Software Metrics Reporting Proposal

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Program Analysis and Evaluation

Contractor Cost Data Report Project Office

PA&E

Goal

- **Document both the anticipated and actual costs and sizes of DoD software developments so that software cost estimators can base future estimates on prior experience.**

  - **As remarkable as it may seem, there is currently no way to study the outcomes of DoD software projects.**

  - **Anticipated cost, size, and schedule are documented as part of the planning process.**

    However -

  - **Final size, schedule, and quality are rarely recorded.**

    » **Time passes, requirements change, and people leave projects as they wind down. Data on the actual experience is lost.**

Software Metrics Proposal

- **Software metrics background**

- **Proposal summary**

- **Metrics**

- **Metric planning and collection process**

- **DoD 5000.2-R SW Metrics Language**

- **Draft Request for Proposal language**

- **Recap of where we have been**

- **Where we are going**

Software Measurement Stakeholders

- **Cost Analysis Improvement Group (CAIG) within PA&E is responsible for developing independent estimates for weapon systems (ACAT IC and ID programs)**

- **Service Cost Centers are responsible for estimating ACAT IA, IC, and ID programs)**
  - **Interested in better data on both embedded and business applications (MAIS)**

- **CAIG sponsors a Contractor Cost Data Reporting Project Office that collects weapon system costs to support all estimators (CAIG and Service Cost Centers)**

Software Measurement Stakeholders (Concluded)

- **PA&E is responsible for reviewing and advising C³I on MAIS life cycle cost estimates and Acquisition Program Baseline breaches**
- **Service Cost Centers requested CCDR-PO research how community can obtain better data to estimate software systems (weapon systems and MAISs)**
  - **Need historical cost and metric data to estimate similar future systems**
  - **Tried and failed to match CARDs with CCDR data**
    - » **Only initial metric data contained within CARD**
    - » **WBS did not go low enough to provide software cost data**
- **Goal is to collect a common minimal set of software data from embedded and MAIS systems to support estimating**

Summary of Proposed Approach

- **Propose change to DoD 5000.2-R that requires software metric reporting on all ACAT I programs**
- **Content:**
  - **Software metric data contained on two pages**
- **Frequency:**
  - **Report will be submitted at three points: At time of a Cost Analysis Requirements Description (CARD) submission, 60 days after contract award or MOA, and 60 days after product completion/delivery**
- **Process:**
  - **Cost Working-Level Integrated Product Teams (CWIPTs) identify elements that need metrics, tailor data elements, create software metrics data plan and data dictionary**

Summary of Proposed Approach (Concluded)

- ## Process (concluded):
  - ### For MDAPs:
    - » **CAIG Chair approves software metric plans and submits to PM who places on contract**
    - » **Contractors submit data to central web site**
  - ### For MAIS (very tentative):
    - » **Information Technology Working Integrated Product Team (ITWIPT) submits software metric plan to PM who either places on contract or obtains data through other means**
    - » **PM submits data to central web site**

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Revised DD Form 2630, Page 1

Software Product Development Report
Page 1: Report Context, Project Description and Size

1.	**Report Context**	

1. System/Element Name (version/release):	2. Report As Of:
3. Authorizing Vehicle (MOU, contract/amendment, etc.):	4. Indicate Reporting Event: ___CARD ___Contract Award ___Final

Items 5 through 10 are to be answered only for Contract Award and Final reports.		
5. Development Organization:	6. Certified CMM Level (or equivalent):	8. Lead Evaluator:
	7. Certification Date:	9. Affiliation:
10. Precedents (list up to five similar systems by the same organization or team		

2.	**Product and Development Description**	**Percent of Product Size**	**Development Process**	**Upgrade or New?**
	1. Primary Application Type:	2. %	3.	4.
	5. Secondary Application Type:	6. %	7.	8.
	9. Third Application Type:	10. %	11.	12.
	13. Fourth Application Type:	14. %	15.	16.
	17. Primary Language:	18. %		
	19. Secondary Language:	20. %		
	21. List COTS/GOTS Applications:			

3.	**Product Size Reporting**	**Provide Estimates at CARD and Contract Award, Actuals at Final**
	1. Number of Software Requirements, not including External Interface Requirements (unless noted in associated Software Metrics Data Dictionary)	
	2. Number of External Interface Requirements (i.e., not under project control)	
	3. Code Size Measures for items 4 through 11. For each, indicate S for physical SLOC (carriage returns); Snc for noncomment SLOC only; LS for logical statements; or provide abbreviation _____ and explain in Software Metrics Data Dictionary.	
	4. New Code developed for COTS/GOTS Integration and under Configuration Control (Size in _____)	
	5. All Other New Code under Configuration Control (Size in _____)	
	6. Modified Generated Code under Configuration Control (Size in _____)	
	7. Unmodified Generated Code under Configuration Control (Size in _____)	
	8. Modified Internally Reused Code under Configuration Control (Size in _____)	
	9. Unmodified Internally Reused Code under Configuration Control (Size in _____)	
	10. Modified External Reused Code under Configuration Control (Size in _____)	
	11. Unmodified External Reused Code under Configuration Control (Size in _____)	

DD Form 2630-R   **Page 1 of 2**

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Revised DD Form 2630, Page 2

Software Product Development Report
Page 2: Project Resources, Schedule, Staffing and Quality

4. Resource and Schedule Reporting		Provide estimates at CARD and Contract Award, Actuals at Final		
Show Start and End Month after contract award (counting from month 1 at contract award), and Total Labor Hours for each phase or activity shown		Start Month	End Month	Total Hours
The following seven items should account for all direct hours charged to the software development project (use item 7 for any direct hours not accounted for in items 1 through 6). Explain any contribution of indirect hours in the associated Software Metrics Data Dictionary.				
1. Software Requirements Analysis				
2. Software Architecture and Detailed Design				
3. Software Coding and Unit Testing				
4. Software Integration and System/Software Integration				
5. Software Qualification Testing				
6. Software Operational Test and Evaluation				
7. All Other Direct Software Engineering Development Effort (Describe: _____ _____) Report hours only:				

5. Staffing Profile

1. Peak FTE's directly charging to project: ____ | 2. Month number of midpoint of peak: ____

3. Percent of personnel: Highly experienced in project domain: ___% Nominally experienced: ___% Entry level, no experience: ___%

6. Product Quality Reporting

1. Required Mean Time to Defect (MTTD) at Delivery (only complete at CARD). Alternatively, provide an alternate method of comparing the required reliability of this system with the nominal reliability for systems of this type: _____ hours

Report cumulative defect counts since project start in each category. Use associated Software Metrics Data Dictionary to define counting rules as necessary.	Actuals After Completion of Software Qualification Test	Actuals After Completion of Operational Test and Evaluation
2. Cumulative Number of Critical Defects Discovered		
3. Cumulative Number of Serious Defects Discovered		
4. Cumulative Total Number of Defects Discovered		
5. Cumulative Number of Critical Defects Resolved		
6. Cumulative Number of Serious Defects Resolved		
7. Cumulative Total Number of Defects Resolved		

Filename and Revision Date of Applicable *Software Metrics Data Dictionary* :

Name of person to be Contacted	Signature	Telephone Number	E-Mail	Date

DD Form 2630-R — Page 2 of 2

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Proposed Processes

- ## For ACAT IC and ID programs:

  - PM prepares and submits DD Form 2630 with CARD

  - PM-led CWIPT identifies software elements, prepares draft data dictionary and documents into a Program Software Measurement Plan, sends plan to CAIG Chair for approval

  - CAIG Chair approves plan and sends to PM along with proposed RFP language

  - PM develops Contract Software Measurement plan and requests data through RFP, DIDs, and CDRL

  - Developers propose Software Development and Measurement Plans (tailored DD Form 2630) and updated dictionary

  - Developer and PM negotiate contract or MOA (for CDAs)

  - Developer submits DD Form 2630 and updated dictionary to central web site 60 days after award and after product delivery

  - PMs approve data for limited distribution

 - Cost analysts access data through secure web connection

Proposed Process (Concluded)

- ## For ACAT IA (MAIS) programs (very tentative):

  - PM prepares and submits DD Form 2630 with CARD

  - ITWIPT likely to coordinate the Software Measure Plan similar to MDAPs, but more coordination necessary to define the process

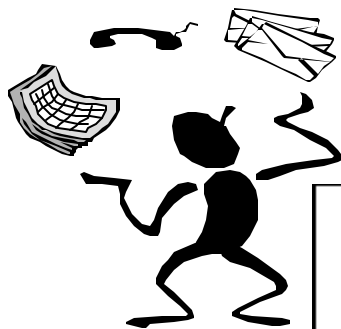 - PMs are to provide the data to the central web site

Software Metrics Planning Process
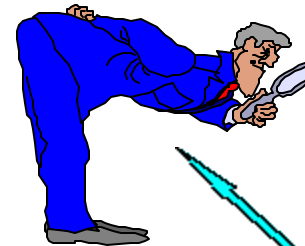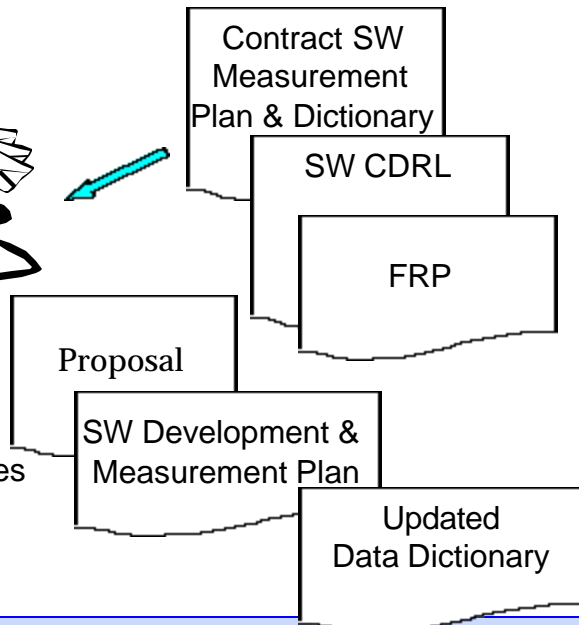# (For ACAT IDs and ICs)

Cost Working Integrated Product Team (CWIPT) identifies software data needs. PM develops Program Software Measurement Plan and data dictionary
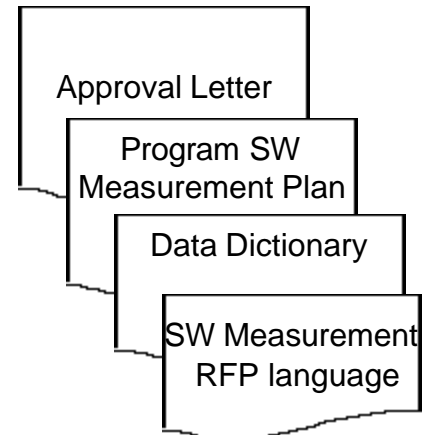
Program SW Measurement Plan (Identifies WBS elements)

Data Dictionary
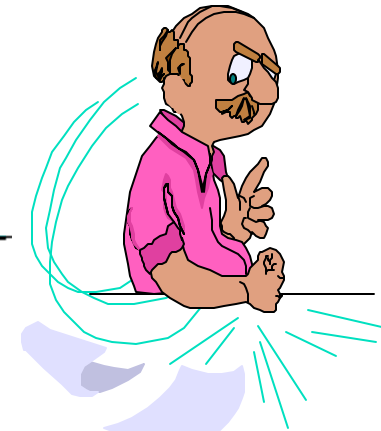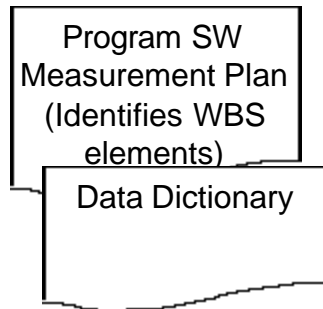
CAIG Chair approves Program Software Measurement Plan

Contract SW Measurement Plan & Dictionary

SW CDRL

FRP

PM evaluates requirements & finalizes RFP

Approval Letter

Program SW Measurement Plan

Data Dictionary

SW Measurement RFP language

Proposal

SW Development & Measurement Plan

Contractor analyzes requirements and prepares proposal

Updated Data Dictionary

1

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Software Metrics Data Collection Process
(For ACAT IDs and ICs)

1

PM & contractor negotiate
software development &
measurement plan & dictionary

Contract

Defense Contractor

DD Form 2630
& Updated
Dictionary

Internet

**DoD
Web
Server**

SSL Traffic

**SW Metrics
Data Base**

**Program
Manager**

**Government
Analyst**
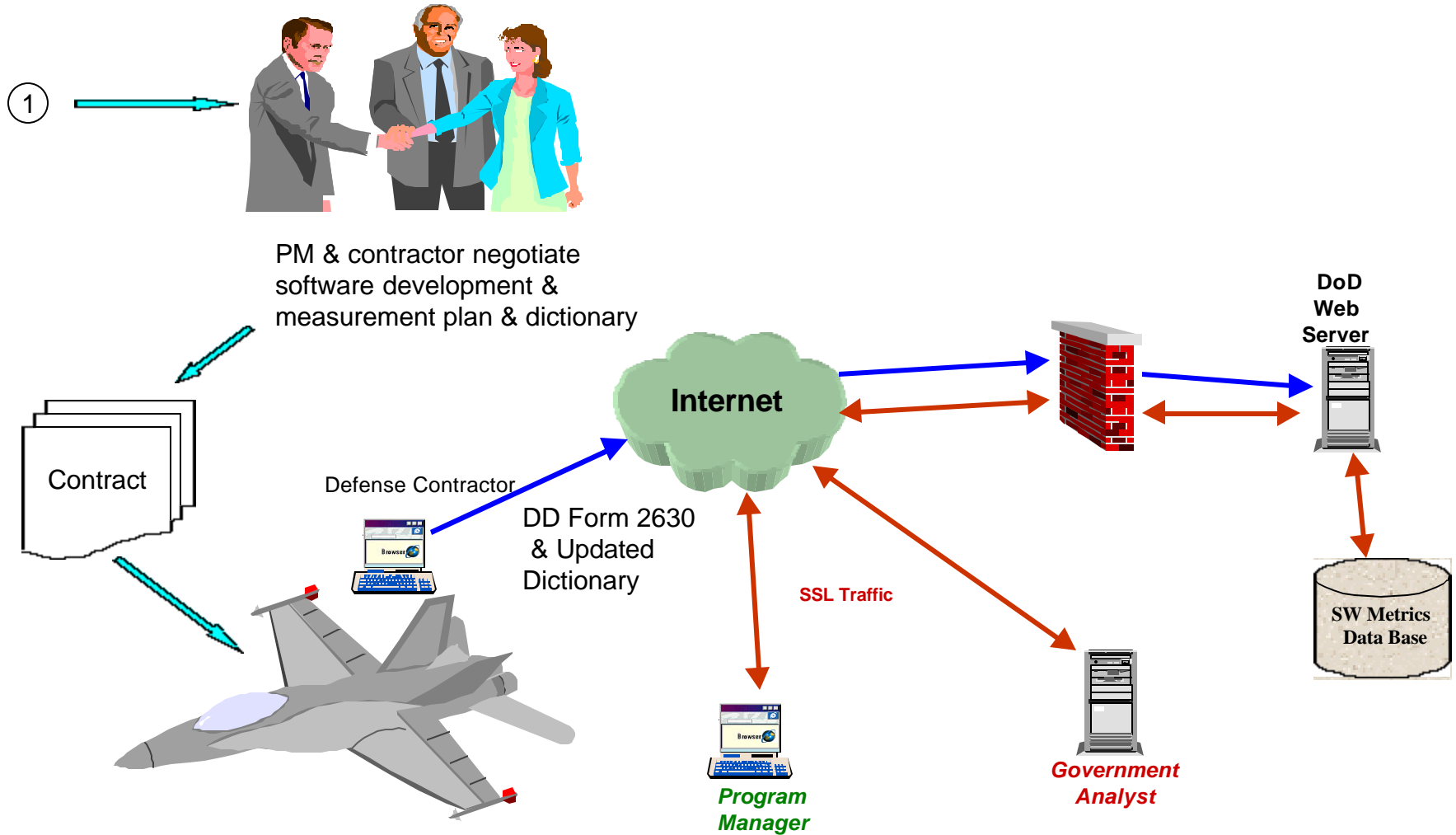
Proposed Software Metric Language for DoD 5000.2-R (New Section 7.11.7.6)

ACAT I programs that contain software intensive elements must submit software metrics data. The specific data to be submitted will be determined by the IPT process using the Software Product Development Report (DD Form 2630) as the baseline. Data will be submitted at three intervals during the life of the program: at the time of cost analysis requirements description (CARD) submission, within 60 days of contract or task award, and within 60 days after software product delivery.

Proposed Request for Proposal (RFP) Language

The contractor must prepare a Contract Software Development and Measurement Plan following the structure and elements shown in the attached Contract Software Measurement Plan and dictionary. The data elements identified in the Contract Software Measurement Plan are the software elements for which the Government desires measurement information. The contractor shall report these elements at the frequency indicated in the plan. The contractor may propose additions, deletions or modifications to those elements identified in the plan if the proposed elements are used by the contractor to manage the development effort. If changes are proposed, the contractor shall so indicate in the Measurement plan and describe them in an updated Software Measurement Data Dictionary.

Software Metrics Research
Where We Have Been

- **Held several meetings with service cost centers and PA&E reps to determine needs (February - May 1999)**

- **Conducted joint industry/government meeting to discuss data elements and collection process (May 25, 1999). Comments/concerns were:**
  - **Metric data does not belong within CCDRs**
  - **Data reporting is duplicative of existing voluntary efforts**
  - **Some data elements are of questionable value**
  - **Recommended we do a business case and research a voluntary approach -- Practical Software Measurement (PSM)**

Software Metrics Research
Where We Have Been (Continued)

- **Researched PSM approach (July 1999)**

- **Revised data content and proposed that it replace an existing form required of embedded systems (DD Form 2630)**

- **Reconvened joint industry/government members (August 3, 1999)**
  - Presented anecdotal evidence of benefits of software measurement
  - Proposed issue driven (PSM) approach and industry agreed
  - Industry suggested we develop a Data Item Description (DID) and a Contract Data Requirements List (CDRL) to facilitate contracting

Software Metrics Research
Where We Have Been (Continued)

- **Held a number of follow-on meetings to resolve content issues**
  - **Industry mainly concerned about**
    - » **Intent to use as oversight**
    - » **Misapplication/Understanding of Quality metric**

- **Presented full proposal to CCDR Focus Group (November 30, 1999)**
  - **Agreed that software metric data is needed to support cost estimating**
  - **Agreed to proposed processes, but expressed concern about mechanics**
    - » **Industry concerned that tailoring the DD Form will be perceived as non-responsive**
    - » **RFP/SOW language needs to be clear that tailoring is encouraged**

Software Metrics Research
Where We Have Been (Continued)

- **Presented proposal to Delores Etter (DUSD, Science and Technology) (April 11, 2000)**
  - Receptive to idea
  - Expressed interest in including data with the Defense Acquisition Executive Summary (DAES)

- **Developed a written proposal (May 9, 2000)**

- **Presented proposal to working level of C^{3}I (April 27 and May 9, 2000)**
  - Positive about idea
  - C^{3}I revealed separate software metric data collection plan
    - » Eight pages of metrics
    - » Proposed monthly reporting
    - » Proposed to include in DAES report

Software Metrics Research
Where We Have Been (Continued)

- **C³I's proposal (concluded):**
  - **C³I proposed to assume full responsibility for collecting metrics and to feed the cost community the data it requested (the data contained on the revised DD Form 2630)**

- **Reviewed proposal comments, revised proposal, and collection processes with cost center representatives, PA&E and CAIG (May 17, 2000)**

- **Reviewed updated proposal with the CCDR Focus Group (May 25, 2000). Concerns:**
  - **Instructions need to clarify the extent to which the report can be tailored by CWIPT or ITWIPT**

Software Metrics Research
Where We Have Been (Concluded)

● **Comments for May 25, 2000 Focus Group (continued):**

   – **No common method is used to count defects**

   » **Use of defect data in any analysis questionable**

   – **Industry wants clear understanding on how defect data will be used**

   – **Defect data can be used to:**

   » **calculate a final reliability measure (Mean Time to Defect) which provides the fourth dimension (Quality) to the metrics**

   » **scale software estimating model outputs**

   » **to predict PDSS effort, I.e., programs with high MTTDs are likely to have lower PDSS efforts**

Software Metrics
Where We Are Going

- **Conduct pilot tests**
  - **Obtain feedback from PSM workshop**
  - **Summarize findings from QSM data collection efforts**
  - **Obtain feedback from 5 MDAPs**

- **Revise the form and processes based on test results**

- **Seek PA&E approval of the proposal and DoD 5000.2-R language**

- **Continue to coordinate with C^{3}I on their software metric effort**

- **Create supporting documentation and implementing instructions -- DoD 5000.4-M-2**

Software Metrics Pilot Test

- **Questions we hope to answer with pilot test**
  - **How readily available are the data?**
  - **How much effort is required to provide the data as defined?**
  - **To what extent is tailoring needed?**
  - **Is it difficult to tailor the DD Form 2630?**
  - **How well does the specification, tailoring, collection, and reporting procedure integrate with contractor processes?**
  - **What improvements can we make to the form or processes?**
    - » **Should data descriptions be more general or more specific?**
    - » **Should we be more or less ambitious in the data categories?**