



Emergency Management Issues Special Interest Group Annual Meeting

Software Quality Assurance Lessons: The CAPARS Experience

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May 2-5, 2011 Charleston Marriott • Charleston, South Carolina



Acknowledgement

- The following superior software developers greatly contributed to the Software Quality Assurance (SQA) work described in this presentation:
 - Frank Willett
 - Jeff Navarra

Preface

- This presentation is NOT about:
 - The SCAPA SQA process
 - The SCAPA toolbox
 - CAPARS SQA
- This presentation IS about:
 - What AlphaTRAC did for SCAPA SQA review
 - The problems we had
 - The tools and systems developed for SQA review
 - Suggestions

Purpose

- Help other model developers going through the SCAPA SQA process
 - Learn from our mistakes and successes
 - Reduce effort and cost
- Initiate a common framework for SQA review
- **NOTE:** SQA is largely a documentation effort

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Background

...setting up the scene

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CAPARS

- A legacy real-time, emergency response atmospheric dispersion modeling system
 - Developed at Rocky Flats
 - Technology transfer to AlphaTRAC
 - Implemented at several DOE facilities
 - Used by state and county departments of health
 - Received formal acceptance
 - Extensive validation program
- Developed before SQA guidelines and requirements existed

Previous SQA Effort

- Internally developed QA programs
 - Based on NQA-1
 - Adapted for software systems
- QA programs updated several times
 - Driven by project needs

Problems with Previous SQA

- About five different SQA programs
 - Inconsistencies, differences, ownership changes, funding changes
- Records retention issues
 - Some development SQA records lost
 - 5-year records retention at Rocky Flats
 - Records transferred from Rocky Flats to AlphaTRAC
 - Media changes
 - Hardbound logbooks, magnetic tape, paper, 3.5” diskettes, etc.

The Challenge for the CAPARS SCAPA SQA Project

- Document current CAPARS SQA state
 - Use SCAPA SQA process
- Present information for reviewers
- Provide a framework for future SQA effort

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Organization

...getting it together

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Organization Issues

- Organization was the greatest challenge
 - How to present, store, maintain information?
 - No widely used systems in industry!
 - Spent about 150 hrs. solving
- Solution:
 - Develop MS SharePoint site for SQA
 - Centralized repository for information
 - Easy navigation and search capabilities
 - Allows for many contributors



SQA ▸ Home



- Sites
 - Project Management and Quality Planning
 - Risk Management
 - Configuration Management
 - Procurement and Supplier Management
 - Requirements
 - Design
 - Software Safety
 - Verification and Validation
 - Problem Reporting and Corrective Action
 - Training and Documentation
- Libraries
 - Site Pages
 - SQA Documents
 - SQA Templates
- Lists
 - Calendar
 - Tasks
 - Change Log
- Discussions
 - Team Discussion

-  Recycle Bin
-  All Site Content

CAPARS Software Quality Assurance (SQA) Site

This is the CAPARS SQA web site. As of 2010, CAPARS SQA follows the U. S. Department of Energy (DOE) Subcommittee on Consequence Assessment and Protective Actions (SCAPA) SQA guidelines for safety-related and non-safety applications titled Software Quality Assurance Guidance for Consequence Assessment Software Designed for Safety-Related and Other Non-Safety Applications (SCAPA SQA 2010).

SCAPA SQA 2010 contains ten components. To organize CAPARS SQA information, this site contains ten sub-sites that correspond to the ten SCAPA SQA components. (See links located to the left.)

Methodology for Identifying SQA “Benchmark” State

- Create metadata tags for:
 - SCAPA SQA elements
 - Code elements
- Upload all SQA-related documents to SharePoint
 - Tag each document for SQA and code elements
- Identify completeness of each SQA element

SCAPA SQA Elements

- 10 SCAPA-defined “work activity” components
 - 39 sub-components
 - Some not part of SCAPA SQA
- Example:
 - Design: Technical Description
 - V&V: Test Results: System Tests
- Can develop / implement others
- These are common for all following the SCAPA SQA process

Code Elements

- Define everything that makes up a system
- Code element structure should be identical for all modeling systems
 - Other groups should be able to use this concept
 - Specific entries will be different

Code Elements (continued)

- System
 - Main collection of all elements (e.g. CAPARS v5.11)
 - 21 CAPARS releases identified
- Sub-system
 - Discrete elements that usually function independently
 - Meteorological Data, User Interface, Model, Task Manager, Mapping Server, Utilities, Product Display and Access
- Component
 - Conceptual portions of sub-systems
 - (e.g. health, depositions components of Model sub-system)
 - 26 CAPARS components

Code Elements (continued)

- Program
 - Executable computer elements that make up components
 - 122 CAPARS programs
- Module
 - Software elements that make up a program
 - About 600 CAPARS modules

Code Element Hierarchy

- System
 - Sub-system
 - Component
 - Program
 - » Module
- CAPARS v5.11 system
 - Meteorological Data sub-system
 - Generic Meteorological Data component
 - extract_and_store program
 - » c_isam_store.c module

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Archeology

...a blast from the past

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The Dig

- Collect all relevant documents
 - In my possession
 - In the office
 - From off-site storage
- Scan paper documents
- Catalog each document based on SQA and CAPARS code element metadata tags



SQA ▾ SQA Documents ▾ All Documents ▾

Share a document with the team by adding it to this document library.

AlphaTRAC Intranet CAPARS AlphaACT PlayGround IT ▾										Search this site...
Sites	Type	File Name	Version	AT Doc Rev	CAPARS	Sub-system	Component	Program	Module	SQA Element
Project Management and Quality Planning		20010302a-puddle_initial_temperature	0.2	R0-1	Release:5.10		Component:Aloha Source Term			Design:Technical Description; V&V:Test Plan; V&V:Test Results
Risk Management		5.7.diff	0.1	R0-1	Release:5.10					Design:Technical Description
Configuration Management		Acceptance Process for CAPARSv4.0	0.2	R0-1	Release:4.0					V&V:Test Plan:Procedures; V&V:Test Plan:Objectives
Procurement and Supplier Management		AlphaTRAC software QA Program	0.2	R0-1	Release:3.0					Management:QA Plan; Management:QA Records
Requirements		canned met data input	0.2	R0-1	Release:5.10					Design:Technical Description; Training:User Documentation:System Use
Design		CAPARS conceptual design	0.2	R0-1	Release:3.0					Design:Technical Description; Design:Control Flow & Logic; Design:Data Flow; Design:Functional Overview; Design:I/O; Design:System Components
Software Safety		CAPARS data flow	0.2	R0-1	Release:3.0					Design:Technical Description; Design:Data Flow; Design:Control Flow & Logic; Design:I/O
Verification and Validation		CAPARS Element Tree	1.2		Release:5.10					Design:System Components
Problem Reporting and Corrective Action		CAPARS executable description v 2.5	0.2	R0-1	Release:5.10			Program:deposition		Design
Training and Documentation		CAPARS executable description v 3.0.1	0.2	R0-1	Release:5.10			Program:deposition		Design
Libraries		CAPARS GUI Input Parameters	0.2	R0-1	Release:3.0	SubSystem:User Interface				Design:Technical Description; Design:Control Flow & Logic; Design:Key Parameters; Design:Data Flow; Requirements
Site Pages		CAPARS Issue Tracking Program Rev 1	1.0	R0-1	Release:5.10					Problem Reporting
SQA Documents		CAPARS PA map comparison	0.2	R0-1	Release:5.2.3					V&V:Test Results:System Tests
SQA Templates		CAPARS Performance Improvements	0.1	R0-1	Release:4.0			Program:combine_puffs; Program:combine_receptors; Program:define_receptors; Program:deposition; Program:health; Program:select_crit_puff; Program:select_puff; Program:select_puff_window; Program:tandd; Program:unique_sort		V&V:Test Results:Installation Tests; Problem Reporting:Evaluation and Corrections Procedures:During Development and Testing; V&V:Test Results:Unit Tests
Lists		CAPARS Performance Improvements	0.2	R0-1	Release:5.0alpha					V&V:Test Results:Performance Tests
Calendar		CAPARS QA Plan	0.2	R0-1	Release:3.0					Management:QA Plan; Management:QA Records; Configuration; Problem Reporting; Procurement; Requirements
Tasks										
Change Log										
Discussions										
Team Discussion										
Recycle Bin										
All Site Content										

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LANL CAPARS Installation

...a chance to try all this out

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CAPARS v5.11 Installation

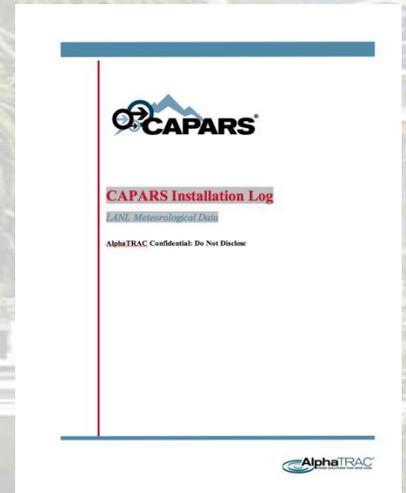
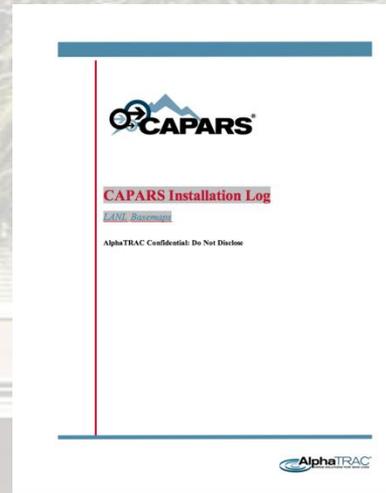
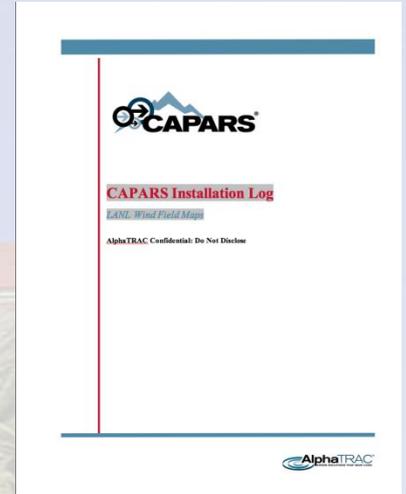
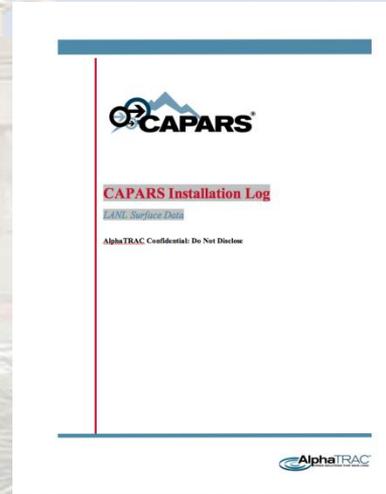
- LANL CAPARS installation performed during SCAPA SQA benchmark evaluation
 - AlphaTRAC decided to use the SCAPA SQA process
- Installing CAPARS at LANL required four system modification projects
 - Identified two types of SQA documentation:
 - Installation SQA
 - Development project SQA

SQA Documentation Plan From Now On...

- After SQA benchmark, AlphaTRAC will:
 - Document all SQA work in electronic logbooks
 - Use MS Word documents
 - Enter logbooks into SQA SharePoint site
 - Tag with appropriate SQA and code metadata tags
 - Add other electronic documents as necessary
- Installation SQA requires multiple logbooks depending on activity
- Development project SQA requires two logbooks:
 - Administration Log
 - Project Log

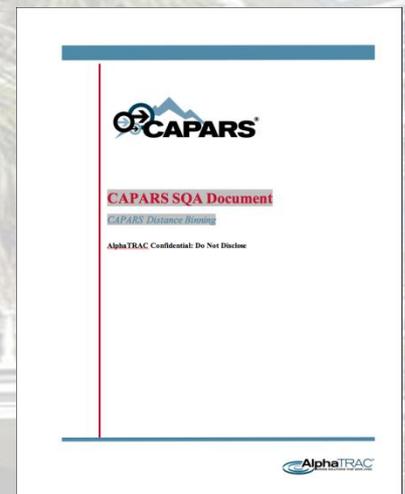
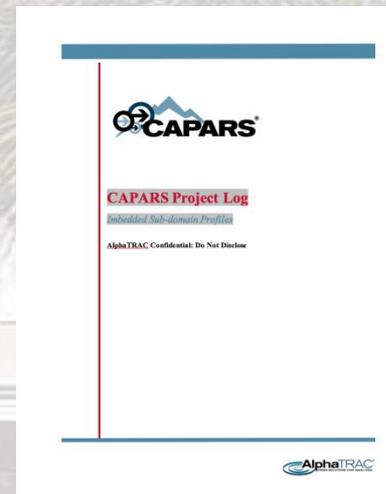
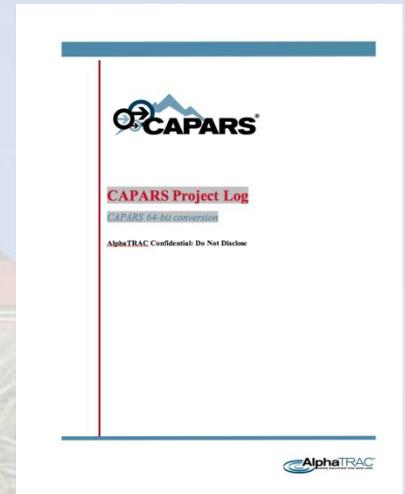
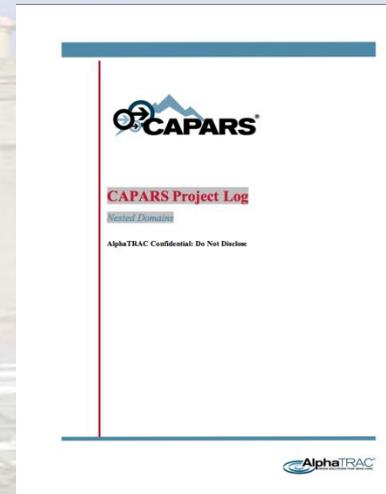
Installation Logs

- Basemaps
- CAPARS Computer
- Surface Data
- Wind Field Maps
- Meteorological Data



Project Logs

- Embedded Profiles
- Nested Domains
- 64-bit Conversion
- Distance Bins



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Lessons

...what we've learned

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Lessons

- SQA organization is difficult
 - Use existing tools, templates, etc.
 - AlphaTRAC's SQA SharePoint design can save much effort
- Install SharePoint properly
 - This caused many problems
- Keep using the system you build
 - Otherwise you end up unable to benchmark again

Lessons (continued)

- Benchmarking work performed more than 5 years ago is challenging
- Following the SCAPA SQA process will add cost to projects
 - We need to quantify this additional cost
 - Continually following a well-designed SQA system should minimize this cost
- Need a process for “small” tasks
 - Simple modifications should not require the full documentation effort

Lessons (continued)

- Reviewers need easy access to SQA documentation
 - Can simplify recertification process
- Benchmarking CAPARS took about 700 hours of effort
 - Could not implement everything envisioned
 - Separate web pages for each SQA element
 - Documents hyperlinked to pages
- Use of SCAPA SQA process is viable option for SQA
 - Can obtain benefit of SQA for << \$1 million

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Questions?

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