

Reuse – A Management View

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Abstract

In this paper, we present a management view of reuse. Topics of discussion include the steps in planning and implementation of reuse, the associated changes to the existing development process, the support infrastructure and the impact on development culture of an organization. We also discuss the cost and benefit of reuse in a tangible manner. Finally, we present the problems and issues encountered during reuse adoption and implementation, and the lessons learned.

Keywords

Reuse, reuse center, reuse program, corporate reuse, asset certification, reusable assets.

1. Introduction

Reuse is an architecture and standard to ease development of assets independently and sharing of assets globally. When one thinks about reusable assets, the scope spans multiple technologies. Development for and development with reuse should be a long-term culture for an organization [1,2,3]. Use of functionally proven and reliable assets will increase productivity, improve quality, shorten time to market and reduce development cost. Reuse will meet challenges facing the industry today such as increased market competition, globalization of markets, increased complexity of products, demand for high quality, and reduction of development budgets. On the other hand, there are many issues to be considered in the adoption and implementation of reuse. We will be exploring the steps in planning and implementation, cost and benefit, issues arising from the technical and process aspects, impact

on the culture of development, and overall lessons learned.

2. Reuse Implementation Process

The process for implementation of reuse is illustrated in Figure 1. It begins with a reuse readiness assessment, which is a survey to the organization planning for reuse. Based on the result for assessment, an adoption plan is developed. Implementation is then execution of the adoption plan together with implementation of the infrastructure and related processes. Finally, the reuse program goes into the maintenance phase while continuous improvement is ongoing.

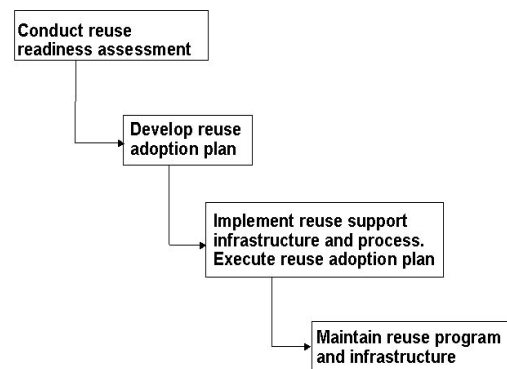


Figure 1. Reuse Implementation Process.

3. Reuse Readiness Assessment

Before starting any activities in planning, it is important to conduct a reuse readiness assessment for the organization. This is a survey

sent to all parties: executives, managers, team leaders, engineers and developers. The results of the assessment will help to identify existing expertise within the organization and understand the expectation of various parties on reuse. For example, executives may be interested in the cost and benefit analysis of reuse prior to committing to sponsor the program. Managers in general may be interested in the impact on development cost and time. Developers and engineers may be interested in how the change in development process is going to affect their work, how to certify an asset for reuse and how to retrieve the right asset for reuse. The assessment will then help identify the target technologies, processes and tools for reuse. A reuse infrastructure will be defined with the appropriate strategies.

4. Reuse Adoption Plan

The reuse adoption plan covers both the reuse infrastructure for the program and the reuse plans for development organizations.

4.1 Reuse Infrastructure

4.1.1 Reuse Center and Library

The reuse center leads the planning and implementation of reuse within the organization. It also establishes asset centers for overseeing asset certification and storing domain-specific assets that span multiple technologies. It defines the reuse metrics, rewards and recognition for the reuse program.

The reuse center also develops and maintains a web-based reuse library that centralizes the storage of version-controlled assets designed for reuse, authenticates users, secures handling of assets with comprehensive search and browse utilities. The library provides usage instruction and examples, and reports metrics such as hit and access rates.

4.1.2 Asset Center

An asset center is a location for logical grouping of various types of reusable assets and for storing the assets. Typical groupings include document templates, business processes, code

assets for different languages, test cases, design, use cases, etc.

4.1.3 Asset Certification

Certification standards for various types of assets are defined. Certification is to be done by an asset expert together with the submitter. The asset certification and reuse process is given in Figure 2. Note that rewards are given to the submitter in submitting an asset for reuse and to the reuser in reusing an asset.

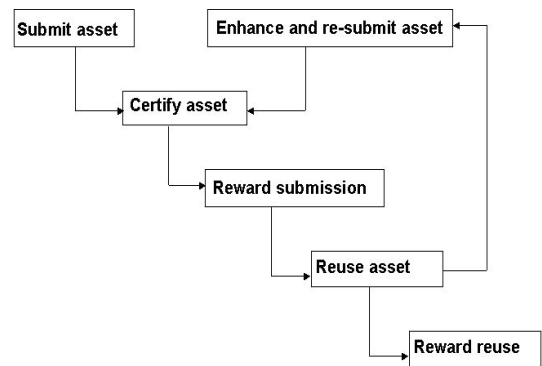


Figure 2. Asset Certification and Reuse Process.

4.2 Reuse Plans for Development Organizations

Organizations must change their development processes slightly in submitting reuse plans or engagement forms as part of the project planning deliverables. The main objective is to encourage development organizations to plan for reuse at an early phase. The commitments detailed in the reuse plans or engagement forms will be checked for fulfillment at the end of the project.

4.2.1 Development for Reuse

Goals will be set in the reuse plan for development of a certain number of reusable assets for submission to the asset center. Each reusable asset will be budgeted with additional effort for development. For example, for a piece of code asset, it will be developed with generic design and more elaborative documentation. It will also be tested extensively to ensure high quality for reuse. Review will be conducted with

the asset expert and test results will be presented as part of asset certification.

4.2.2 Development with Reuse

Goals will also be set by development organizations to plan for reuse of some existing assets. Each asset will be either reused with no change as is, or reused with minor modifications. In all cases, it is expected that the benefits of reuse will be realized.

5. Reuse Cost and Benefit

5.1 Reuse Cost

There are initial investment and ongoing maintenance costs related to the infrastructure of the reuse program. The initial investment involves resources to establish the reuse and asset centers, develop the reuse library and define asset certification standards. Ongoing cost involves maintenance of the reuse library, certification of assets for submission to the library and maintenance of certified assets.

There is additional cost associated with development for reuse. Extra effort should be budgeted for developing, reviewing, testing and certifying assets with intent for reuse. For example, the Constructive Cost Model (COCOMO) [4] recommends the use of effort multipliers of 1, 1.01, 1.02, and 1.03 for reuse across projects, across program, across product lines, and across multiple product lines respectively. For a development involving 100 staff-months of effort, intent for reuse across product lines is estimated to require an effort of 102 staff-months, or 2 additional staff-months.

5.2 Reuse Benefit

There are many benefits on reuse of functionally proven and reliable assets such as improvement in quality, reliability, productivity, and time to market. Tangible benefits of reuse can range from reusing simple assets such as a document template that will save as little as 1 person-day of effort, to reusing a subsystem that will save many staff-months of effort. Table 1 shows an example, based on the COCOMO estimate, listing staff-months of saving for various percentage of reuse on different project sizes

given in thousands of lines-of-code (KLOC). For example, 5% reuse in a 50 KLOC project will save 10.2 staff-months of effort.

Table 1. Saving (in Staff-Months) for Percent Reuse on Different Project Sizes

Size (KLOC) Versus % Reuse	1%	5%	10%	20%	50%
100	4.3	21.2	42.2	84.2	208.3
50	2.1	10.2	20.4	40.7	100.6
10	0.4	1.9	3.8	7.5	18.6
5	0.1	0.9	1.8	3.6	8.9

A complete cost and benefit analysis can be performed for the reuse program. The breakeven point is when sufficient reuse has reduced costs enough to offset the costs of program infrastructure and developing assets for reuse [5].

6. Reuse Metrics, Rewards and Recognition

6.1 Reuse Metrics

We can define a set of new metrics for reuse to measure its effectiveness and tangible benefits [6]. Initial gathering of the metrics will serve as the baseline for benchmarking and continual improvement.

6.1.1 Metrics on Asset Search and Access

The hit rate measures how often an asset is being referenced from search operations on the reuse library. The access rate on an asset measures how often an asset is being reused.

6.1.2 Metrics on Asset Quality

The quality of an asset in the reuse library can be measured by the elapsed time between asset submission and certification, complexity of the asset, and number of problems reported.

6.1.3 Metrics on Overall Benefits of Reuse

The benefit of reuse in saving of development time can be expressed in terms of days or months. Increase in productivity can be expressed in terms of saving in staff-months of

development effort. Improvement in quality of the overall product can be expressed in terms of the number of system problems reported, mean time to defect (MTTD), or mean time to failure (MTTF).

6.2 Reuse Rewards and Recognition

A reuse reward and recognition program should be launched to promote the culture of reuse. Initially, no one will have any idea about the extent of reuse. A cautious or conservative implementation of the reward and recognition program is to use a point system that accumulates reuse scores for individuals or departments submitting assets for reuse and reusing assets. The exact reward and recognition can be determined, and given to individuals and teams by visiting the point system on a quarterly or bi-annual basis. Rewards can range from certificates of achievement, movie tickets, gift certificates, group events, to tangible cash bonus awards.

7. Problems and Issues with Reuse

Despite all the measures discussed above, reuse has been of limited success across the industry. There are some key barriers to reuse that need to be recognized [7].

– *Funding Commitment*

During normal course of business operation, there will always be challenges in core funding. Improvement initiatives such as the reuse program will be targeted for cutback.

– *Motivation to Reuse*

There is lack of motivation in adopting the reuse culture. First, there is a lack of design process to enhance production of reusable assets [8]. One may question whether reuse will in fact make it difficult for developers. Development for reuse implies that more design and test efforts are needed in development compared with non-reuse development. Can developers afford to take on the additional responsibility in an already tight schedule? For development with reuse, there is always doubt in relying on the work of others. People are skeptical on reuse of assets not invented locally. If the reuse catalog is not kept

current in the reuse library and not in synchronization with the application under development, there is no guarantee of quality support. Other than promoting asset submission to the reuse library, how do we make the decision of deleting obsolete assets in the future?

– *Cost Consideration*

One can always question the asset discovery cost versus the new development cost. People may not be aware of the existence of the reuse library, policies and procedures. From a development budget viewpoint, developing for reuse will require additional funding to conduct better designs, more testing and reviews in qualifying assets to the reuse library. Will tight budgets really allow that? Can a development organization easily request additional funding to develop reusable assets? For development with reuse, it is natural to allocate less budget to the development organization since less development effort is needed as a result of reuse. Will a development organization be willing to give up headcount and funding due to reuse? A typical excuse is to say that we are developing something different and unique this time, and no reusable assets can be utilized.

– *Unfair Reward and Recognition*

A point system will most likely result in awards and bonus on an individual basis. The drawback is that it does not promote team spirit. People may still question the exact reward and exact monetary amount. Should one really bother with the reuse reward? Questions also remain in the ownership of the assets once produced. In the future, when enhancements are made to an asset, who owns it, who maintains it, and who gets the reward? During the initial phase, more awards will be allocated to encourage submission of reusable assets to the reuse library. At a later stage, rewards will slant towards reusing assets from the reuse library. What is the turning point for this decision? On the other hand, executives may simply say that reuse should be part of the job – no reward or recognition should be specifically allocated for reuse.

The problems and issues with reuse are detailed, but no solutions are given. The solutions can be very specific to an organization, dependent upon its mission, vision, management style and development culture.

8. Lessons Learned

The key contribution of this paper is the practical experience associated with reuse, specifically on the planning, implementation, social and organizational aspects, processes, cost/benefit, metrics, and key barriers.

Despite the challenges we are facing, there is no doubt that reuse will improve quality and productivity. Use of functionally proven and reliable assets will improve reliability and shorten time to market. If an organization decides not to implement reuse, it runs the risks of eventually lagging the competitors in development cycle and quality.

Regardless of whether there is a formal reuse program, informal reuse always exists with conscious individual efforts. Formal reuse needs to be complemented with management support, Capability Maturity Model (CMM) improvement [9,10], funding, training, mentoring, and communications. Development for reuse will only succeed with relief in schedule and development budgets. Development with reuse must be conducted with the desire to improve, starting small with templates and simple assets, and growing with development and reuse maturity.

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