UCRL-TR-205418

LAWRENCE
LIVERMORE
NATIONAL
LABORATORY

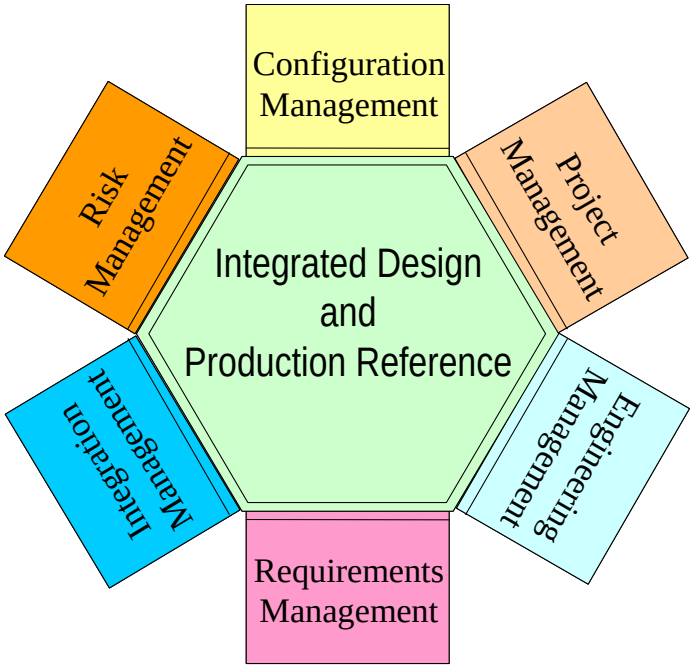
Software Quality System for the Integrated Design and Production Reference V1.00

R. H. Barter

July 29, 2004

This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under Contract W-7405-Eng-48.

Software Quality System
for the
Integrated Design and Production Reference



Version 1.00
July 29, 2004

R. H. Barter

Change History

Version	Date	Description
0.01	March 14, 2004	o Initial Draft
0.02	March 15, 2004	o Editorial changes
0.03	July 13, 2004	o Removed references to sensitive topics
1.00	July 29, 2004 February 14, 2005	o Initial release o Removed DRAFT, fixed version number

Table of Contents

Acronyms

ADAPT	Advanced Design and Production Technologies
CVS	Concurrent Versioning System
DWI	Distributed Workflow Infrastructure
IDPR	Integrated Design and Production Reference
LEP	Life Extension Program
LLNL	Lawrence Livermore National Laboratory
NNSA	National Nuclear Security Administration
XDE	Cross-Complex Data Exchange

1 Introduction

1.1 Overview

The purpose of this document is to define the software quality system that is being applied to the development of the Integrated Design and Production Reference (IDPR).

1.2 Scope

This document applies to the software development activities performed by the IDPR at Lawrence Livermore National Laboratory. IDPR is funded by the Advanced Design and Production Technologies (ADAPT) Program within the National Nuclear Security Administration (NNSA).

1.3 Organization of This Document

The remainder of this document discusses the general characteristics for the quality system as applied to IDPR and then describes the specific quality provisions used on the project.

2 General Characteristics

IDPR is a three-year, three million-dollar project. The goal of the project is to field an information management tool to assist engineers and engineering managers make engineering and management decisions about complex systems.

The project leverages Open Source software and configures the software to meet the unique needs of the Life Extension Program. IDPR is "User focused". The project's approach is to understand, first the way engineers think about complex systems and the activities required to extend the life of those systems. The project has chosen a cyclical development model that strives to understand the User needs and expectations and to build an enduring product to meet those needs and expectations.

The first two cycles of the project focus on rapid prototyping to elicit User input in an operational environment. Little effort is expended on the quality system during the first two cycles. The transition from the second to the third cycle is marked by the definition of a detailed requirements document and a ratcheting up of the quality system. Two major validations occur: validation of the User requirements at the beginning of the third cycle, and validation of the production system at completion of the third cycle. Verifications occur during the development of the production system during the third cycle.

3 Quality Provisions

The following quality provisions are based on the requirements of ISO 9000-3:1997.

3.1 Management

It is the policy of the IDPR project to develop the highest quality software product consistent with requirements and available funding. The size of the project does not warrant the creation of a specific quality assuring function within the project. All project personnel will be aware of the need to assure quality and specific quality assuring processes will be defined and implemented as described below.

The IDPR project lead has overall responsibility for the quality of the delivered product. The IDPR contract engineer has responsibility for assuring that software contractors have quality programs consistent with the quality goals of the project. The IDPR project lead has responsibility for interacting with W Program Users to assure that the delivered product meets their expectations. Resources needed to assure the quality of the delivered product consist of the set of existing classified servers and workstations plus additional unclassified servers for use by the IDPR development team and the software development contractor.

The W Program Chief Information Officer is the senior executive that has overall responsibility and authority for the quality of information technology projects within W Program. The Lawrence Livermore National Laboratory (LLNL) ADAPT Program Manager is the senior executive that has overall responsibility and authority for the quality of information technology projects developed at LLNL with ADAPT funds. The ADAPT Program Manager reports to the W Program Chief Information Manager.

The effectiveness of the IDPR quality program is reviewed through regularly scheduled W Program progress reviews and ADAPT technical reviews.

3.2 Quality System

This document defines the quality system used to develop the IDPR. There are three roles external to the IDPR development team: *Customer Representative*, *Users*, and *Stakeholders*. The *Customer Representative* is the individual representing the organization that is funding the IDPR. The Customer Representative is the ADAPT Program Manager. The *Users* are the direct beneficiaries of the IDPR. The Users are the engineers and engineering managers that use IDPR to make engineering and engineering management decisions. *Stakeholders* are those people that have an interest in the outcome of the IDPR. It is intended that IDPR will be available for

deployment at other sites within the NNSA complex. Members of the ADAPT Enterprise Integration Steering Committee are Stakeholders.

The Customer Representative has final responsibility for the success or failure of the project. The Users advise the Customer Representative as to the acceptability of IDPR. Stakeholders convey their needs and opinions to the Customer Representative.

The IDPR project is a three-year effort. The initial statement of Customer need and milestones are defined in the ADAPT Program documentation. The initial statement of Customer need was for a system that would allow engineers and engineering managers engaged in a Life Extension Program to make engineering and engineering management decisions about the life extension program. The IDPR project is structured as a cyclical development effort that consists of three major deliverables; a Pilot system, Prototype system, and a Production system.

The purpose of the Pilot system is to generate initial User interest for the purpose of elaborating on the initial statement of Customer need. The purpose of the Prototype system is to develop a detailed set of requirements based on daily use of the system in an operational environment. The purpose of the Production system is to extend and generalize IDPR so that it can be deployed to multiple sites in a production environment.

The quality of the IDPR will be assured through validation of the detailed requirements document and final acceptance of the production version of the product. Verification activities leading up to the definition of the requirements document are of two types. First, daily interaction with the User community and rapid turnaround of User requests assures that the Prototype implementation is an accurate instantiation of User requirements. Second, the completed requirements document will be reviewed by the User community to assure that the document is an accurate representation of User need. Development of the Production version will be contracted to a software development organization. The contractor will be required to have a quality program acceptable to the IDPR project. Final validation of the Production version will be accomplished through a test period in which Users interact with the Production system. The requirements document will be converted to a “checklist” to assure adequate User coverage of Prototype functionality.

3.3 Contract Review

The IDPR project does not operate in a strict contract environment. A set of expectations are established at the time that the request is made for funding. Funding and, presumably, the accompanying expectations are periodically

modified with little or no prior consultation with the project. The project revises cost, schedule and scope in response to the changes.

The closed nature of the NNSA environment alleviates some misunderstandings as to terminology as it exists in the initial expectations. Product acceptance by the Customer is based on acceptance by the Users. The Customer, acting as liaison between the project and NNSA, communicates funding changes to the project and requests information and demonstrations for the NNSA.

During the Pilot and Prototype development phases, the Users are incrementally trained as the system takes shape. The Production version will be delivered with training materials (viewgraphs) and a User manual. On-site training will be provided at the User's expense.

Software upgrades are made in a series of releases. Releases may include changes to the operating system, base enabling software, IDPR specific software, or configuration data. Release packages will include the enhancements as well as any required migration facilities. A release may include planed product improvements, bug fixes, and requested enhancements to the system.

Issues are collected during development, User acceptance, and operations. Issues associated with the Pilot and Prototype versions are dealt with according to a prioritized backlog. The backlog items and their priorities are negotiated between the development team and the Users. For the Production software, each issue is evaluated and assigned to an upcoming release. Release assignments are negotiated with the development team and the Customer.

Monthly progress reports are submitted to the Customer. The progress reports (in the form of 'quad charts") include Earned Value updates, project risk assessments milestones, and Customer high-level expectations

3.4 Product Design

The procedure for controlling the IDPR development process is implied in the project lifecycle and milestones as contained in the ADAPT Enterprise Integration Planning documents. The design process uses intensive elicitation of User requirements through the two-stage prototyping approach. The requirements document is the departure point for rigorous development of the production version of the system. Software vendors wishing to bid on the project must submit a description of their quality assurance process. Evaluation of the vendor's quality processes will contribute to the vendor selection process.

The IDPR project is an effort to develop an engineering support tool that may be used by engineers engaged in a Life Extension Program (LEP). LEPs are similar to any effort that attempts to engineer a complex system. LEPs also have unique characteristics that warrant special attention. The objective is to develop an engineering tool that: 1) supports an engineering methodology and core project data structure; 2) integrates design and production data; and 3) serves as an enduring repository that spans multiple life extension cycles. The project is a three-year effort that involves the cyclical development of a Pilot, Prototype, and Production version of the system. The project tailors an information management system to a system engineering methodology with special attention to usability by engineers engaged in a specific LEP. Information used to populate the Pilot and Prototype implementations and used to validate the Production version will come from the specific LEP. The effort to populate the system is funded outside the project. Two other projects complement IDPR. The Cross Complex Data Exchange (XDE) will provide legacy production data for IDPR. The Distributed Workflow Infrastructure (DWI) will enable IDPR to be distributed across multiple sites. XDE is currently funded. DWI is in the proposal stage. The success of IDPR as a single-site engineering tool is not dependant upon either XDE or DWI. As a multi-year project, IDPR is vulnerable to tides of wisdom of NNSA Management. The intent is to achieve stable states at the end of each fiscal year so that useful intermediate products may be available if funding is disrupted.

W Program is the User organization that influences ADAPT funding priorities. Monthly project updates are made to ADAPT, W Program and the Defense Nuclear Technologies Directorate. Technical reviews are conducted by the Computation Directorate at the request of W Program. Weekly meetings between the Users and project personnel guide the development effort.

The Pilot and Prototype development efforts are designed to get a usable product into the hands of the practicing engineers for the purpose of eliciting a robust set of User requirements.

The Pilot and Prototype system are developed without regard to formal design documentation and have, instead, concentrated on the elicitation of User requirements in a rapid prototyping environment. The Production system requires the vendor to develop design information as a deliverable for the project.

3.5 Document and Data Control

Documents such as the requirements document and project plan will be placed under version control. Changes to the document will be controlled by the IDPR Lead Engineer. Software, beginning with the Production

version, will be placed under version control. Data that is entered into the IDPR will be capable of being placed under version control. Control of data integrity outside IDPR is outside the scope of the project.

3.6 Purchasing Requirements

The IDPR Production version will be procured to a requirements specification according to the policies and procedures of the LLNL Procurement Department.

3.7 Product Identification and Tracing

Software will be arranged in a product tree with a complete system at the top level of the tree. Software versions will use three point-delimited fields. Primary field changes indicate a major change in architecture most likely requiring data migration software to upgrade one release to another. Secondary field changes indicate changes in functionality that do not require data migration from one change to the next. Tertiary field changes indicate small changes and minor bug fixes that do not alter functionality or architecture.

3.8 Process Control Requirements

Change requests will be collected and assigned to releases. A mapping will be maintained that documents the change requests and software changes associated with each release.

The Concurrent Versioning System (CVS) will be used to manage software changes.

3.9 Product Inspection and Testing

Software requirements are validated against Customer expectations through the development of the Pilot and Production versions of the IDPR. Validation tests will be developed from the software requirements and used for product acceptance from the software vendor. Release candidate software will undergo User validation prior to official release.

3.10 Control of Nonconforming Products

Software modifications will be maintained in the CVS tree. Software release candidates will be defined that aggregate a set of modules in the CVS development tree. Nonconforming software in a release candidate will result in a new release candidate being defined that includes the software that corrects the nonconformance.

3.11 Corrective and Preventive Action

Issue tracking and software release mapping will be used to document corrective actions.

3.12 Handling, Storage and Delivery

Production software will be stored in two physically separate locations. W Program will be requested to develop software surveillance procedures as part of its ongoing surveillance program.

3.13 Control of Quality Records

Software quality records will be maintained by the Engineering Records Center.

3.14 Training Requirements

Software developers will be trained in Python, Zope, Content Management Framework and Plone.

3.15 Servicing Requirements

Issue tracking will identify short-term maintenance requirements. Long-term requirements, such as the need to keep up with technology changes, will come from the surveillance program.