Defense Cost and Resource Center

The DoD Software Resource Data Report – An Update

9th Annual Practical Software and Systems Measurement Users' Group Conference
19 July 2005

Enhancing DoD Cost Analysis

DCARC

DCARC Mission & Objectives

- Mission
  - To collect historical Major Defense Acquisition Program cost and software resource data in a joint service environment and make those data available for use by authorized government analysts to estimate the cost of ongoing and future government programs, particularly DoD weapon systems
- Objectives
  - Make cost and software data report (CSDR) collection as inexpensive and least disruptive as possible for contractors
    - Contractor Cost Data Report (CCDR)
    - Software Resource Data Report (SRDR)
  - Provide wide availability of CSDR data to legitimate government users
  - Maintain integrity and accuracy of data collected
  - Improve quality of data reported by industry

Primary Objective:
Ensure that DoD cost estimates provided to senior management reflect as accurately as possible DoD's cost experience.

Outline

- A Quick SRDR Refresher
- Status
- Initial Results
- Challenges/Looking Forward
- Summary

SRDR Refresher

- The SRDR is a contract deliverable that identifies key attributes of the software development
  - Formalizes delivery of software metric information
  - Requires both estimated (provided at contract/build start) and final as-built information
- SRDR deliverable requirement was established via DoD Instruction 5000.2 policy *"All major contracts and subcontracts, regardless of contract type, for contractors developing/producing software elements within ACAT I and ACAT IA programs for any software development element with a projected software effort greater than $25M (FY 2002 constant dollars)"*
- Specific SRDR guidance provided in DOD 5000.4-M-2
- Current implementation of SRDR via DD Form 2630 was the result of collaborative efforts of
  - OSD Cost Analysis Improvement Group (CAIG)
  - DoD Service Cost Centers
  - Industry
  - Academia (including Practical Software and Systems Measurement Users' Group)

Updated policy for SRDR reporting has been in place since 2003

SRDR Reporting Requirements

Event	Report Due	Who Provides?	Scope of Report
Pre-Contract (180 days prior to award)	2630-1	Government Program Office	Estimates of the entire completed project. Measures should reflect cumulative grand totals.
Contract award	2630-2	Contractor	Estimates of the entire completed project at the level of detail agreed upon. Measures should reflect cumulative grand totals.
At start of each build	2630-2	Contractor	Estimates at completion for the build only.
At end of each build	2630-3	Contractor	Actuals for the build only.
Contract Completion	2630-3	Contractor	Actuals for the entire project. Measures should reflect cumulative grand totals.

Salient Features of Data Requested

- It does not collect cost data
- Intent of SRDRs is to collect data that developers already possess and routinely use to manage their software projects
- Goal is to use a consistent (and efficient) set of data fields that capture size, effort, schedule of large weapon system and large automated information system (AIS) development projects.
- Government suggests specific data elements via DD Form 2630 template.
  - At a minimum, that data must reflect size, effort, and schedule with corresponding definitions
  - Quality (defect) reporting only if directed by Cost Working Integrated Process Team (CWIPT)
- Delivery mechanism is flexible
  - Spreadsheet files preferred
  - Burden is on users to interpret and analyze

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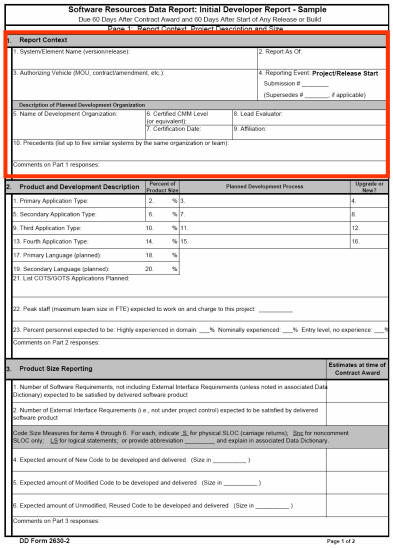
Section 1-Report Context

1. System/Element Name
2. Report As Of
3. Authorizing Vehicle
4a. Reporting Event
4b. Submission #
4c. Supersedes #
5. Name of Development Organization
6. Certified CMM level or Equivalent
7. Certification Date
8. Lead Evaluator
9. Affiliation
10. Precedents



Software Resources Data Report: Initial Developer Report - Sample

Due 60 Days After Contract Award and 60 Days After Start of Any Release or Build

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. Reporting Event: Project/Release Start
Submission # _____
(Supersedes # _____ if applicable)

Description of Planned Development Organization

5. Name of Development Organization:
6. Certified CMM Level (or equivalent)
7. Certification Date:
8. Lead Evaluator:
9. Affiliation:
10. Precedents (list up to five similar systems by the same organization or team):

Comments on Part 1 responses:

2. Product and Development Description

	Percent of Product Size	Planned 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 (planned):	18. %		
19. Secondary Language (planned):	20. %		

21. List COTS/GOTS Applications Planned:

22. Peak staff (maximum team size in FTE) expected to work on and charge to this project: _____

23. Percent personnel expected to be: Highly experienced in domain: ___% Nominally experienced: ___% Entry level, no experience: ___%

Comments on Part 2 responses:

3. Product Size Reporting — Estimates at time of Contract Award

1. Number of Software Requirements, not including External Interface Requirements (unless noted in associated Data Dictionary) expected to be satisfied by delivered software product
2. Number of External Interface Requirements (i.e., not under project control) expected to be satisfied by delivered software product

Code Size Measures for items 4 through 6. For each, indicate _S_ for physical SLOC (carriage returns); _Snc_ for noncomment SLOC only; _LS_ for logical statements; or provide abbreviation _____ and explain in associated Data Dictionary.

4. Expected amount of New Code to be developed and delivered (Size in _____)
5. Expected amount of Modified Code to be developed and delivered (Size in _____)
6. Expected amount of Unmodified, Reused Code to be developed and delivered (Size in _____)

Comments on Part 3 responses:

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Enhancing DoD Cost Analysis

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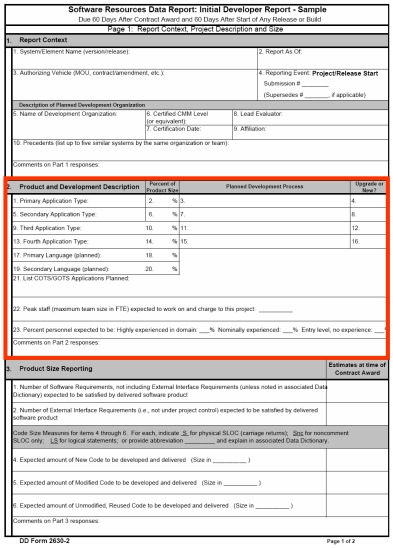
Section 2-Product and Development Description

1. Primary Application Type
2. Percent of Product Size
3. Planned Development Process
4. Upgrade or New?
5. Secondary Application Type
6. Percent of Product Size
7. Planned Development Process
8. Upgrade or New?
9. Third Application Type
10. Percent of Product Size
11. Planned Development Process
12. Upgrade or New?
13. Fourth Application Type
14. Percent of Product Size
15. Planned Development Process
16. Upgrade or New?
17. Primary Language
18. Percent of Product Size
19. Secondary Language
20. Percent of Product Size
21. COTS/GOTS Applications Used
22. Peak Staff
23. Personnel Experience



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6. Expected amount of Unmodified, Reused Code to be developed and delivered (Size in _____)

Comments on Part 3 responses:

DD Form 2630-2 — Page 1 of 2

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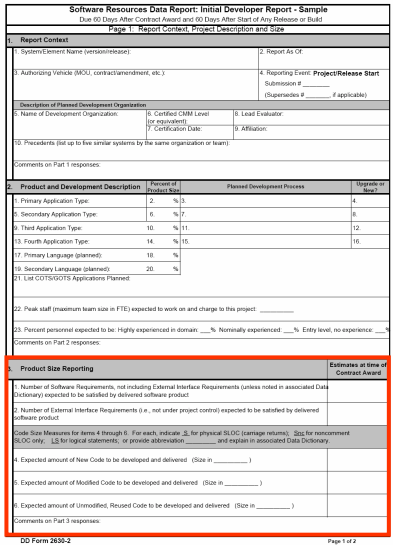
Section 3-Product Size Reporting

1. Number of Software Requirements (Internal)
2. Number of External Interface Requirements
3. Custom Size Units
4. New Code Developed and Delivered
5. Modified Code Developed and Delivered
6. Unmodified, Reused Code Developed and Delivered



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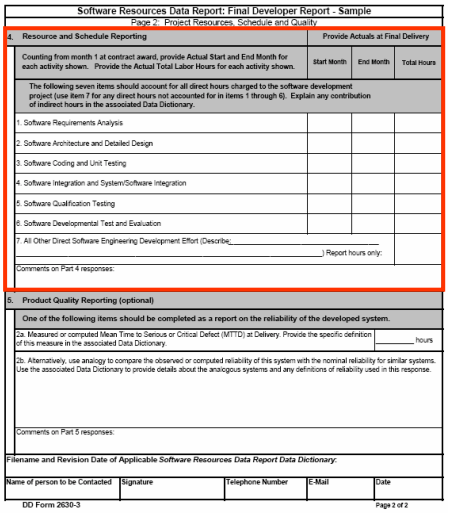
Section 4-Resource and Schedule Reporting

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 Developmental Test and Evaluation
7. Other Direct Software Engineering Development



Software Resources Data Report: Final Developer Report - Sample

Page 2: Project Resources, Schedule and Quality

4. Resource and Schedule Reporting — Provide Actuals at Final Delivery

Counting from month 1 at contract award, provide Actual Start and End Month for each activity shown. Provide the Actual Total Labor Hours for each activity shown.

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 Data Dictionary.

	Start Month	End Month	Total Hours
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 Developmental Test and Evaluation			
7. All Other Direct Software Engineering Development Effort (Describe:_____) Report hours only:			

Comments on Part 4 responses:

5. Product Quality Reporting (optional)

One of the following items should be completed as a report on the reliability of the developed system.

2a. Measured or computed Mean Time to Serious or Critical Defect (MTTD) at Delivery. Provide the specific definition of this measure in the associated Data Dictionary. _____ hours

2b. Alternatively, use analogy to compare the observed or computed reliability of this system with the nominal reliability for similar systems. Use the associated Data Dictionary to provide details about the analogous systems and any definitions of reliability used in this response.

Comments on Part 5 responses:

Filename and Revision Date of Applicable *Software Resources Data Report Data Dictionary:*

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

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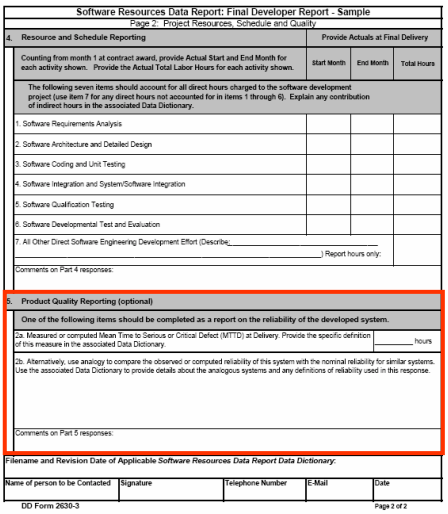
Section 5-Product Quality

2a. Mean Time to Serious or Mission Critical Defect (MTTD)
2b. Analogous reliability

1. *This Section is not applicable for initial reporting (2630-2)*
2. *Product Quality Reporting is considered an optional reporting item. This item is included based on the recommendation the (CWIPT)*



Software Resources Data Report: Final Developer Report - Sample
Page 2: Project Resources, Schedule and Quality

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1. Software Requirements Analysis			
2. Software Architecture and Detailed Design			
3. Software Coding and Unit Testing			
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6. Software Developmental Test and Evaluation			
7. All Other Direct Software Engineering Development Effort (Describe:_____) Report hours only:			
Comments on Part 4 responses:			

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Comments on Part 5 responses:

Filename and Revision Date of Applicable *Software Resources Data Report Data Dictionary*:

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

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Additional SRDR Comments

- SRDR does not collect labor rate information
  - SRDR intentionally avoids requesting financial information
  - Labor rate could be computed using data from the Contractor Cost Data Report (CCDR) Form 1921-1
- Sizing Issues
  - Some sizing measures are not permitted
    - Equivalent New Source Lines of Code (ESLOC), total Delivered Source Lines of code (DSLOC)
    - However, they can be provided as supplemental information
  - Why 'SLOC'?
    - Still the prevalent sizing measure for weapon system software development
    - Intended as a default sizing metric
    - Function points and other measures are permitted as long as the contractor uses them for both the initial submission and the final submission

Outline

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Status of Current SRDR Holdings

- Current SRDR holdings from 17 unique programs
- Only one program– Cooperative Engagement Capability (CEC) currently reflects actuals
- Many programs have multiple contractor/contracts. An 'X' doesn't imply complete coverage for program
- Projects represent new development, upgrade development, and maintenance type efforts

Program Name	2630-2	2630-3
Advanced Anti- Radiation Guided Missile (AARGM)	X	
B-2 Radar Modernization Program	X	
Cooperative Engagement Capability	X	X
Cobra Judy	X	
CVN-21 - Electromagnetic Aircraft Launch System (EMALS)	X	
E-2C Advanced Hawkeye (AHE)	X	
EA-18G	X	
Force XXI Battle Command, Brigade-and-Below (FBCB2)	X	
Future Combat System – SOSCOE	X	
Future Combat System – IS&T	X	
Future Combat System – C4ISN	X	
Joint Simulation System (JSIMS)	X	
Littoral Combat Ship	X	
Multimission Maritime Aircraft	X	
Multi-Platform Radar Technology Insertion Program (MP-RTIP)	X	
Joint Mission Planning System (JMPS)	X	
Mobile User Objective System (MUOS)	X	
Transformational Communication Satellite System (TSAT)	X	
Warfighter Information Network-Tactical (WIN-T)	X	

DCARC

Why Aren't There More Programs?

- Many are already in production (too late for SRDRs)
- Programs in development prior to 2003 are (generally) not required to submit SRDRs
- Many development programs with SRDR reporting requirements will not complete their development for a number of years
  - However, many of them will be reporting actuals (i.e. 2630-3) as they complete each build

Expected Development Completion

2006	1	WIN-T
2007	3	EXCALIBUR C-130 AMP LCS
2008	2	JTRS CLUSTER 1 MPS
2009	6	AARGM ARH B-2 RMP CVN-21 MUOS ACS
2010	3	E/A-18G DDX MP RTIP
2011	2	COBRA JUDY VXX
2012	3	MMA F-35 (JSF) TSAT
2013	1	E-2C AHE
2014	2	FCS MEADS

DCARC

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- A Quick SRDR Refresher
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Initial Results

- Descriptive data
- Productivity
- Example of using the data in analysis
- Caveats
  - The following set of displays is intended for illustrative purposes. Additional validation of the data is needed before use.
  - Some information has been deliberately omitted in order to protect proprietary data
  - Results reflect data pulled from 2630-2. Therefore, the data reflects contractor estimates, not actuals
  - Displayed data reflects lower level information provided on SRDR that has been aggregated to the program level
  - Data are not normalized across multiple contractors

Descriptive Data

CMM/CMMI	Programming Language								Tailored Phases?	Internal Reqt's	Counting Convention
	C	C++	Java	Ada	Jovial	Assembly	VB	XML			
5	x								No	1,178	Snc
Unk		x					x		No	5,000	Snc
3	x	x		x					No		LS
5		x						x	Yes		Snc
5	x	x							No	3,478	LS
3	x	x							No	3,189	Snc
3	x								Yes	492	Snc
3		x			x	x			Yes		Snc
Unk		x	x						Yes		LS
5	x	x							No		ESLOC
3		x	x						No	834	S
5	x	x		x			x		No	7,628	LS
3		x							No	1,023	Snc
3	x	x		x					No	752	LS
5	x		x						No	458	Snc
Unk	x								No	1,400	Snc
4	x	x	x	x		x			Yes	171,051	LS
Unk		x		x					No	61	Snc

Notes: Data pulled from DD 2630-2 Submissions and aggregated to program level

Snc = Non-Comment, Non-Blank SLOC, LS = Logical Statement, ESLOC= Equivalent New Source Line of Code
S= Physical carriage returns

Productivity

- Display reflects productivity for Code & Unit Test Only
  - Most contractors are reporting effort by specific software development activity
  - However, contractors have differing sets of included/excluded activities
- Outliers may be an indication of the inclusion of auto-generated code (need follow-up with the data provider)
- In some cases, the sizing data does not reflect the entire software system
  - Missing system component data
  - Missing sub-contractor SRDR submissions

Counting Convention	DSLOC	ESLOC	ESLOC/MM
Snc	438,994	416,730	172
Snc	556,754	351,468	369
LS	2,357,989	585,176	426
LS	6,305,835	1,271,294	1,211
Snc	36,850	32,450	299
Snc	266,857	51,503	352
S	3,326,940	445,202	18,359
ESLOC		836,900	185
Snc	270,882	239,850	1,176
Snc	99,530	73,993	898
LS	1,043,008	233,325	490
Snc	13,107	1,092,996	60,501
Snc	295,000	188,500	551
Snc	39,211	18,813	161

Notes:
Data pulled from DD 2630-2 Submissions and aggregated to program level

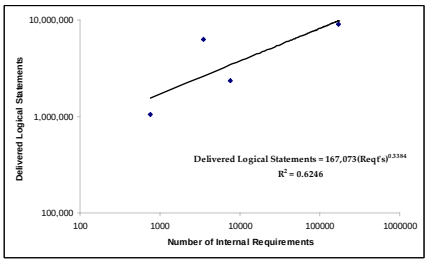
DSLOC = New + Modified + Unmodified

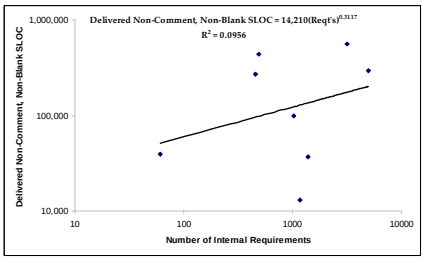
ESLOC = New + .5*Modified + .1 * Unmodified

ESLOC/MM = 152* (ESLOC/**Code & Unit** Test Hrs)

Example Analysis: Requirements versus Size

- A demonstration relating requirements to software size
- Requirements counting conventions differ by contractor
- Without normalization, it will be difficult to compare requirements counts across contractors/programs
- Data within a contractor should be very comparable





Common Quality Issues

- Submissions contained little to no contextual information
- Submission doesn't include a dictionary
- Dictionary didn't define enough details
  - Example 1: Effort reported in man-months, no hours per man-month was specified
  - Example 2: Sizing was provided in ESLOC (already a "no-no"), no definition was provided on ESLOC computation
- Vital information was omitted
  - Effort completely omitted
  - Sizing
- Information wasn't valid
  - ESLOC or DSLOC was provided
- Data appears unusual
  - Large amount of new code development, unusually small amount of development effort
  - Could be correct, but need to validate with the contractor

Outline

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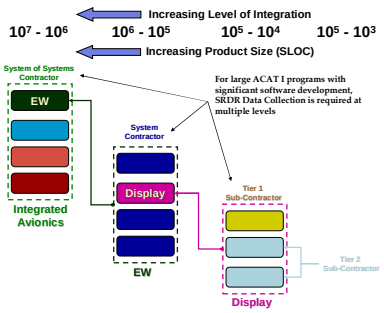
Challenges

- Size of Acquisition Category (ACAT) I program increases data collection complexity
  - Large number of software components
  - Large team of software developers, each required to report if > $25M of software development effort
  - Currently, integration of this data is the responsibility of the individual cost analyst
  - Heterogeneous data within a given program with multiple contractors is likely
- ACAT I program developments are lengthy
  - Historical data collected good for correlating mission, size, complexity of software with cost. However, good chance that tools, computing platforms, and development processes are obsolete at project completion.
  - Program restructurings can/will hamper collection efforts. May result in resetting of SRDR reporting.
- Current DD Form 2630 is better suited for waterfall type developments. Some challenges reporting data by software build



Looking Forward

- Emphasis to date has been on weapon systems. AIS programs will eventually come into the spotlight for SRDR reporting
- Current cost reporting (CCDR) and software reporting (SRDR) guidance documents are undergoing revisions to integrate them into one guidance document
- Future revisions to DD 2630 are needed to reflect lessons learned, current industry practice, and increased knowledge of emerging software cost and schedule drivers

CSDR Training Activities

CY 2004-CY 2005

- Aircraft Systems: August 25-26: Lockheed Martin, Ft Worth
- Missile/Ordnance: Sept 22-23: Raytheon, Tucson
- Space Systems: Oct 16-17: Lockheed Martin, Sunnyvale
- Ship Systems: Nov 16-17: Northrop Grumman, New Orleans
- Electronic Systems: February 1-2: Northrop Grumman, Baltimore
- Surface Vehicle Systems: February 23-24: TACOM
- Missile/Ordnance: May 24-25: Lockheed Martin, Grand Prairie

◆ Upcoming Training

- Aircraft Systems: August 9-10: Lockheed Martin, Marietta
- Ships: September 13-14: Northrop Grumman, Newport News
- Surface Vehicles: October 19-20: Boeing St. Louis
- Electronics/AIS: November 16-17: Raytheon, El Segundo

◆ SRDR training is provided at each of these sessions

Summary

◆ How can I get the data?

- Currently available only to DoD cost analysts
- SRDR data is not yet available online. Forward a request to the DCARC office to request the data

◆ Growing pipeline of programs submitting SRDR information

◆ Not a turn-key set of data

- Analysts must properly integrate the information
- Analysts should have relevant knowledge of both the system and the specific development effort

SOFTWARE DATA IS ON THE WAY

DCARC

Additional Resources

- SRDR forms and guidance
  http://dcarc.pae.osd.mil/srdr/index.html
- SRDR training schedule and training materials
  http://dcarc.pae.osd.mil/Training/index.html
- DCARC Office
  Phone: (703) 602-3301
  - Director (Ron Lile) x215
  - Lead Government Analyst (Mike Augustus) x218
  - Plans & Analysis x204
  - IT support x217