

Independent Quality Assurance in Major IT Projects of Large Enterprises

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In this presentation, the authors will use examples from the State of Oregon to illustrate specific points. This presentation provides a perspective for independent quality management in large enterprises and should be applicable to both the public and the private sectors unless otherwise stated.

Presentation Overview

Background

Independent Quality Contractors

- Why?
- What scope?
- How to implement in practice?

Considerations

- Project Quality process vs. Independent Quality process
- Independent QA / QC Mix: Process Review vs. Work Products Review
- Independent Artifacts Reviews vs. Independent Testing

Independent Testing

- Levels of testing
- Functional and non-functional types of testing
- Reviews as a testing technique

Conclusion

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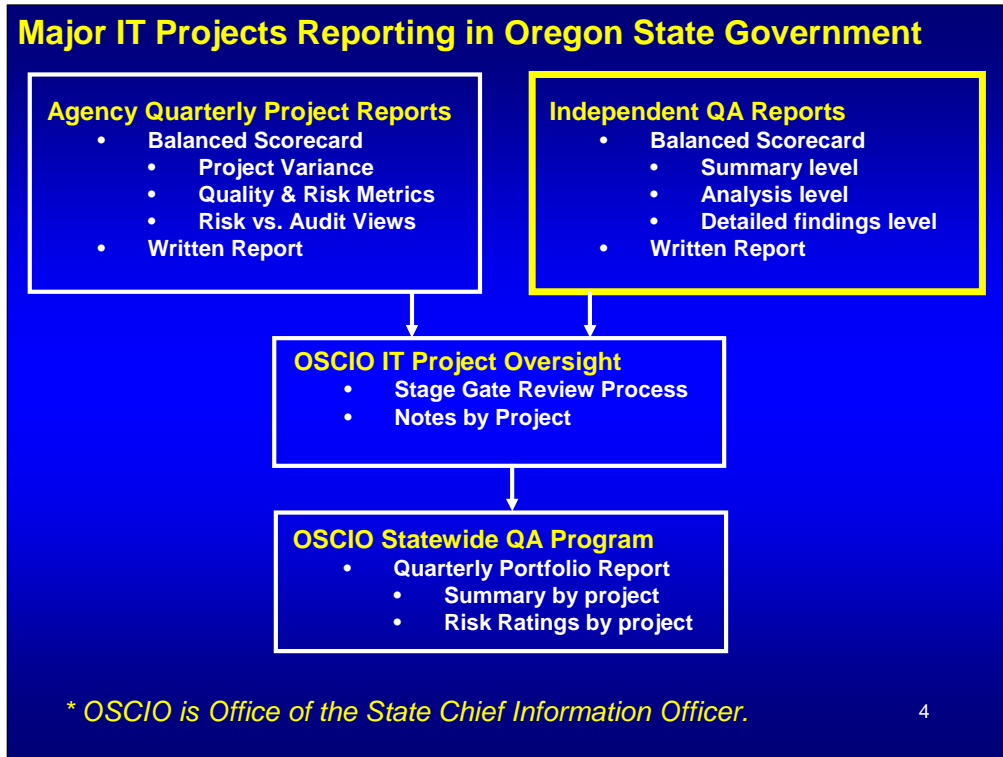
Select Major IT Projects in Oregon State Government – February 2016

Agency / Project	Budget
Dept. of Justice / Child Support System Modernization	~\$124 M
Oregon Health Authority / MAGI Medicaid System Transfer	~\$65 M
Dept. of Revenue / Core System Replacement	~\$32 M
Oregon Health Authority / Behavioral Health Integration	~\$26 M
Oregon Health Authority / Health Information Technology	~\$17 M
Oregon Health Authority / WIC Electronic Benefits Transfer	~\$8.3 M
Oregon Employment Dept. / Office of Administrative Hearings Case Management	~\$4.5 M
ODOT / Microfilm Replacement	~\$4.5 M
ODOT / Time and Attendance Management	~\$4.3 M
Dept. of Forestry / Woods Accounting and Log Tracking	~\$3.8 M
Public Employee Retirement System / Individual Accounts Program Administration	~\$2.9 M
Oregon Health Authority / Medicaid Statistical Info System	~\$2.4 M

This is a background slide regarding major IT projects in the State of Oregon.

At any one time over the last three years, the State of Oregon may have between 10 to 20 major IT projects. These projects have various characteristics, including but not limited to the following:

- They have budgets above US\$1 million.
- They are mission critical and/or enable major change in the state agencies where the work are undertaken, both in terms of their operations, staff, and stakeholders. These stakeholders usually consist of internal and external stakeholders; both in and out of state government and other government jurisdictions.
- They affect citizens or the public in important ways.
- The State’s major IT projects portfolio has a total value in the hundreds of million of dollars as of February 2016; as seen in this chart. Most major IT projects listed are planned, designed, developed, and implemented by private contractors working with State staff. As such, most technical work and the technical “heavy lifting” are outsourced to contractors.



Major IT projects in the State can be thought of as having multiple levels of oversight.

Typically, a project is under the oversight of the following entities:

1. the management of the agency planning and executing the project;
2. independent QA contractor retained to provide independent assessment of project status, performance, and risks;
3. IT Oversight Analysts in OSCIO;
4. Statewide QA Program in OSCIO.

In addition, all projects are subject to oversight of the Legislative Fiscal Office, audits of the Secretary of State (which is constitutionally independent from all executive branch agencies), and other sources of oversight.

With the exception of (2), this may not be too different from a large enterprise in the private sector; in which a project or program may report into a director or VP of an operating division, but is under the oversight of the various C-level managers, such as the CIO and the CFO. There may be process audits by an independent auditor.

In Oregon state government and by statewide policy, the use of independent QA contractors is expected for major IT projects greater than \$1 million for agencies under OSCIO oversight. The goal of independent QA is to assure the independence of assessment but also to assure project performance is measured against industry best practice with recommendations for process improvement. OSCIO recommends that 4% to 6% of the overall budget of a major IT project be reserved for independent QA contractor services, based on a standard Enterprise QA statement of work; more and up to 10% if custom development is involved.

Presentation Glossary - 1

“Major IT projects”

- a potentially risky project involving significant investment (dollars, effort, etc.) with
 - design
 - development
 - implementation
 - transition into business program / operations
- tailoring to organization’s specific business requirements
- integration / customization of commercial off-the-shelf (COTS) products and custom software development.

“Quality Management”

- quality management
- quality control (review of work products) - QC
- quality assurance (review of processes) - QA

Presentation Glossary - 2

“Risk Management”

is the systematic identification, classification, characterization, and response to project risks. A risk realized is called an issue.

“Independent contractor”

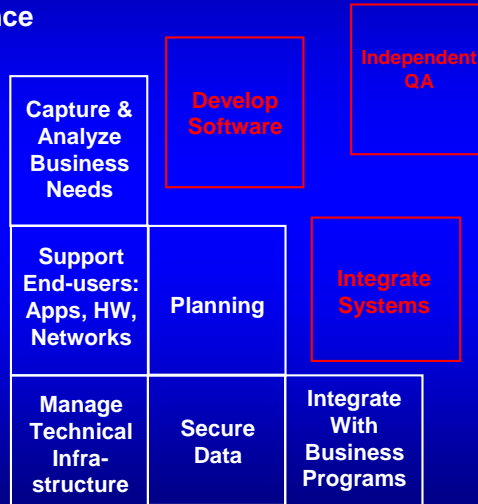
is not affiliated with the an organization acquiring a system or an organization delivering it and does not have conflict of interest with either organization.

Notes on terms important to this presentation:

- “Software QA”, if mainly testing, is QC; but QC is more than testing in the traditional sense of running codes with or without test plan / scripts.
- “Information system audit”, if mainly process review, is QA; but an IS audit that does not recommend process improvement is not QA by itself.
- An “Independent QA Contractor” performs quality & risk management activities independently, in the sense defined above.

Reasons for using contractors

- Non-Core Functions
- Lack of Certain Skills
- Independence



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Depending on the enterprise, what is considered “core” functions or core competency may be different from enterprise to enterprise. As an example, companies such as Nike do not consider manufacturing to be core functions and use contract manufacturers extensively to fulfill its manufacturing needs.

For IT, enterprises may view users tech support and information security as core. Increasingly, enterprises view project management, software development, and system integration as non-core. As such, the design, development, and implementation of major IT projects are increasingly outsourced, with in-house development by internal IT staff becomes correspondingly less common.

In Oregon state government, the red boxes in this slide (i.e. integrate systems, developing software, and independent QA) are generally not part of core IT functions. The enterprise is not staffed or well staffed for these functions, and procurement of professional services in these areas is necessary and common.

Why Independent QA (High Level)?

- **Independence & Objectivity**
- **Accountability to the Public**
- **Safety & Users Well Being**
- **Regulatory Compliance**
- **Mission Criticality High**

Industries that Use Independent QA

- **Government**
- **Military**

- **Construction**
- **Energy**

- **Consumer electronics & appliances**
- **Medical & scientific labs**

- **Publicly traded companies**

General Benefits of Independent QA

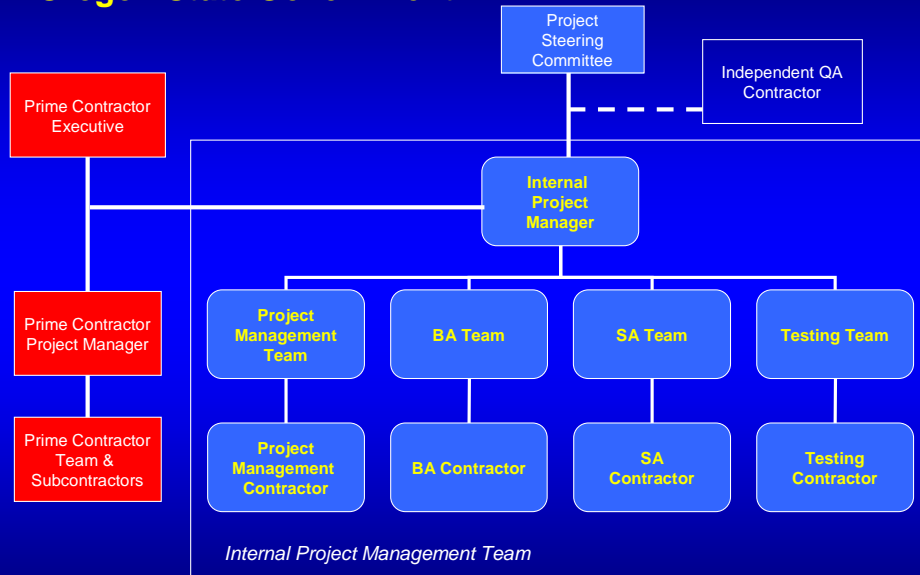
- **Objectivity**
- **Mitigation against “group think”**
- **Earlier identification of quality problems
→ cheaper / easier fix of defects**
- **Direct communication channel to senior management → quicker response to major issues and risks**

General Challenges of Independent QA

- **Cost of independent QA contractor**
- **Expertise in vertical domain / industry**
- **Expertise in specific technology, product, or solution selected**
- **Project resources required to work with or coordinate with independent QA contractor**
- **Project participants dislike being “watched over the shoulder”**
- **Hard to maintain independence & objectivity**

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Context of Major IT Projects In Oregon State Government



BA = Business Analysis; SA = System Analysis

Independent Quality Contractors – why in Oregon?

Large organizations are complex

- Many stakeholders
- Many requirements
- Prioritization difficult
- Complex coordination
- Different types of oversight

Management accountability challenges

- Large organizations routinely outsource much of the project work to one or more contractors
- Insufficient resources for internal management team
- Difficult to verify contractor performance
- Objectivity in self reporting project issues

→ For major IT projects, independent quality contractors may add expertise and objectivity while simplifying communications.

Independent Quality Contractors – What Scope?

Enterprise Independent Quality Contractor SOW

Task 1: Independent Quality Planning

Task 2: Independent Quality Control (“QC – Part 1”)

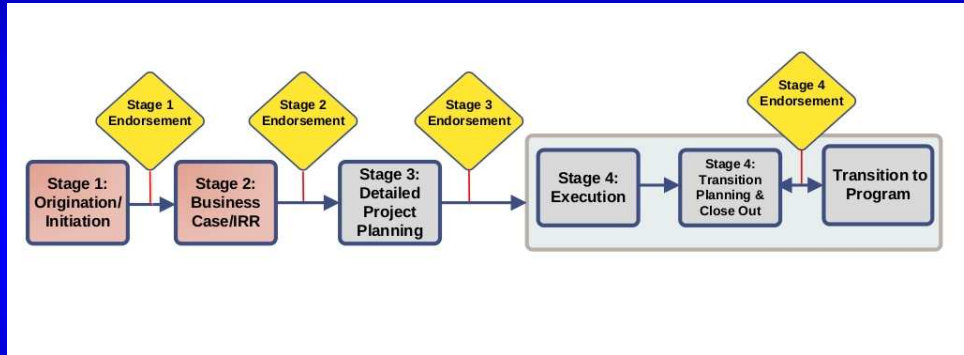
Task 3: Independent Quality Assurance

Task 4: Independent Testing (“QC – Part 2”)

Task 5: Independent Risk Assessment

→ Independent QA Scope: what needs to be done to achieve an appropriate level of independent verification & validation (IV&V).

Stage Gate Review Process in Oregon State Government



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There are four (4) Stages in Oregon's Stage Gate Review Process:

Stage 1: Concept / Origination

Work activity during Stage 1 corresponds to a project's Concept / Origination Phase, where the organization prepares high-level project justifications and plans for internal review and acceptance, and then formally presents project initiation documents to the Office of the State CIO (OSCIO) for its review and approval.

Stage 2: Business Case / Information Resource Request (IRR)

Work activity during Stage 2 corresponds to a project's Initiation Phase, where the organization prepares and then formally presents the detailed business case, project charter, initial risk assessment, and other project documents to the OSCIO for its review and approval.

Stage 3: Detailed Project Planning

Work activity during Stage 3 corresponds to a project's Planning Phase, where the organization prepares detailed project management planning artifacts and then formally presents those project management plan documents to OSCIO for its review and approval. Also, project financials and other planning artifacts previously submitted will be updated.

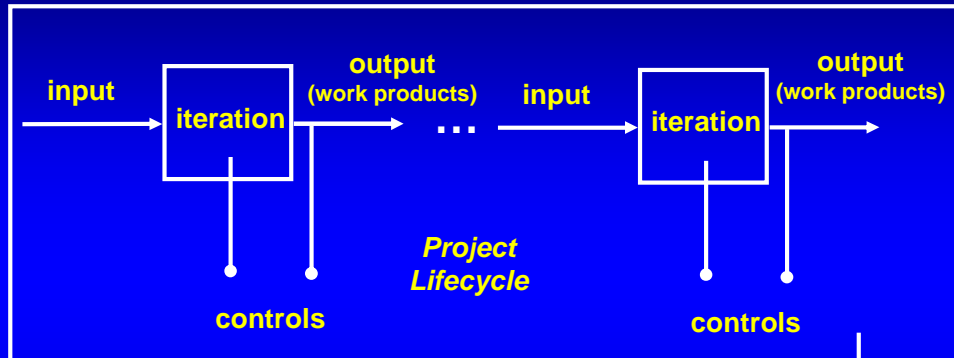
Stage 4: Execution, Transition, and Close-Out

Stage 4 consists of the main work of the Project: Execution (when design, development, and implementation take place); to be followed by Transition and Close-Out. In Stage 4, the organization implements the plans that were developed in Stages 1, 2, and 3, delivers the functionality described in the project requirements documents and vendor Statement(s) of Work, prepares project tracking and (eventually) close-out artifacts for OSCIO review and, if necessary, approval.

Independent Quality Contractors – How in practice?

Project Stage	Independent QA Contractor Task	Independent QA Contract Task No.
2 & 3	<i>During Planning</i> – QC review of important planning artifacts (e.g. Business Case, Requirements, Prime Contractor SOW, Project Plan, etc.)	2
3	<i>Before Execution</i> -- Initial Risk Assessment	5
4	<i>Early Execution</i> -- Quality Management Plan supported by Quality Standards (QA use) and Quality Checklists (QC use)	1
4	<i>During Execution</i> -- QC review of important Prime Contractor artifacts (e.g. fit-gap analysis, architecture / design, SDLC artifacts, project status reports, testing reports, etc.)	2
4	<i>During Execution</i> – independent testing activities based on a Master Test Plan	4
4	<i>During Execution</i> – Quarterly QA review (360-degree review) of all aspects of project management, project performance, risks, and opportunities for process improvement	3
4	<i>Before Closing</i> -- QC review of Transition Plan including On-going Support & Maintenance	2
4	<i>During Closing</i> -- Project Evaluation & Lessons Learned	1

Management accountability necessitates controls for project processes and work products



Control points are opportunities for IV&V

- work products review – QC
- process review - QA
- risk assessment

Mix of three type of quality processes

- prime contractor
- internal project team
- independent QA contractor

controls

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Enterprises outsourcing IT projects desire high quality contractor work. In quality management paradigm such as ISO 9000, quality usually refer to the quality of work products and the quality of processes for performing and managing work.

For major IT projects in large enterprises, a project and its management may be “under the magnifier” at all times. Stakeholders, including senior management, expect to be informed frequently about project status, quality, and risks. The fact that management accountability necessitates management oversight means that projects must be managed in a way where project performance can be transparently assessed or audited at all times, sometime by independent quality assurance personnel.

The process diagram above depicts a prototypical project plan for which an “iteration” may denote a specific iteration in an iterative SDLC, a phase in a spiral SDLC, or a major task in a waterfall-like SLDC. Management control points can be imposed during the execution of an iteration to review work in progress or work already completed.

From a management standpoint, control points are opportunities for assessing work product quality usually by means of verification and validation (V&V); usually associated with design review, codes review, testing and other means to establish that work products are “fit to use”, compliant with applicable regulations, and meet business needs. These management control points are also opportunities for assessing and reporting project performance, such as percent of completion for a task and for the overall project and the actual amount of resources (time and budget) used vs. planned.

Independent QC of Artifacts vs. Independent Testing

- **Value of Pre-Test Artifacts Review -- “Static Testing”**
 - To permit a process to go forward with a defined task, e.g. test phase.
 - To prevent a task from starting which would entail more (wasted) effort compared to the effort needed to remove the failed entry criteria.
- **Value of Independent Testing -- “Dynamic Testing”**
 - Needs different levels of Independence
 - Avoids author bias
 - Needs a different mindset than that of the developer

→ Appropriate mix of artifacts review vs. testing is important for quality.

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A certain degree of independence (avoiding the author bias) often makes the tester more effective at finding defects and failures. Independence is not, however, a replacement for familiarity and expertise, and developers can efficiently find many defects in their own code. Several levels of independence can be defined as shown here from low to high:

- Tests designed by the person(s) who wrote the software under test (low level of independence)
- Tests designed by another person(s) (e.g., from the development team)
- Tests designed by a person(s) from a different organizational group (e.g., an independent test team) or test specialists (e.g., usability or performance test specialists)
- Tests designed by a person(s) from a different organization or company (i.e., outsourcing or certification by an external body)

Independent Testing – 1

Levels of Testing (ISTQB)

- 1. Component (unit testing)**
- 2. Integration testing**
- 3. System testing**
- 4. Acceptance testing**

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1. The testing of individual software components.
2. Testing performed to expose defects in the interfaces and in the interactions between integrated components or systems.
3. The process of testing an integrated system to verify that it meets specified requirements.
4. Formal testing with respect to user needs, requirements, and business processes conducted to determine whether or not a system satisfies the acceptance criteria and to enable the user, customers or other authorized entity to determine whether or not to accept the system.

Independent Testing - 2

- **Functional testing**
 - Testing to make sure the artifact does what it is supposed to do

- **Non-functional testing**
 - Testing the quality attributes of the artifact
 - includes usability, reliability, efficiency, portability, ...
 - called the “...ilities”

Independent Testing - 3

- **Relevance of Automated Testing**
 - **Compressed software release cycles – per DevOps and Agile SDLCs**
 - **Time availability for smoke testing and regression testing**
 - **Possible collapse of Testing Levels**
 - **Potential for “career limiting” defects**

Independent Testing – 4

- **Reviews as a testing technique**
 - An evaluation of a product or project status to ascertain discrepancies from planned results and to recommend improvements.
- **Common types of reviews**
 - Informal
 - Walkthrough
 - Technical
 - Inspection (most formal)

→ One more time: Appropriate mix of artifacts review vs. testing is important for quality.

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Informal Review

No formal process; May take the form of pair programming or a technical lead reviewing designs and code; Results may or may not be documented; Varies in usefulness depending on the reviewers; Main purpose: inexpensive way to get some benefit.

Walkthrough

Meeting led by author; open-ended sessions; May take the form of scenarios, dry runs, peer group participation. Optional pre-meeting preparation of reviewers and / or optional preparation of a review report including list of findings; Optional scribe (who is not the author); May vary in practice from quite informal to very formal; Main purposes: learning, gaining understanding, finding defects.

Technical Review

Documented, defined defect-detection process that includes peers and technical experts, with optional management participation; Preparation of a review report which includes the list of findings, the verdict whether the software product meets its requirements and, where appropriate, recommendations related to findings; May vary in practice from quite informal to very formal

Main purposes: discussing, making decisions, evaluating alternatives, finding defects, solving technical problems and checking conformance to specifications, plans, regulations, and standards.

Inspection

Led by trained moderator (not the author); Usually conducted as a peer examination; Defined roles; Includes metrics gathering; Formal process based on rules and checklists; Specified entry and exit criteria for acceptance of the software product; Pre-meeting preparation; Inspection report including list of findings; Formal follow-up process (with optional process improvement components); Optional reader; Main purpose: finding defects

Summary of Considerations in Independent QA / QC

- Independent testing can be critical to the success of projects, of any dollar amount.
 - but needs to be part of overall mix of quality & risk management activities that involve all project participants.
- Testing needs to be combined with QC reviews of important project artifacts and work products.
- QC needs to be combined with periodic QA reviews of management processes and approaches.
- QC and QA need to be combined with Risk Management.
- Independent findings should support decisions regarding process improvement and overall project governance.

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Conclusion

- Independent QA / QC can add value in large scale IT projects, especially in large enterprises.
- There are benefits but also challenges for the use of Independent QA Contractors.
- For organizations that follow well-defined processes that integrate the findings of Independent QA Contractors into overall project governance, independent quality & risk management can add great value to overall project quality:
 - Detect and respond to issues and risks early.
 - Avoid “group think”.
 - Reduce cost of overall solution delivery.
 - Minimize “technical debt” after deployment in operations.
 - Better outcome and return-in-investment (ROI) than large in-house testing teams and enterprise testing tools alone.

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“Testing alone cannot produce high quality software.”

- Capers Jones

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The authors believe that the key to quality is process, and the management of quality is ultimately about management of process that “designs in” quality. We end this presentation with this quote. Thank you.

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