SCRAM: A Method for Assessing Schedule Compliance Risk

SSTC 2011
Salt Lake City, Utah May 2011

Elizabeth (Betsy) Clark
Software Metrics Inc.
Haymarket, VA

Angela Tuffley
Systems and Software Quality Institute
Queensland, Australia

Bradford Clark
Software Metrics Inc.
Haymarket, VA

Adrian Pitman
Defence Materiel Organisation
Australian Dept of Defence
## Report Documentation Page

Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.

### 1. REPORT DATE
MAY 2011

### 2. REPORT TYPE

### 3. DATES COVERED
00-00-2011 to 00-00-2011

### 4. TITLE AND SUBTITLE
SCRAM: A Method for Assessing Schedule Compliance Risk

### 5. AUTHOR(S)

### 6. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Software Metrics Inc, Haymarket, VA, 20168

### 7. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

### 8. SPONSOR/MONITOR’S ACRONYM(S)

### 9. SPONSOR/MONITOR’S REPORT NUMBER

### 10. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

### 11. SUPPLEMENTARY NOTES
Presented at the 23rd Systems and Software Technology Conference (SSTC), 16-19 May 2011, Salt Lake City, UT. Sponsored in part by the USAF. U.S. Government or Federal Rights License

### 12. ABSTRACT

### 13. SECURITY CLASSIFICATION OF:

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

### 14. NUMBER OF PAGES
42

### 15. SUBJECT TERMS

### 16. LIMITATION OF ABSTRACT
Same as Report (SAR)

### 17. LIMITATION OF ABSTRACT

### 18. NUMBER OF PAGES
42

### 19. NAME OF RESPONSIBLE PERSON

---

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18
What does SCRAM mean?

- Go away!

- **Secure Continuous Remote Alcohol Monitoring**
  - As modeled here by Lindsay Lohan

- **Schedule Compliance Risk Assessment Methodology**
Collaborative effort:

- Australian Department of Defence - Defence Materiel Organisation
- Systems and Software Quality Institute, Brisbane, Australia
- Software Metrics Inc., Haymarket, VA
DMO SCRAM Usage

- SCRAM has been sponsored by the Australian Defence Materiel Organisation (DMO)
  - To improve our Project Schedule Performance in response to Government concern as identified by the Australian National Audit Office (ANAO)
    - ANAO is equivalent to the US Government Accountability Office (GAO)

- DMO equips and sustains the Australian Defence Force (ADF)
  - Manages 230+ Major Capital Equipment Projects & 100 Minor (<$20M) defence projects
DMO SCRAM Usage (cont.)

- SCRAM has evolved from our reviews of troubled programs
  - Schedule is almost always the primary concern of program stakeholders (delays to war fighter capability unacceptable)
  - SCRAM is a key component of our initiative to identify and remediate (and eliminate) root cause of schedule slippage
Topics

- Three Common Questions Addressed by SCRAM
- Benefits of Using SCRAM
- SCRAM Key Principles
- SCRAM Process
- Future plans for SCRAM
Three Common Questions

- SCRAM addresses three fundamental questions.
  1. Why is schedule slipping?
     - Root cause analysis
  2. Is the schedule credible?
     - Assess risk and identify Issues (including estimated rework)
     - Assess BoEs (Basis of Estimate)
     - Perform schedule “Health Check”
     - Perform Monte Carlo analysis using inputs from other SCRAM areas
  3. How can future slips be prevented?
     - General recommendations based on SCRAM review findings
     - Guidance on “leading indicators” of slippage
What SCRAM is Not

- Not an assessment of technical feasibility

- Not an assessment of process capability
  - However, may be identified and treated as an issue if process performance is identified as contributing to slippage
Why is schedule slipping?

- Program managers are flooded with a wealth of data and details
  - Challenge is to organize all of this information
    - Identify cause(s) of slippage
    - Schedule slippage is a symptom of other factors
    - Take effective action to address problems
  - Organizing the information based on SCRAM should:
    - De-clutter the massive amounts of information on a project
    - Relate the different issue areas to each other
    - Highlight missing information

- SCRAM is based on a “Root Cause Analysis of Schedule Slippage - RCASS” model
Root Cause Analysis of Schedule Slippage (RCASS) Model

After many assessments, refined RCASS for guidance in:

- Categorizing the wealth of data and details
- Assessing the causes of slippage
- Recommending a going-forward plan

Adapted from Integrated Analysis Model in McGarry et al., *Practical Software Measurement: Objective Information for Decision Makers*
SCRAM-RCASS

- Stakeholders
  - Subcontractors
  - Functional Assets

- Requirements
- Workload
- Rework

- Staffing & Effort

- Schedule & Duration
- Schedule Execution

Management & Infrastructure
Root Cause Analysis - Examples

- **Stakeholders**
  - “Our stakeholders are like a 100-headed hydra – everyone can say ‘no’ and no one can say ‘yes’.”

- **Requirements**
  - Misinterpretation of a communication standard led to an additional 3,000 requirements to implement the standard.
Root Cause Analysis - Examples

- **Subcontractor**
  - Subcontractor omitting processes in order to make delivery deadlines led to integration problems with other system components.

- **Functional Assets (COTS/MOTS)**
  - Commercial-off-the-shelf (COTS) products that do not work as advertised, resulting in additional work or replacement with different products.
  - Underestimating amount of software code that must be written/modified in a legacy system.
Root Cause Analysis - Examples

- **Workload**
  - Optimistic estimates
    - Source lines of code underestimated
    - Contract data deliverables workload often underestimated by both contractor and customer

- **Staffing & Effort**
  - High turnover, especially among experienced staff

- **Schedule & Duration**
  - Area of primary interest
Root Cause Analysis - Examples

- **Schedule Execution**
  - Schedule replans are not communicated to program staff or stakeholders
  - Lack of, or poorly integrated, master schedule
  - Integrated schedule elements not statused consistently across program. Actual status unknown.
  - External dependencies not integrated or tracked

- **Rework**
  - Often underestimated or not planned for (e.g. defect correction)

- **Management & Infrastructure**
  - Lack of adequate test facilities (in terms of fidelity or capacity)
Three Common Questions

1. Why is schedule slipping?
   - Root Cause Analysis of Schedule Slippage - RCASS model guides the analysis approach

2. Is the current schedule credible?
   - Assess the risks and issues
   - Assess the BoEs (Basis of Estimate)
   - Perform “Schedule Health Checks”
   - Perform Monte Carlo analysis

3. How can future slips be prevented?
Assess the Risks and Issues

- Are risks and issues understood and managed?

- What mitigations are in place to address the risks?

- Have the issues been analyzed to determine corrective actions?
  - Are corrective actions being managed through to closure?

- Is there contingency in the schedule if risks are realized?
  - Or is the schedule so tight that nothing can go wrong?
Assess the BoEs

- Technical expertise is essential

- Basis of estimate will vary by phase and activity
  - Requirements
  - Source Lines of Code
  - Test cases/procedures

- Evidence of use of historical data, models
Schedule Health Checks

- To evaluate schedule construction and logic
  - Includes analyses of task dependencies, task constraints, and available schedule float

- WBS and Master Schedule are reviewed for alignment

- Government, Prime, and Subcontractor schedule integration / alignment is reviewed

- Ensure external dependencies are included and linked in the schedule
  - Interfaces, resources, facilities, Government Furnished Equipment (GFE), test assets etc.
Schedule Health Checks (cont.)

- Allocate three point estimates to tasks on critical and near-critical path based on identified risk from RCASS
  - optimistic, pessimistic & most likely task duration

- Perform Schedule Risk Simulation (e.g. Monte Carlo)
Monte Carlo Analysis Example
Three Common Questions

1. Why is schedule slipping?
   - Root Cause Analysis of Schedule Slippage - RCASS model guides the analysis approach

2. Is the current schedule credible?
   - Assess the BoEs (Basis of Estimate)
   - Perform schedule “health checks”
   - Perform Monte Carlo analysis

3. How can future slips be prevented?
   - General recommendations based on SCRAM assessment
   - Guidance on measurements to serve as “leading indicators” of future slippage
SCRAM Recommendations - Examples

- Clarify the delivery scope (requirements and acceptance criteria)
- Create an Integrated Master Schedule
- Test Procedure development should be more closely tracked and time should be added to the schedule for their review and correction
- Additional time in all test phases should be added for re-running tests that fail or are blocked
- Enhance fidelity of integration lab to improve defect identification
Root Cause Analysis of Schedule Slippage Model

- Provides guidance for collection of measurements
  - For visibility and tracking in those areas where there are risks
Topics

- Three Common Questions Addressed by SCRAM
- Benefits of Using SCRAM
- SCRAM Key Principles
- SCRAM Process Reference / Assessment Model
- Future plans for SCRAM
SCRAM Benefits

- SCRAM root-cause analysis model (RCASS) useful in communicating the status of programs to all key stakeholders
  - Particularly executive management

- Identifies Root Causes of schedule slippage and permits early remediation action

- Provides guidance for collection of measures
  - Provides visibility and tracking for those areas where there is risk

- Provides confidence in the schedule
SCRAM - Benefit

- Validate schedule before execution

- Widely applicable
  - SCRAM can be applied at any point in the program life cycle
  - SCRAM can be applied to any major system engineering activity or phase

- Examples
  - Software-Hardware Integration
  - Aircraft Flight Testing
  - Installation/integration of systems on ship
  - Logistics ERP application roll out readiness
Topics

- Three Common Questions Addressed by SCRAM
- Benefits of Using SCRAM
- SCRAM Key Principles
- SCRAM Process Reference / Assessment Model
- Future plans for SCRAM
SCRAM Key Principles

- **Minimal Disruption**
  - Information is collected one person at a time
  - Interviews typically last an hour

- **Independent**
  - Review team members are organizationally independent of the program under review

- **Non-advocate**
  - All significant issues and concerns are considered and reported regardless of origin or source (Customer and/or Contractor).
  - Some SCRAM reviews have been joint contractor/customer team – facilitates joint commitment to resolve outcomes
SCRAM Key Principles (cont.)

- Non-attribution
  - Information obtained is not attributed to any individual
  - Focus is on identifying and mitigating the risk

- Corroboration of Evidence
  - Significant Findings and Observations based on at least two independent sources of corroboration

- Rapid turn-around
  - One to two weeks spent on-site
  - Executive briefing presented at end of second week
Topics

- Three Common Questions Addressed by SCRAM
- Benefits of Using SCRAM
- SCRAM Key Principles
- SCRAM Process
- Future plans for SCRAM
SCRAM Process

1.0 Assessment Preparation

2.0 Project Awareness

3.0 Project Risk / Issue Identification

4.0 Project Schedule Validation

5.0 Data Consolidation & Validation

6.0 Schedule Compliance Risk Analysis

7.0 Observation & Reporting

Schedule Compliance Risk Quantified
SCRAM Team Composition

- Assessment conducted by a small team including:

  - Engineering Assessors
    - Validate WBS, engineering-related basis of estimates (BoEs), work load estimates, technical risk assessment

  - Scheduler experienced in the project schedule tool
    - Validates schedule – conducts schedule health checks
    - Performs Monte Carlo risk modelling

  - Other project domain specialists as needed
    - E.g. Aeronautical Flight Test Engineers
SCRAM Key Steps

- SCRAM Team briefs the Project on the principles, purpose and approach of the SCRAM

- The Project provides the SCRAM team with an initial overview of the current status and project issues

- Project Issues and Risks are confirmed by the SCRAM Team through interviews, reviewing documentation and other project assets

- Schedule health checks and Monte Carlo analysis are performed
SCRAM Key Steps (cont.)

- Executive out brief is prepared and presented
  - Observations, findings and recommendations
  - Presentation structured using the RCASS model
    - Shows cause and effect linkage
  - Findings allocated a risk code rating
  - Presented at the end of the second week

- The final report is prepared and delivered (an additional two weeks)
SCRAM Findings - Examples

Sample Findings with Risk Code Rating

- **POSITIVE:**
  - Functional requirements based-lined and agreed; no evidence was identified of requirements churn or creep

- **POTENTIAL RISK:**
  - Limited schedule contingency exists for further rework

- **HIGH RISK:**
  - Lack of an integrated high-level schedule precludes the ability to accurately forecast project milestone achievements
    - 13 major schedules not integrated at the program level
Process Reference / Assessment Model

- Developed as an ISO/IEC 15504 conformant Process Reference Model and Process Assessment Model
  - Funded by the Australian Defence Materiel Organisation (DMO)
  - Developed by
    - Systems and Software Quality Institute and Software Metrics Inc.
  - Delivered June 2010
  - The models are publicly available to download from:

http://www.scramsite.org
Topics

- Three Common Questions Addressed by SCRAM
- Benefits of Using SCRAM
- SCRAM Key Principles
- SCRAM Process
- Future plans for SCRAM
Future Plans

- Currently developed Diagnostic SCRAM (D-SCRAM)
  - Full scale application of the method to evaluate challenged projects or Projects of Concern.
  - Used to assess likelihood of schedule compliance, root cause of schedule slippage and to recommend remediation of project issues

- Further evolve the SCRAM process for:
  - Pro-active SCRAM (P-SCRAM)
    - To be conducted prior to Contract or at Integrated Baseline Review (IBR) to ensure common systemic issues are avoided before the Program Schedule is contracted or baselined
  - Monitor SCRAM (M-SCRAM)
    - Reduced version of D-SCRAM that maybe used to monitor project status – project health check performed ad hoc or conducted to support appropriate Gate Reviews
Future Plans (cont.)

- SCRAM Training & Assessor Qualifications

- SCRAM Process Reference and Assessment Model
  - Further revisions
    - Based on feedback from use during SCRAM assessments and
    - Change Requests (Appendix D in the model)

- SCRAM Assessment Tool
  - Prototype has been used
  - Under development
SCRAM

QUESTIONS

For further information contact:

Govt to Govt - Adrian Pitman: adrian.pitman@defence.gov.au
Australia - Angela Tuffley: a.tuffley@ssqi.org.au
USA - Betsy Clark: betsy@software-metrics.com
USA - Brad Clark: brad@software-metrics.com
Acronyms

- ANAO – Australian National Audit Office
- BoE – Basis of Estimate
- COTS/MOTS – Commercial off the Shelf/Modified off the Shelf
- DMO – Defence Materiel Organisation (Australia)
- GAO – Government Accounting Office
- GFE – Government Furnished Equipment
- ISO/IEC 15504 – Information Technology – Process Assessment
- RCASS – Root Cause Analysis of Schedule Slippage
- SCRAM – Schedule Compliance Risk Assessment Methodology
- SMI – Software Metrics Inc. (United States)
- SSQi – Systems & Software Quality Institute (Australia)