How Much Test Costs Are Impacted by Test Environment Development and Maintenance?

Mendonça, Cassio Henrique
INPE – Instituto Nacional de Pesquisas Espaciais
chmendonca1977@yahoo.com.br

Ambrosio, Ana Maria
INPE – Instituto Nacional de Pesquisas Espaciais
ana@dss.inpe.br

Abstract

It is a consensus that tests are expensive but nobody denies that they are indispensable to the development of dependable systems. There are many items involved in the estimation of the tests costs as test environment, schedules, people, training, etc. There are many metrics to be analyzed. But what to consider in order having the more precise measure of test costs? This paper arises discussion about the items to be taken into account in the calculus of test costs, focusing on test environment for on-board autonomy satellite test environment.

1. Introduction

One can easily find information about test metrics related to errors, average time to execute tests, rate between tests passed versus executed tests, etc. in the most cases applied to software development. However when the issue is cost of hardware and software integration tests, there is a lack of information. Some authors inform values based on percentage of total product development cost without determining exactly how to get these values. In this article we have raised a set of questions created in order to initiate discussions about tests costs. Our reference is on a test environment for LATTES satellite system to be developed at INPE.

2. Lattes Satellite and Autonomy in Decision

Lattes is a scientific satellite that is planned to be launched for 2013. This satellite is expected to perform experiences on space climate and x-rays monitoring. It is part of multi-mission platform developed by Brazilian National Institute for Space Research (INPE) [1], [2].

The main difference of this satellite is the intention to implement autonomy concepts to take on-board monitoring and control decisions. It is important to give empowerment to the controller to decide for replanning which actions might take to allocate resources for mission operations, data management and fault management. It enables, for instance, the satellite to be reconfigured to make monitoring of event while the satellite is positioned outside of visible area that means until 90% of the time of each pass.

3. Cost of Tests

All information gathered about tests agrees in that tests have a high impact over costs and schedules. It usually is the guilty for delays in time to market causing over passing budget limits. Tretmans and Belinfante affirm that "in some software developments projects testing may consume up to 50% of the project resources" [4]. In the same way, INCOSE has stated that "testing continues to consume as much as 40% of new product development" [6]. Extrapolating this information for software and hardware integration, it is possible to consider about 40-50% of total product development as test costs.

This highlights the importance of well defined testing roles to avoid that test costs outburst the project budget. Assumptions and questions have been arisen to define or at least to show what points have impact over tests during product development.

Metrics are the best way to demonstrate project updates and impacted points. Before implement metrics, it is necessary to define what to measure to add value to the project. Thus, it was identified some major points related with tests that could be used to start the study of test metrics. We suggest starting with the following issues: test environment, schedule and tests activities. All of three can be sliced in minors items depending on the project characteristics.

For this work, test environment was defined as the focus, once test cost is a very wide issue enabling a huge number of discussions and researches.

4 Test Environment

Basically, test environment is a place with real and/or simulated system parts, environmental models to simulate operational conditions and user interfaces that allow configuration changes, signal insertion, fault simulation and monitoring used to perform different types of testing. They can be simple or complex depending on the product characteristics.

4.1 Which Features Test Environment Should Have to Comply With Autonomy Tests

Test environments are totally dependent of product and it will define its characteristics and complexity. When testing a highly integrated, complex and autonomous product, a set of points must be considered such as cost of product, its lifecycle, associated risks, market expectation concurrency, etc.

In general, on-board autonomy tests require simulation of components failures for reconfiguration spatial environment, ground station, Earth surface and atmosphere.

4.2 What Questions To Answer Before Requesting a Test Environment?

There are technical and non technical points to consider when requesting a test environment for highly integrated and complex systems. Questions about test environment are stated here.

Budget: How much budget is available to build a test environment? How much stakeholders are willing to spent for more improvements on test environment?

Market: Is there marketing objectives over test environment? Is there COTS products to compose the environment? Is the time to market essential for the project? How to handle delays and concurrency?

Laws and Regulatory Instructions: Is there any regulatory agency involved or that should be involved? Are there rules and guidelines to follow and to accomplish with? Certification or Qualification are applied to the development?

Rig installation, improvements and updates: Is there an appropriate area for installation? In house implementation is simpler or cheaper than turn key solutions? Are the suppliers able to support RIG during all product test lifecycle? For maintenance, which components should have spare parts? How many hours are taken for maintenance? Does the RIG allow growth for integration with other RIGs?

Automation: Are the tests repeatable? Are the tests reusable for different products? Does it decrease the size of staff for testing? Is complete test environment automation feasible? And is it necessary?

Operation: How much is the cost per hour? Is the RIG easy to use or is necessary training?

Disposal: When the test environment should have its use interrupted? Is it reusable for future development? What to do with old parts? How to care about environmental questions around discarded parts?

5. Conclusion

As depicted here, there is a lack on test environment development. These are some questions applied to for highly integrated, complex and dependable systems. Could have more questions that were not stated here and it is dependent of project characteristics.

It is necessary to give real importance in researches to answer those questions that have high impact and can bring contributions for product development. It is an opened and wide field of research.

10. References

[1] F. de N. Kucinskis and M. G. V. Ferreira, "An Internal State Inference Service for Onboard Diagnostics, Prognosys and Contigency Planning Applications", SpaceOps 2008 Conference

[2] F. de N. Kucinskis and M. G. V. Ferreira, "Taking the ECSS Autonomy Concepts One Step Further", SpaceOps 2010 Conference

[3] J. L. Amsell, "Enhanced Integrated Satellite Factory Test Environment", AUTOTESTCON 2003. IEEE Systems Readiness Technology Conference. Proceedings

[4] J. Tretmans and A. Belinfante, "Automatic Testing with Formal Methods", EuroSTAR 1999

[5] L. Clemmer, "The importance of a Testing Environment" http://www.theemailadmin.com/2009/10/the-importance-of-a-testing-environment/, last visited at: 01/06/2011

[6] SYSTEST – Developing Methodology for Advanced System Testing, INCOSE. http://www.incose.org/secoe/0105.htm, last visited at: 12/27/2010

[7] Volvo Trucks Europe Division, Public Relations, "The world's largest test rig – a powerful tool in the hunt for increased payload" http://www.volvotrucks.com/trucks/NewZealand-market/en-nz/newsmedia/pressreleases/pages/pressreleases.aspx?pubid=9857, last visited at: 01/06/2011