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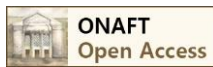
# INVESTIGATION AND ANALYSIS OF AUTOMATIC TESTING SYSTEMS OF APPLICATIONS

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*Annotation:* The focus of this article has been about automated testing in practice. Using testing tools is quite common phenomenon in software companies. The article studied the use of software testing tools. Testing software is enough ordinary things in the IT software development company. But the using automated testing tools only develop in the educational training of IT professionals. Information study of the use of testing tools for the control of software quality IT professionals and IT students was held. Statistical analysis of the data shows the percentage of how many people use the testing tools, but most still depends on manual testing. The main purpose of the article is to find out the facts related to the research questions of creation of new testing tools for educational purposes of highly qualified IT professionals.

**Key words:** tests, software, testing, verification, validation, automated testing system

## Introduction

Today there is little doubt in the feasibility of the testing process of software products under developing. There is applies as the professional commercial development, as the development of programs for training developers. The ensuring the quality of the developed software is the aim of any project of testing of the developed product. Automation increases the testing efficiency and, therefore, improves the quality of software generated (Soft). The main task of the article is to give sufficiently clear picture of the pros and cons of existing automated testing system of various applications.

According to IEEE Std 829-1983, testing is the process of analysis of software, aimed at identifying differences between its real and desired properties (defect) and at evaluation of properties of software.

By ISO/IEC 12207: 2008 «System and software engineering - Software life cycle processes» in software lifecycle among others supporting processes of verification, validation, joint analysis and audit are determined. The process of verification is the process of determining that software functioning is in full compliance with requirements or conditions implemented in previous works. This process may include analysis, control and test (testing).

The process of certification is the process of determining the completeness of compliance with statutory requirements, the established system or a software product to their functional purpose. The process of joint analysis is the process of evaluation of the states and, if necessary, of the results of works (products) by project.

Benefits of automated testing:

- the "human factor" is excluded while performing: test - script does not allow mistakes by negligence;
- quick start;
- automatically generated and saved reports on the results of testing;
- run against the background - during the execution of tests, you can do other tasks or perform the test - scripts at non-working hours.

Disadvantages of automated testing:

- the uniformity - all written tests will always be carried out strictly according to the algorithms implemented in them, while the tester performing the test manually, can pay attention to some details, and find the defect. (For example, after a renovation of the project in the form of operation an optional field has been added, but the developer has made a mistake and the format of data for entering has failed. During the functional /regressive testing of application the test – script will work without errors, because in its algorithm the interaction with the field is not implemented);
- the costs for support - more often change the application, they are higher. (As a result of improvements the specific functional may vary, resulting in partial or complete unsuitability of test - scripts. A challenge to bring the test - script (s)



to the current state will raise for a specialist in automated testing);

- high costs for the development of the test frame for a particular project (in fact, there is a development of application that tests the other one).

### The introduction of automated testing

Before thinking about the implementation of automated testing, you must make sure that the quality control process on projects is built, documented and works like a clock. Using automation - this is not a fad. This task, designed to raise the quality control on the project to a new level, as a consequence, increases the effectiveness of the test project.

The second step is to automate the process of testing on a professional level and in a short time. When implementing projects on test automation "from scratch", in most cases, it is recommended to develop proper framework. This approach will allow the experts to refine their own framework and to develop the test coverage -scripts. Today it is the most technologically advanced solution in terms of price/effort/effectiveness.

The special features of such framework may include:

- maximum flash reusable code: create virtually API (Application Programming Interface), which manages the control of implementation process;
- application of Data Driven tests (tests on the same scenario, carried out at different sets and / or values of initial data);
- all test cases and test suites are also described in external files, making it easy to manage startup parameters;
- the framework has the maximum flexibility: we can easily add, delete, edit existing test scripts and run packages at the same time for this task additional qualification is not required, but only the ability to work with the framework is needed;
- new operations can be easily added to the system or existing ones can be modified; it does not require any complicated actions, you will need to write only a new function. This makes it easy and painless to expand the framework itself;
- for many parts of this test this solution can be a panacea, because as a result of the development of the framework and after a brief training to work with it, the requirements to the professional qualification of specialists, covering system with autotests are significantly reduced, it is enough to have XML skills.

### Benefits of Using of the automatic testing of commercial software

We may indefinitely talk about supporting technology and tools. But to bow the final user to the correct choice, we will give real numbers and graphs of efficiency of the use of the proposed technology and instruments.

In the world there are many companies that have or otherwise use technology IBM Rational, but it is rather the use of the individual tools, and not process.

Although such use gives effect, but it is not so great as it would be at full transition to technology IBM Rational.

We will give real data about one of companies where they fully implemented testing process RUP (Rational Unified Process) in a large project of development of several successive versions of a large system (of the communication area) for demonstrating the efficiency of technology.

Figure 1 shows how the number of errors is reduced using software versions in application of technology IBM Rational. At this case we are talking about the application of regressive testing. Pay attention to point "Peak". This point means at the same time the maximum load, the maximum number of found errors and the maximum of the use of testers, as the complexity of this step is large enough, as it is necessary to create the imitation of all range of functional abilities of the software under test with special testing language.

The graph shows that in all following versions of the software the number of found errors decreases.

As well as the testing process is automated, the labor costs of testers are reduced, respectively, the volume of tests increases and, consequently, software is tested more and more fully.

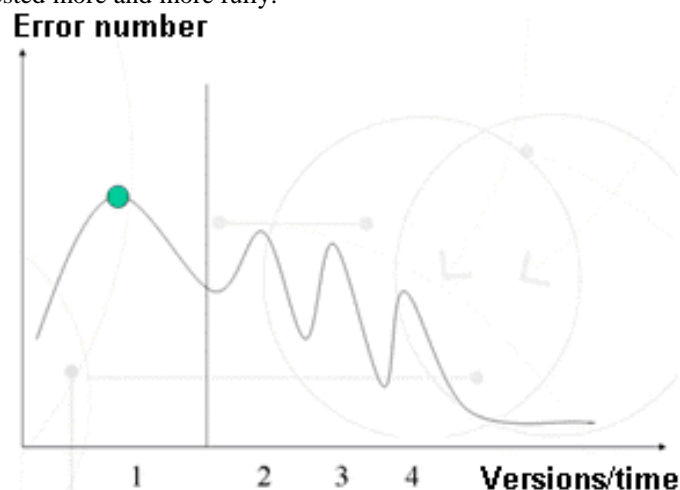
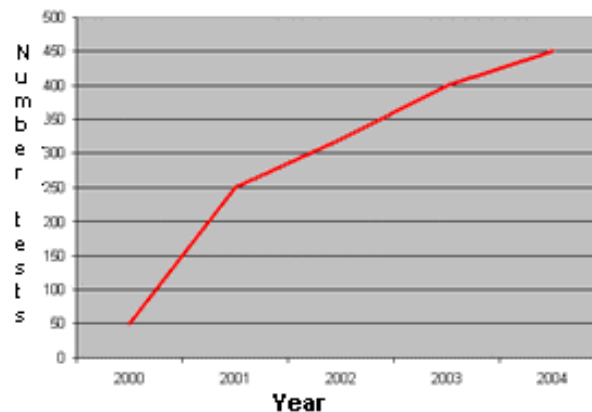


Fig. 1 – Number of errors found in versions of the software



The following figure shows a test of growth during the development. The starting point was 50 by manual tests which tested the software. Manual labor is not known to very productive. Test automation has allowed dramatically increase the number of tests (now not tested only the most important functions) and bring it number to 450. Manual execution of such a large number of tests would require enormous resources. The number of testers don't change.



**Fig. 2 – Number of tests in time**

And some more characteristics of volume testing. Initially in this example, 50 tests were carried out initially for one version; currently testing is performed for four versions for thirty customers. Herewith the costs for testing each version were decreased.

There are various kinds of tests, for example, the load tests of modeling of loads on client - server systems. The facts show that one of the companies abandoned the development of its promising communication system. The decision was made after the entire complex of load tests. Cause: the system was not prepared for the real load. The company has estimated the risks, drew conclusions, and basing on the knowledge acquired designed and implemented system differently.

Key benefits of test automation:

- reduction of principal risks of the customer, and developer;
- saving of resources by automating of regressive testing;
- software quality improvement on account of multiple changes checks;
- improving the quality of testing through the use of modern technologies.

Now we will look closer at some popular means of test automation.

#### HP QuickTest Professional

Means of automation from a Hewlett-Packard Company is distributed on a fee basis (8000-10000 USD). It is the main tool for automating functional testing of a given manufacturer. It allows you to automate functional and regression tests by recording user actions when dealing with the application under test, and then to perform the recorded actions to verify software.

Recorded actions are stored in the form of scripts. Scripts can be displayed in a tool like VBScript (expert view), or as a visual sequential steps with actions (keyword view).

Each step can be edited and you can add a verification points (checkpoint), which compare an expected result with an obtained one.

#### IBM Rational Functional Tester

Also for an extra charge (6,000 USD). Rational Functional Tester provides testers automated with testing tools that let you perform functional testing, regression testing, user interface and data-driven testing.

#### Selenium

Free of charge package from the company OpenQA.org. At the core of Selenium lies testing framework for web-applications, implemented in JavaScript and checking directly with the browser means. Within the project Selenium three tools are produced, each of which has its own characteristics and application area: Selenium Core, Selenium IDE, Selenium RC and Selenium GRID.

Supported technologies: DHML, JavaScript, Ajax. Supported OS: Mac OS, Microsoft Windows, Linux, and Solaris. Test Language: HTML, Java, C #, Perl, PHP, Python, and Ruby. Tested applications: web applications.

Basic properties of means Purify, Quantify and Pure Coverage:

- can be integrated with the means of functional testing Robot, Test Manager and Visual Test;
- can be integrated with Clear Quest, for documenting and tracking arising in the process testing errors;
- produce accurate and detailed information on the performance of the application;
- use OCI technology - Object Code Insertion, allowing you to closely monitor and catch errors not only in the developed module, but also in the external libraries;



- represent a comprehensive additional review of data on performance, area of code coverage and stability;
- have flexible adjustment in accordance with the demands of developers and testers;
- allow you to test the application multiple times (during development), to track changes for each recompilation, thereby forming the data for later analysis;
- can be integrated with the development tools (Visual Studio 6.0, Visual Studio .NET , Visual Age For Java);
- test the components ActiveX , COM / DCOM, and ODBC;
- have the interface API that allows the developers to develop their own interfaces for the most thorough and effective testing.

#### **The benefits of using automated testing process of educational software**

During the practical training at the university on programming the problem of automation of scanning tasks solutions is actual. The revision of programming codes of students and pupils is enough time-consuming procedure, which does not always allow finding logic errors in the program and does not always provide objective verification.

The system of testing of programming solutions of tasks:

- allows to automate the process and reduce the work of the professor on reviewing the source texts of solutions of the tasks;
- ensures the independence and objectivity of the checking process;
- offers professors and students a convenient means of viewing statistics of delivery of solutions;
- promotes the development of a student's skills programs testing.

Herewith the system of automated checks - this is not a universal program that can check a solution of any problem. This is a program that knows how to run the tested program on a complete set of test data (that is, a set of input data), to analyze the results and, perhaps somehow to conduct a protocol and to maintain a table of the results.

You need to prepare the tests specifically for this task to make the system check a certain problem.

Moreover, unlike the professor, the computer can check the solution at a very high quality - in one minute you can get rid of a hundred of different tests (including those with large enough volume of input data). If they are passed, the program will be recognized correct. If a test is not passed - then, obviously, the program has a bug.

The authors develop a system of automated test programs of students and pupils in accordance with the requirements on the subject.

Advantages of the system being developed:

- server is written with the use of modern and powerful technologies (NodeJS, Express);
  - easy and clear interface for all users;
  - possibility to improve one's skills in problem solving and programming;
  - broad functionality for professors:
1. to special user-friendly interface for evaluation and verification of students knowledge;
  2. to select tasks;
  3. to set the time of control;
  4. automatic score will be calculated;
  5. completely independent auto system and evaluative of the level of training of the pupil (student).

The developed system involves the use in the following areas:

- educational institutions of all levels of accreditation;
- during various control tests and/or examinations;
- distant learning;
- training courses (offline/online).

#### **Conclusion**

It must be noted that the purpose of automation is to improve the efficiency of the process (in this case the process of testing) which leads to the release of specialists (both developers and teachers) and therefore to reduce costs.

An important task in any testing organization is search the balance between manual and automated testing of any software product (both commercial and educational).

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