
    - Validate test and operation procedures



Design Review Improvements Overview

Development Processes of Seven Companies Were Reviewed

Strengths:

- Contractor team members who are familiar with their own company's Command Media stated that they had a formalized development process
- Reviewers are trained in the development process (command media) and what to expect in the data products
- Contractor team members have lessons learned databases as part of the development process (by both the design team and review team)
- Have identified a best practice for folding Lessons Learned into the Design Development Process Command Media

Note: Development Process is a general concept that encompass both the actual design process and the design review

Design Review Improvements Overview

Weaknesses

- The scope, criteria, and reviewer guidance for conducting a design review were inconsistent across industry with opportunities for improvement
  - *No reviewer minimum experience for participating in a review*
  - *No minimum lead time for reviewer to have material*
    - Is not always specified by contract
  - *No explicit requirement for reviewer relevant experience*
  - *The context of lower level reviews becomes lost as the unit development process matures and becomes overly summarized*
  - *Review process tailored by program-driven constraints (time, schedule, dollars) preserves the intent of any given milestone even though the design review is not ready*
- No effective command media for mixed technology units (digital, RF, analog/ power/ ground, and FSW are all separate disciplines, reviewed separately)
- Action item closure with originator approval not consistent
- No requirement for having a fully tested EM before CDR

Findings Summary

- The key to a successful product development is the experience and skills of the development engineers
  - *The expectation that a codified process can catch all escapes is unreasonable*
  - *It depends on both a robust process and the skills of those involved*
  - *Just as you cannot expect to review in quality–you cannot expect to "review" in a good product*

Example of Recommendations

Reviewer Skill Set:

- Ensure that the development process defines the minimum relevant domain experience to be a Lead or Senior Reviewer
  - There should be recognized subject matter experts with the relevant material under review

Design Changes for Obsolescence or Application:

- Design changes due to obsolescence or revectoring for a new application (how used) needs a rigorous-heightened review supported by test

Immature or Incorrect Data Products or Unknown-Unknowns:

- Utilize a fully tested EM in support of CDR
  - Forces early discovery of defects while maturing data products

Inadequate analysis in context with the desired application:

- Ensure that the development process provides for the reviewer to review the analysis scope in context to the requirements as part of the design reviewer's tasks

Design Review Improvement Product Traceability

Deliverable Requested	Location Covered in Product
Identify strengths and weaknesses of the current design review process at the component/unit/box level and below	Section 4.1: Current Design Review Practices
Recommend codified changes and/or upgrades to the process that will effectively and efficiently identify and/or prevent design errors early in the program lifecycle	Section 3.1: Recommended Design Review Changes
Recommend updates to the entrance and exit criteria for the design review process	Section 3.1.1: Entry and Exit Criteria
Recommend criteria for the selection of independent design reviewers with the proper subject matter expertise	Section 3.1.2: Design Reviewer Selection
Define the level of technical rigor required to successfully prepare for and conduct a thorough design review	Section 3.1.3: Technical Rigor
Define the actions to be taken when deemed not ready to proceed with the design review	Section 3.1.4: Reviewer/Lead Responsibilities
Identify programmatic benefits for conducting a thorough technical design review	Section 4.3 Program Benefits

Intended Product Use

- What is the intended use of the product?
  - *Who is the target audience?*
    - Engineers, program office, mission assurance professionals, designers, systems engineering, suppliers, subcontract management, customers, and senior leadership
  - *How should/could it be used?*
    - The recommendations should be used to augment the current design review process in order to reduce escapes, costs, and schedule
- Specific recommendations for industry:
  - *What should industry do with the product near term/long term?*
    - Consider adopting recommendations to contractor process
    - Collect and develop best practices for development and review of mixed technology units
- Specific recommendations for government:
  - *What should government do with the product near term/long term?*
    - Consider adopting recommendations for government participants in review process
    - Understand risk areas for escapes to better understand trades (e.g., EMs)

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