CDI® IT Solutions

White Paper:

Expanding the Quality Assurance Function as a Cost Savings Strategy

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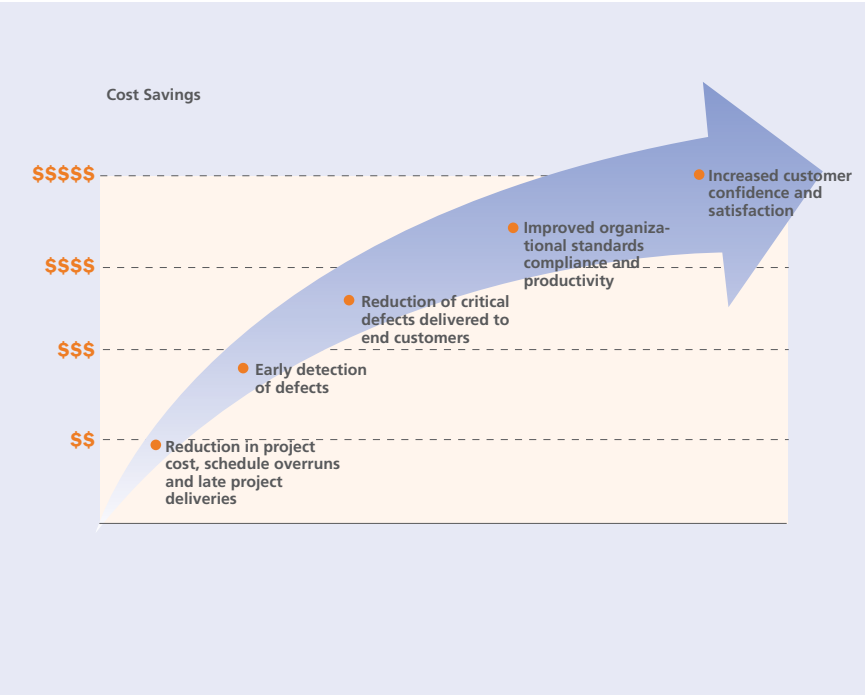
Recent difficult economic conditions have had a great impact on many organizations, affecting their customer base and reducing sales volume. In order to avoid significant impact to the bottom line, companies need to reduce overhead costs to match the reduction in income level. The initial approach to this belt tightening was to reduce nonessential personnel, cut benefits, delay projects, reduce or eliminate merit increases and bonuses, increase work load per person and other cost cutting actions. However, one successful cost savings strategy was often completely overlooked, outsourcing.

Outsourcing can provide significant cost savings by allowing a company to expand their Quality Assurance (QA) function to include the three dimensions of QA: Testing, Process Improvement and Compliance Oversight.

This approach reduces project costs, allows for early detection of defects, improves time to market and increases customer satisfaction while improving overall IT department productivity.

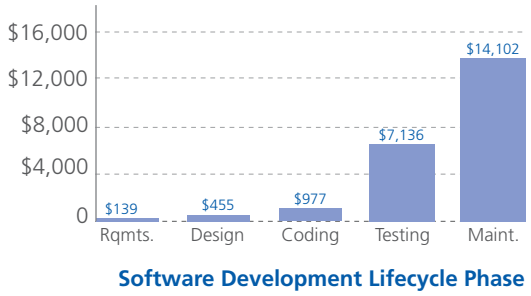


Defect Detection versus Defect Prevention

For many in the software industry, quality assurance means testing. As a result, many organizations have focused on optimizing their testing capability (Defect Detection), however, the desired outcome of productivity improvement is not achieved. The secret is early defect detection combined with defect prevention.

With a proper testing strategy, a company can catch defects and release good products to their customers, but at what cost? Even if you can catch defects throughout the life cycle and minimize defects going into production, the costs involved can be prohibitive. Significant savings can be achieved if defects are detected early on; however, the prevention of defects is the real challenge.

Costs of Correcting Defects



Source: B. Boehm & V. Basil, "Software Defect Reduction Top 10 List", *IEEE Computer*

The later defects are found, the more expensive it is to correct them. For example, a defect found during the design phase costs on average approximately $455 to fix. Defects found after delivery to the customer cost an astonishing $14,102 to fix. Because of the significant costs involved in finding a defect towards the end of the Software Development Life Cycle (SDLC), it is important to determine how to find defects early in the development process and prevent them from happening in the future. This can be achieved by implementing all three dimensions of a software quality assurance function that address testing, process improvement and process compliance.

Mature IT organizations that have pursued quality process improvement strategies, such as the Carnegie Mellon Software Engineering Institute (SEI) Capability Maturity Models integrated (CMMi), understand these concepts and many have implemented them successfully. Those that achieve CMMi level three typically enjoy a 35% improvement in overall productivity with an average ROI of 8x. For those who have not proceeded down the CMMi path, there exist simple steps that can be implemented to achieve significant productivity gains.

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Three Dimensions of QA

In most organizations, the QA function is typically looked at as a testing organization when in reality it should be so much more. To fully realize the benefits of an effective QA solution, all three dimensions of QA need to be addressed: Provide Product Validation and Verification (Testing), Drive Process Improvement and Provide Process Compliance Oversight.

Three Dimensions of Quality Assurance
The QA Professional

- Provide Product Validation and Verification (Testing)
- Drive Process Improvement
- Provide Process Compliance Oversight

1. **Testing is Product Verification & Validation**
   The first dimension of QA is testing, essentially product verification and validation. Verification ensures that the product functions as it was designed. Validation confirms that the product functions as expected by the customer. Verification involves integration testing, system testing, performance testing, regression testing, code reviews and peer reviews. Validation involves customer acceptance testing. By only addressing the testing element of QA, defects can reoccur and process improvement can not be effectively realized. The level or rework remains constant or even gets worse.

2. **Process Improvement**
   Process improvement ensures that lessons learned are fed back into the delivery process. This includes process optimization resulting from the incorporation of industry best practices or internal process changes resulting from defect analysis.

   During the process improvement step, defects are analyzed and tending is done to identify grouping of defects and where they exist in the SDLC. A plan is developed which identifies required process changes and how and when they should be implemented. The goal is to make the revisions necessary to prevent defects from occurring again.

   By performing defect analysis, required changes to policies, processes, procedures, templates, methodologies and standards can be determined. One approach to defect analysis is to utilize defect cause codes that are assigned to each defect. Grouping and performing a trend analysis will determine where in the SDLC the defect(s) are being generated. A process improvement plan can then be developed to correct specific guidelines as required.

   A defect cause code assignment is a subjective decision based on the facts available, and is not always 100% accurate. However, over time and with the proper analysis of codes, it is possible to pinpoint exactly where in the SDLC a defect is generated. For example, table 1 (next page) shows the results of defect data collected for a specific software release. As illustrated, grouping defects by cause code clearly identifies issues in the SDLC. By assigning a weighting system shown in table 2 (next page), process improvement targets can be identified. Simple data collection focuses on the SDLC phase and the process areas where the defect originated. This provides the targets for process improvement activities. If this was implemented over multiple software efforts, very accurate trending could be achieved.

Table 1: Defect Cause Code Analysis & Process Improvement Targets

Defect Cause Codes	Significance Weight	SDLC Phase Defect Was Caused	Defects Found	Total Weighted Impact	Focus Areas for Process Improvement
User Documentation Defect	1	4	3	12	No
Technical Documentation Defect	1	4	7	28	Yes
Test Plan Defect	1	5	2	10	No
Business Requirements Defect	3	1	9	27	Yes
Functional Requirements Defect	4	3	7	84	Yes
Design Defect	4	4	2	32	Yes
Interface Code Defect	5	5	0	0	No
Code Defect	5	5	41	1025	Yes
Test Case Defect	4	4	6	96	Yes
Infrastructure Related Defect	5	4	1	20	No

Table 2: SDLC Phase & Weights Assigned as to the Significance of Defect Detection

Initiation Phase	1
Planning Phase	2
Requirements Phase	3
Design Phase	4
Construction Phase	5
Testing Phase Functional	6
Testing Phase Regression	7
Testing Phase Customer Acceptance	8

Defect cause codes should be part of a larger metrics program that addresses defects through testing and peer reviews and other indicators, such as requirements vulnerability, standards compliance and defect density. The metrics program is an important part of the process improvement journey. Final analysis should illustrate where weaknesses or deficiencies exist in the SDLC process. Personnel training requirements or policy issues may also be identified. Actions are then taken to improve, change or modify as required in order to prevent the defects from reoccurring in the future.

Tools that can help prevent defects or identify them early on in the SDLC include:

- Code reviews
- System and regression testing practices supported by a repeatable testing process and test cases
- Test tools that allow or support defect cause code assignment and reporting
- Peer review procedures

3. **Compliance & Oversight**

Compliance and oversight ensures that defined policies, processes, procedures, standards and methodologies are implemented as defined. Once process improvements are defined, it is important that they are implemented and adhered to as planned so that gains are realized long-term and real process improvement occurs. This reduces rework while improving end product quality and time to market.

How compliance and oversight are achieved is not as important as what is accomplished. Compliance reviews can be done internally by the project team as long as they are not performing compliance checks against their individual efforts. Another option is to have an independent QA organization conduct the reviews. Companies often invest a significant amount of time and money into the development and implementation of their methodologies in order to have control over product quality. Unfortunately, in many companies most of this work is never implemented and the gains of the hard work to build tailored industry best practices for the company are not fully realized. In addition, these methodologies are seldom improved upon or used as part of a process improvement strategy. Items that should be evaluated for compliance include policies, methodologies, processes, procedures, templates, standards, guidelines, tools and process tailoring compliance items.

The Cost of Implementing the Three Dimensions of QA

A fully functional QA organization should range between 3% and 6% of the total IT organization's project related budget. This includes management and planning of the testing activities, ownership of the process improvement and metrics program and the process compliance and oversight functions. This does not include testing team labor. This cost is variable depending on the level of test automation, number of test cases across application levels being conducted such as interface, system, regression, performance and customer acceptance testing, as well as the overall maturity level of a QA organization. Test team labor may vary from 10% to 25% of a total IT organization's budget. Therefore, the expected range of costs for a full quality assurance function addressing all of the dimensions of QA should range approximately between 13% and 31% of the total IT budget. Typically, an organization that is already conducting adequate testing is only adding 3% to 6% additional cost to the total IT budget by implementing all three dimensions of QA. By reducing rework and improving productivity, cost savings can be realized that will greatly offset these costs. For example, a company with a $1 million dollar IT budget can expect to spend 6% of the total budget ($60k) for additional QA efforts with an expected savings of 20% ($200k) or a net cost reduction of $140k.

"Typically, an organization that is already conducting adequate testing is only adding 3% to 6% additional cost to the total IT budget by implementing all three dimension of QA."

How to Assess Your Current State of Readiness to Implement the Three Dimensions of QA

If you can answer yes to the following questions, you are ready to implement the three dimensions of QA.

Testing

- Do you have a documented testing strategy that is supported by policy and identifies what kind of testing is to be accomplished such as unit, interface, system/ functional, regression, performance and customer acceptance testing and test automation?

Compliance

- Do you have a documented set of standards and/or methodologies that are phase related and include a defined step-by-step process that involves some form of compliance checking? It is necessary to perform process improvement activities against these methodologies based on your process improvement metrics.
- Are your methodologies and processes institutionalized across your organization?
- Do you have a basic set of process compliance questions that can be used to perform compliance checks? Compliance checks can be done by an independent QA organization or informally by project team members.

Process Improvement

- Do you have a metrics program in place that collects defect information on documents, code and other project artifacts through peer reviews, code reviews and testing?
- Do you have cause codes established to identify what caused the defect such as code error, design error, requirements error, test cause error or policy error?
- Are you performing metrics analysis? This should include a process to establish who collects the metrics, how and when they are documented and how they are analyzed and reported.
- Do you currently have process improvement teams in place to establish trends, develop solutions to resolve defects and implement those solutions?