Requirements for Technical Quality of Software Products

SimSat case study

Ground Systems software follows a well-defined process as defined by the Software Engineering Standards for Ground Segments in ESA (BSSC). From the specification to the actual deployment and operation of the software, every step of the process is rigorously documented to ensure a correct implementation of the functional requirements. Technical quality of software is addressed, as part of that process, in the Software Product Assurance Plan and through code reviews using Telelogic’s Logiscope. However, is this enough to ensure high technical quality of ground system software? Using as case study SimSat, we present the findings of an assessment of the technical quality of software products. We identify several technical quality problems. Low technical quality leads to high maintenance effort. We conclude that maintenance effort could be reduced by imposing and enforcing measurable requirements on technical quality of software products.

Reducing software maintenance effort by addressing poor technical quality

The ISO 9126 international standard for software product quality identifies maintainability as one of the six main quality characteristics. Maintainability is then subdivided into analyzability, changeability, stability and testability. For rating these characteristics on the basis of the source code a quality model* employing metrics has been proposed by the Software Improvement Group. Volume (the overall size in staff-years), Duplication (the percentage of code that is exactly copied), Unit size (size of methods and procedures measured in LOC), Unit complexity (number of decisions per method or procedure), and Test quality (the existence of both unit and integration tests). The analysis of these metrics allows the identification of potential risks and the calculation of ratings. Ratings are expressed in stars: five stars mean excellent quality, four stars good, three stars fair, two stars poor and one star very poor.

We analyzed the source code quality of the Simulation Infrastructure for Modelling of Satellites (SimSat), version 4.0.1, according to the metrics above referred. SimSat is available as two modules: Kernel and MMI.

The overall rating for SimSat is two stars, indicating poor maintainability. Based on industry average productivity statistics, and assuming that 15% of the code is changed yearly, we estimate that SimSat has a maintenance effort of 6 staff-years. We estimate, that when duplication and complexity are improved, the maintenance effort could be reduced to 5 staff-years (17% reduction). To conclude, although SimSat was developed following a strict process, quality problems were still found, in particular regarding duplication, complexity and unit size. We recommend that actions should be taken to solve these problems and that the degradation of quality is monitored. This would not only improve overall quality but also reduce maintenance effort. Moreover, new projects could benefit from adding to the requirements that all software have at least four stars for quality. Generalizing from this SimSat case study, the application of these techniques to other ESA ground systems software would offer a better overview of the overall quality, insight about the existent risks and decision support for controlling and improving software quality.

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