Quality as the Main Requirement for the Competitive Survival of the Software Development Industries in the Future

Quality/Process Improvement and Management

Abstract

The understanding of the difficulties for producing software with quality has lead the software development Brazilian Industries to search for methods, techniques and tools to give support to software development and to guarantee its quality. However, researches in this area have demonstrated that, in most cases the use of these new technologies does not guarantee a software product with quality, since technical and management aspects related to activities planning and control of a specific development process are not considered.

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Introduction

The new economic world order makes industries engage in direct competitive dispute under all aspects, manly under those related to the quality of their respective products and services, as well as to satisfaction of their clients needs and expectations.

Quality has become, nowadays, a very important aspect for industries to succeed in a very competitive and aggressive global market. More than ever, clients systematically demand formal proof of industries' quality procedures in designing, developing and commercially supporting its products.

In order to implement quality monitoring, objective procedures, parameters and measurements are designed and implemented as a way of verifying, weather or not, certain product is within its admissible limits. For such, for each product characteristic, a standard measure is defined, as means of making evaluation as independent as possible from evaluator's personal opinion.

In the software case, however, although becoming more and more frequently seen as any other regular product, it has rarely being submitted to formal evaluation of quality. Actually, very few actions have been taken in that direction. What usually is observed is that the subject is, when much, just superficially treated, leaving the outcoming product quality subject to informal programmers and analysts abilities and opinion.

As a direct consequence of the little attention dispensed to the subject, mainly during project designing and development, its known that more than 50% of total production and implementation time is spent in activities such as software testing and maintenance. (Fenton,1999)

A more effective attention given at the beginning of the project, mainly on precise requisites and parameters specification, quality objectives and approval criteria, could therefore, mean

significant time and development cost reduction, resulting in a meaningful increase in competitivity and therefore, profitability.

Quality in the Software Industry

Quality measurements, together with continuous development process improvement, are today, the two main goals pursued by many of the competing software industries (Jorgensen, 1999). A strong increase is being observed in concerning expectation for quality not only by final clients, but by professional markets as well. Today, it is not enough to just deliver products with technical excellence. Products must be easy to use and conform to particular clients' professional needs.

Quality in terms of software, has been focused and defined according to a diversity of points of view, among them are:

- Software quality is determined by a set of quality factors. (ISO 8402-1986 and IEEE 610.12-1990). Quality is the totality of a product or service characteristics, that embrace the implied necessities. Examples of such characteristics are: efficiency, flexibility, integrity, maintainability and profitability.
- Software quality is determined by user satisfaction (Deephouse, 1995).
- Software quality is determined by the errors or unexpected behaviours presented by the software (Carey, 1996; Lanubile, 1996). This has been the most usual definition adopted in the software industry.
- Software quality has been traditionally defined in terms of adequacy to use (Yourdon, 1989; Martin, 1988; Dunn, 1998). A software product is then judged by its performance according to a given client satisfaction level, in terms of its functionality and operation continuity. (O'Brien, 1991; Folkes, 1992).

From the previous definitions, one may imply that software quality is somewhat, more a matter of intuition than rationality. They are all based on the hypothesis that software quality can be summarized in only one aspect, stated as: The degree of meeting the users needs.

Quality may also be classified as (Nigel, 1999):

- Internal Quality, which is measured by the static properties of the code, typically by inspection.
- External quality, which is measured by the dynamic properties of the code when executed, such as response time.
- Quality of use, which is measured by the extent to which the software meets the needs of the users in the working environment (productivity).

Presently however, just satisfying clients' needs, does not guarantee commercial success continuity. It is necessary also, that one should do things at least well, or preferably better than his competitors will. It is therefore important to establish programs that allow for achievement of development processes continuous improvement.

According to the ISO 9000 standards, product quality is highly dependent of the processes used in its creation and therefore, following the product quality becomes a consistent proof, a reliable method for the software process evaluation. The results obtained by such evaluation, according to Glass, (1992), allow the elaboration of a continuous improvement program.

Besides, Paulk (1995), states that the increment in the software industry's capacity to deliver high quality software products in their respective schedules and budgets, show, in the later years, that part of the software community has been adopting a more systemic approach in order to achieve processes improvement.

Software improvement must be carefully planned and systematically executed. The majority of the well-succeeded industries had used some models for the improvement of their projects. These models have been chosen based on their strategic needs (Jones, 1996).

Many institutions have been worrying about creating policies and tools in order to allow for correct evaluation of, not only the final product, but of the development process as well. Some of these mentioned rules are stated for each of the relevant area involved, as follows.

a. Product Quality:

- ISO/IEC 9126: Software Quality Product.
- ISO 15498: Guide for Quality Evaluation.

b. Software Process Quality:

The most recent studies about quality are, in their great majority, focused in the software process development improvement. Not implying that product quality is no longer important. But the fact is that, as quality of the process is guaranteed, a great step is already given towards product quality achievement as well. Among the most important studies in this area we may name:

- ISO 9000-3 – Standards for implementation of the ISO 9000 series to software production process.
- ISO 12207 – Life Cycle Process.
- CMM – Capability Maturity Model
- PSP – Personal Software Process
- SPICE – Software Process Improvement and Capability Determination – ISO 15504
- Trillium Model.
- Bootstrap Methodology.
- Software Clean-room Engineering.

Among the industries that achieved good results with the above-mentioned procedures, are: NASA, Microsoft, Raytheon, General Electric and IBM. All considered large industries. However, according to William (1995), it might be impossible for a small organization to implement an improvement program due to the great demand of material and financial resources involved. Although some success cases have been published by CMM and ISO on

implementing such programs, small industries have in general, encountered significant difficulties in these implementations remaining indecisive in their adoption.

Quality in the Brazilians Software Industries

Along the latter years, a strong increase in the consciousness of the software industry has been noticed in Brazil. Industries are beginning to realize the importance of the quality issue as means of achieving higher productivity levels, increasing therefore competitive. Significant efforts have been dispensed by many Brazilian Software Industries in search of improving their software processes and consequently, their quality certification.

In this context, direct research has been done focusing Brazilian Software Development Industries, with the objective of keeping track of the industry's evolution, regarding the strategic planning aspects of these industries' like: quality and certification systems, human resource management, client-company relationship, along with software quality procedures adopted and practiced in the Country.

Actions and Strategies that are proposed based on realistic and objective diagnostics of the industry, represent a trustful foundation to effective competition of Brazilian software products and services in international level, in a moment when world economies undergo intensive globalization process as market become further and further liberalized.

According to Cabel (1999), quality is presently being identified by the Brazilian Software Industries as the main competitive strategy, either to maintain, or to gain market share. This vision can be stated as: "Produce the best software in the market" and "Comply to all of clients specifications regarding the product".

Besides, it has been also identified the fact that, among other aspects, the main activities defined to achievement of the mentioned competitive strategies, are: concern with the correct specification of requirements, adequate documentation, problem origin identification, number of tests performed. (Cabel, 1999).

However, even with the recognition of the importance that the quality issue may have for the Software Industry, many of the standards and quality tools developed and proposed for the area, have been little or not at all applied. This occurs, mostly, because of the inexistence of a development process control. There are no management tools and techniques available and there isn't an adequate knowledge of the metrics that are necessary for an adequate software measurement. And, given that, many of this tools and standards take, a great amount of time to be developed and implemented (months, years), the Brazilian software industry, mainly the small ones, which represent most of the Brazilian industry, have no capacity to support such investments.

Since 1993, the evolution of the quality in the Brazilian Software Industry has been monitored based on data originated by a bi-annual survey that is made by the Secretary of Information Technology and Automation of the Department of Science and Technology, in the attribution of the Sector Subcommittee of Software Quality and Productivity. According to these surveys, in the later years, it has been identified that:

- 69% of software industries that generating their strategic plans, business plans or goals, include targets related to quality.

- 42% of executives recognize that investments made in quality produce extremely positive results. Not doing anything is what costs a lot. Losses caused by company's image decay, associated to bad quality may be irreparable.
- The number of industries with a quality program or something similar to a quality program has doubled in the last six years. And an increase in the number of industries that are in the process of quality programs implementation can be observed every year.
- The number of industries that have not formally implemented any quality program has not significantly moved downward, however. Which shows for a stagnation of the sector in an incipient level regarding the formal treatment of quality.
- There is a number of industries (60%) of industries with quality systems, be they specific or not, for the area of software development. There are also industries (28%) that have ISO 9001 and ISO 9002 certification, observing that there are industries that maintain presently even more than one certification up-dated.
- Among other standards and models that show to be appropriate for the sector, for the construction of quality indicators for the software processes and related products, were identified:
    - The ISO /IEC 12207 standard, Information Technology Software Life Cycle Process.
    - CMM – Capability Maturity Model
    - SPICE – Software Process Improvement and Capability Determination
    - ISO/IEC 12119 standard, Information Technology –Software Packages – Tests and Quality Requirements.
- Quality Consciousness remains in ascendance, as users and clients become more and more quality demanding worldwide. It is not enough any more, to comply to specifications in order for the quality of a service or product be considered adequate. Expectations now have to be exceeded.
- The number of industries that promote quality survey on their clients is also significant. With the predominance of surveys of satisfaction (70%) over surveys of expectations (59%).
- Listening to the market, collecting data through formal surveys and regular complaint logging and analysis, shows to be more and more important. These data used by the industries in revising current or old projects or in specifying new ones.
- The main methods utilized in Brazil for prevention of defects were: adoption of in-house standards and procedures, prototyping, critical conjunct analysis and project management. Some of the methods for defect prevention may be classified as advanced for the software development process. Among the selected methods in the research, are: prototyping, the reuse e auditing. Configuration Management and Adoption of Metric Measures did not stand out among the other types.
- Among the main types of tests performed, are: functional tests, field tests, acceptance tests, integrated system tests along with integration tests.
- Also among other software engineering practices printed by the industries, we have: control of versions, data modeling, user interface project, data dictionary, e object-oriented methods.

- Some tools, used for software development where mentioned as well: screen generators, source coding generator, project managers, CASE, library module managers, configuration manager and prototype.
- For measuring the software processes quality, industries utilize metrics like function points and Code Line.

Conclusions

Although many industries in Brazil, already recognize the importance of quality in software, a significant group is still not aware or does not utilizes the standards for evaluating the product or process. Efforts to revert situation are necessary.

Whatever the approach used for software process improvement be, it is necessary that the industries:

– Cultivate the habit of systematically measuring their processes.
– Learn to identify the causes of the defects or problems detected during the adopted measuring procedures.
– Learn to act correctly and preventively in order to eliminating these problems.

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