Software Testing Tools Return on Investment (ROI)

Executive Summary

This paper addresses the question of 'Return on Investment' in testing tools. It looks at the subject from two perspectives: the tangible and the intangible. Under tangible benefits, measurable short-term (single project) cost-savings are considered. Intangible benefits, which include longer-term gains such as reduced maintenance costs, corporate reputation and similar factors, are also discussed.

IPL is an independent software house founded in 1979 and based in Bath. IPL was accredited to ISO9001 in 1988, and gained TickIT accreditation in 1991. Both Cantata++ and AdaTEST 95 have been produced to these standards.

Software Products Group
IPL
Eveleigh House
Grove Street
Bath
BA1 5LR
UK
Phone: +44 (0) 1225 475000
Fax: +44 (0) 1225 444400
Email: tools@ipl.com

Last Update:18/03/2011 11:34:00

1. Measurable, Short-Term Factors

IPL's software testing tools (Cantata++® and AdaTEST 95® *) are intended to support the unit and integration testing phases of the software life cycle. ROI is calculated on the basis of a comparison with the cost of performing these activities without the support of such tools. The operational cost saving, less the cost of purchasing the tools can be used to obtain the ROI (ratio of saving over the cost of the investment in the tool).

1.1. Example 1 – Unit Testing

Firstly consider manual software unit testing (i.e. without specialist tool support). Based upon IPL's metrics, a typical software module (defined as an independently compilable unit of code containing approximately 100 lines of code, of 'average' complexity) would take a reasonably experienced engineer about 2 days to test (achieving 100% coverage of all decisions in the code). At a representative cost per engineer-day of say €450 **the cost of manual software unit testing would be €900 per module**. Note however, that without appropriate tool support, the engineer would be unable to prove that 100% decision coverage had been achieved, and may therefore continue producing tests beyond those necessary to achieve the coverage requirement.

Metrics from IPL and its customers suggest that by using Cantata++ and AdaTEST 95 the effort required to achieve the required testing can be reduced to just 1 day[1], so **the cost of software unit testing would be €450 per module**.

Applying these figures to a 'typical' software development containing say 400 software modules, the saved effort would be 400 engineer-days, yielding a cost saving for unit testing of €180,000. Depending on the technical aspects of such a project it is likely that a 5 user floating licence for Cantata++ or AdaTEST 95 would be required, for standard platforms costing about €29,000. The unit testing Return on Investment for the project is calculated by taking the net realised saving of €151,000 (€180,000 unit test saving - €29,000 tool investment), and dividing this by the tool investment:

$$\text{ROI} = \frac{€151{,}000}{€29{,}000} * 100 = 521\,\%$$

1.2. Example 2 – Integration Testing

Large projects typically expend 10% of the total project effort on manual integration testing (i.e. without specialist tool support). Effort savings of 50% can again be made at this stage when Cantata++ and AdaTEST 95 are used. Taking a total project effort of 20 man years €2m (4,500 working days at €450 per day), manual integration testing would cost €200,000. Again depending on the technical aspects of such a project it is likely that a 5 user floating licence for Cantata++ or AdaTEST 95 would be required, costing about €29,000. The integration testing return on investment for the project is calculated by taking the net realised saving of €71,000 (€100,000 integration test saving - €29,000 tool investment), and dividing this by the tool investment:

$$ROI = \frac{€71{,}000}{€29{,}000} * 100 = 245\,\%$$

1.3. Example 3 – Unit and Integration Testing

When considering the return on investment calculations for Cantata++ or AdaTEST 95 use in both unit testing and integration testing phases of a project, we can combine the savings from each stage, but recognise that we will not need to purchase tool licences twice. This calculation ignores the significant reductions in integration testing that thorough unit testing brings, where previously no structured unit testing has been undertaken before integration testing. Hence, the actual ROI would be even better than indicated here.

The combined unit and integration testing return on investment for the initial 12 months is calculated by taking the net realised saving of €251,000 (€180,000 unit test saving + €100,000 integration test saving - €29,000 tool investment), and dividing this by the tool investment:

$$ROI = \frac{€180{,}000 + €100{,}000 - €29{,}000}{€29{,}000} * 100 = 1066\%$$

1.4. Subsequent Projects

For subsequent projects, the ROI greatly increases, as maintenance renewal costs of such tool licences would be only 15% of the original cost, but the savings would continue at the same rate assuming unit and/or integration testing with the tool continue at the same rates. So once the initial outlay is repaid, it is usual to see a very high ongoing ROI.

Clearly the above arguments do not take into account the benefits derived from:

- The ability to carry out regression testing easily and repeatably: reducing the cost of software changes.
- The cost savings derived from not needing to develop or maintain 'home-grown' testing solutions.
- The tools' ability to measure test coverage – thus increasing the quality of testing, and the resultant quality of the software produced.

These factors are further discussed below.

2. Immeasurable, Longer-Term Factors

The IPL tools not only enable more cost-effective testing, but also 'better' testing. For example, they contain facilities (such as stubbing and wrapping) to enable modules and other components to be tested more thoroughly than without such facilities [2]. This means that products are less likely to be released with bugs in them [3], and the consequence is reduced damage to supplier's reputation and less cost in fixing faults when in the field [4].

The IPL tools play a further role in two key aspects of reducing long-term software support costs:

1. An important capability in maintaining software quality is the facility to run periodic regression tests. IPL's tools can be run in batch mode as well as interactively, making regression testing easy. The most general example of application of regression testing at the unit test level, would be regularly (nightly or weekly) rerunning of all unit tests, to ensure that all code modules work correctly. Such testing will detect problems in units which were seemingly unaffected by changes to other areas of the code. Similarly, regression testing is very important when porting applications to new environments [6].
2. The static analysis (code metrics) element of IPL's tools can help enforce coding rules that will help ensure that code units are maintainable. The key here is to ensure that code modules are of a manageable size and complexity, adequately commented, and containing no code constructs known to make code unreliable or hard to test [5].

Further intangible benefits from the use of Cantata++ and AdaTEST 95:

- Increased staff motivation: Engineers are provided with appropriate tools to do what might otherwise be boring and time-consuming task[7]. It is a universally acknowledged truth, that few engineers like testing; they have to do it, so make it as palatable as possible by giving them the best tools for the job.
- Modern safety and quality standards demand not only that all levels of testing (including unit tests) be carried out, but also that evidence of the tests, including coverage analysis, be available[8]. Cantata++ and AdaTEST 95 have been specifically designed to provide the required evidence.

3. *Conclusions*

A simplistic calculation of ROI shows that IPL's tools will typically repay their investment well inside the timescales of the first project on which they are used. These cost savings will be even larger for subsequent projects.

In addition to these measurable savings, there are many other benefits. The most significant of these is the improvement in product quality and reliability achievable through more thorough testing at all stages of the development.

* These are generic names for the IPL products which include the older tools, Cantata and AdaTEST.

4. References

These references can be found in the IPL case studies, at http://www.iplbath.com/products/casestudies/pc000.shtml

(1) IPL Case Study 8. " … was able to report productivity metrics of around one man-day per test script for in-house written software" (**Rolls Royce and Associates)**

(2) IPL Case Study 15. "The other key Cantata++ facility was wrapping which allowed a class to be tested independently of all other interfaces. Prior says,

'Without this, difficult external conditions not directly influenced by our code, such as memory allocation errors, may have been difficult to simulate.'" (**Data Systems and Solutions)**

(3) IPL Case Study 11. "We found errors using Cantata++ that we know we would otherwise have missed until later." (**Marconi Communications**)

(4) IPL Case Study 12. "AdaTEST has been instrumental in allowing the project to produce a lot of code with a very low residual bug level." (**Thales Optronics**)

(5) Case Study 6. "(AdaTEST) has also helped in the smooth running of code inspections by providing reports of source size, complexity, and the identification of prohibited Ada constructs." (**Siemens Plessey System,** now **BAE Systems**)

(6) IPL Case Study 17."When switching to a new platform release, Cantata++ was a great relief for us. The regression test ability allows us to verify the success of the migration of our application." (**Alcatel Transport**)

(7) IPL Case Study 8. "AdaTEST was wholly reliable, robust and easy to use. Use of script templates allowed staff to be productive from an early stage…" (**Rolls Royce and Associates)**

(8) Case Study 6. "AdaTEST has allowed us to meet all contractual requirements on evidence of unit testing… its greatest contribution has been the production of hard evidence relating to the adherence to standards…" (**Siemens Plessey System,** now **BAE Systems**)