

# Інфокомунікаційні системи

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## ANALYSIS OF EFFECTS OF INSUFFICIENT QUALITY OF COMPUTER SOFTWARE

*The insufficient quality of Computer Software is one of those reasons that can provoke possible human victims, catastrophes, accidents, financial losses and etc. As a rule, software developers pay not enough attention to the quality of its security. Such situation occurred because of saving such resorts as: human, temporal, logistic and other resorts in a process of rating and securing of the Software quality.*

**Keywords:** *Computer Software (simply Software), software-based projects, software-based products, manufacturing of Computer Software, the quality of Software (Software quality), defects of Software, the quality rating of Software, Computer Programs, Information Systems.*

### Introduction

Nowadays the manufacturing of Software is the biggest economic sector in the world, where engaged 3 million experts (*designers, coders, testers and etc.*). Software has been already developing more than 50 years and for this period of time, the problems that Software can solve, the level of their complexity and the forms of presentation of the acquired results revolutionary changed. And even nowadays we cannot say that the designing of qualitative software-based products became a standard. Also, the designing strategies of reliable Software with appropriate expenses and limited time need to be perfected [1 – 3].

The problem of Software quality complicates the great amount of their reasons, that occur in a process of the modern Software using, that highly increase expenses, connected with its service [4]. Right along the increasing complexity and vulnerability of systems and software-based products from accidental and premeditated negative effects moved out a circle of problems that connected with the quality of Software-based products, that are in the major category and indicate fundamental possibility and effectiveness of using the software-based products in all sphere of industry [5].

**Analysis of Literature and Setting Aim of the Research.** The generalization of results of famous researches showed that the software industry had achieved such level of development, when the demands to securing of the Software quality became mandatory clause of contract, when it goes about the subject of Software designing, because the quality of Software is its main feature from the user's point of view, and the

hours, when we pay more attention to program code, not to his quality, gradually pass.

The quality problem of Software attracts many researchers, because this subject is caused by importance of the role, which plays software in lives of modern society, and also in this case losses are possible, because of low-quality software using. Computer programs operate nuclear reactors, they are used in medicine, in the aircraft, in the financial and credit organizations and many other areas of human activity. Quality of the created software is of its great importance. Because of mistakes in the software, there are technological disasters, and the companies bear direct and indirect losses, people perish. At the same time, we should mention the annual growth of volumes of the world market of Software development and operation.

Therefore the high quality of the developed and operated Software is indisputable competitive advantage. At the same time, in spite of the fact that expenses on software designing make up about 275 billion dollars, only 72% of program projects reach a stage of adoption and only 26% of program projects come to the end with success.

During the ensuring of software quality the first task is the problem of assessment of its quality. Quality of software is a degree according to which the software product corresponds to established demands, while its using under the specified conditions. To achieve this aim in process of research, there are some following problems that were solved:

- to analyze dynamics of defects of the software;
- to investigate negative consequences of defects of the software;

– to provide offers according to ensuring the Software quality.

In his own works V.V. Lipayev points out qualitative characteristics of software: practicality (clearness, simplicity of use, studying), accompanying (analyzability, convertibility, testing), mobility (adaptability, simplicity of installation, replacement).

Attached to the negative impacts of functional operability of Software, they can be completely or partially corrupted by the forthcoming of the destabilizing factors that bring considerable damage:

- technical failures of the external equipment and distortions of initial information from the objects of environment and from users of systems and also from the processed information;
- casual failures and physical destructions of elements and components of hardware of computer systems and means of telecommunication;
- defects and mistakes in program complexes of information processing and in data;
- gaps and shortcomings of detection means of dangerous refusals and expeditious restoration of efficient state of systems, programs and data.

### The analysis of defects and incidents which are the result of insufficient quality of the software

Software mistakes for credit organizations aren't connected with threats for the people life, but aim to serious direct and indirect losses, such as: loss of reputation, a share in the market, penalties for non-performance of the contractual obligations or standard demands that made by regulators, to the response of the bank license because of non-fulfillment of requirements by central bank. The bank branch makes great demands of the quality of software.

Although, the credit organization has no point to proclaim the data of errors of the software, there are similar messages that periodically appear in open sources.

According to the data of the world-wide American-Japanese company Trend Micro [6], which deals with issues of creation and adoption of systems for ensuring information security, every year the quantity of the latent and revealed defects at operation of the software doesn't decrease. Let's give the statistics provided by the Trend Micro company (Fig. – 3) [7].

The defects of the software can lead to errors or refusals of information systems. Let's give statistics of errors and refusals in information systems of critical and business -critical using, and also examples of the most known incidents that caused by information systems of insufficient quality.

Let's imagine incidents, that had happened as a result of Software defects in business -critical systems for 2 last years with the help of the following tabl. 1.

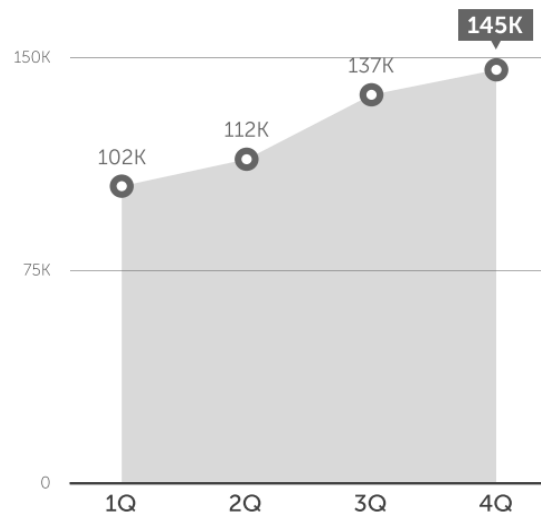


Fig. 1. Quantity of defects, that were found in Banking software for 2014 year

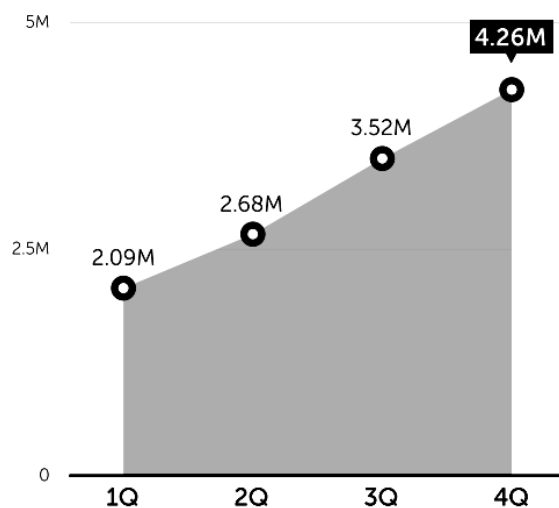


Fig. 2. Quantity of defects, that were found in Software directed by OS Android for 2014 year

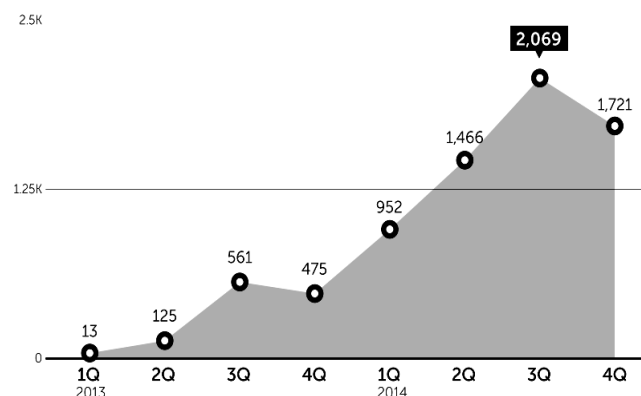


Fig. 3. Quantity of defects, that were found in Software, that supported by technology of portable banking for 2013 and 2014 years

According to the previous researches of the error of the formulation of requirements and designing, they make 25-55% of all mistakes, and the more volume of

Software, the more mistakes are at early stages. Scientists from such companies as Hewlett-Packard, IBM, Hughes, Aircraft, TRW found out that the correction of mistake before its realization is cheaper in 10-100 times, than its elimination at the end of the project work, during testing or after its releasing [7].

Table 1

The list of the incidents  
that had happened as a result of Software defects in business -critical systems

№	Name (year)	Short description	Loss
1	Swiss Bank Coop sent banking account information not to those owners (2014)	Swiss Bank Coop found the defect in their information system, when erroneously sent banking account information at the end of the year. As a result, thousands of banking clients received information not only about their banking account, but also the banking information accounts of other owners.	Reputation of bank and its rating highly decreased
2	The Russian Share Market closed because of software-based error (2014)	The work of The Russian Share Market was stopped during 2 hours because of software-based error. The market was closed early at 4:00 a.m. after trouble-shooting of Software that includes market bonds and shares.	The loss of expected income. Reputation of share market also suffered.
3	The Royal Bank of Scotland was fined when the users couldn't receive the access to their banking accounts (2014)	The Royal Bank of Scotland was forced to pay a fine in an amount of 56 million pounds after the software-based error that led to the access closure of accounting notes of users at taking cash.	56 million pounds.
4	The Singapore Share Market was closed because of software-based error (2014)	The work of The Singapore Share Market was temporarily stopped in December 2014	The loss of expected income. Reputation of share market also suffered.
5	The falling of Bitcoin's market	At the beginning of 2014 year because of well-known defect "transaction malleability" of Software in Bitcoin, that consists in the sensitiveness for security of bank transaction, that can be used by intruders, depositors lost \$ 474 million.	Losses- \$474 million.
6	The software-based error of the Trade Company	The software-based error of the Trade Company cost \$ 440 million for 40 minutes.	Losses - \$ 440 million.
7	The defect of Software infringed the work of Banking information system and Information system of the Health Service.	The defect of Software, connected with the leap year caused that 150 thousand of users couldn't use their electronic medical cards and couldn't pay for medical service	Reputation of the system suffered, The income was lower than expected.
8	The software-based error. The Australian Energy Company	The Australian Energy Company sent banking accounts to their clients, but as a result of the software-based defect, the data was calculated incorrectly that led to the loss in an amount of \$ 2.24 million	Loses- \$2.24 million

Let's analyze accidents of systems of critical application - the management information systems (MIS) - owing to defects of Software. The analysis of accidents of computer systems of complexes of critical application provided in [6], showed that today dynamics of reduction decreases in time of amount of defects because of technical means of management information

systems, and the increasing dynamics of refusals caused by software of MIS (Figure 4) is observed.

It should be mentioned, that from year to year the level of using Software in MIS of rocket-space engineering increases. And it leads to growth of risks of accidents caused by Software. Over the past few years the accidents for this reason began to arise more often.

Let's show the most serious reasons that led to the huge financial expenses and defeats of space programs. Let's

show the most known incidents that caused by defects of Software (tabl. 2).

Table 2

The list of the incidents that had happened as a result of Software defects in business - critical systems

№	Name (year)	Short description	Loss (casualties)	Source
1	Collision of two American satellites: DART and MUBLCOM (April, the 15 <sup>th</sup> , 2006)	The reason of the accident was the defect of Software navigational system one of them Losses summed 110 million dollars.	\$110million	[8]
2	The explosion of European missile carrier aircraft «Ariane-5» (June, the 4 <sup>th</sup> , 1996)	The analysis of this accident allows to make a number of general conclusions, that relate with the peculiarity of using PC in control systems of ARCT. «Ariane-5» was blown up in 40 seconds after the signal start by the aboard of computer managing. The signal was produced because of wrong interpretation the irregular situation: abundance of variable in its function that has no influence on the space flight.	More than \$0,5million	[9]
3	Odious mistake in the line accelerator Therac-25 (from the June, 1985 till the January, 1987)	The reason of the death of some sick people that got mortal doses of radiation during medical treatment, that was realized from the June, 1985 till the January, 1987 in some American and Canadian cancer clinics became the odious mistake that connected with the fast tempo of typing data. These doses, as was found lately, excelled in a 100 times those doses which were usually used during the treatment.	Death of sick people	[10]
4	Common mistake of the Fortrun program	Instead of necessary 'coma' the computer programmer wrote down 'a full stop'. As a result, the loss of connection with the space station "Fobos-grunt" happened because of mistaken command that was sent from the Earth to the PC	More than \$0,5million	[11]
5	The software-based errors in the GLONASS navigational system	Three satellites of navigational system GLONASS fell down into The Pacific Ocean near Hawaiian after their launching very soon. The reason of the accident was accepted a mistake in programming, that caused that the rocket was filled up with the wrong number of fuel	\$150million	[12]

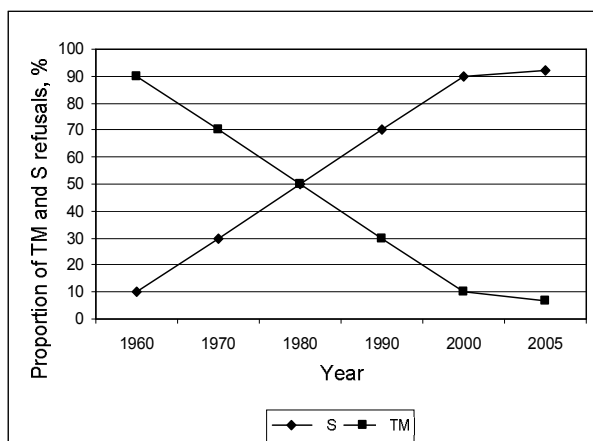


Fig. 4. Dynamics of change of a share of MIS refusals gained with the software (S) and the technical means (TM) [6]

The Research of 50 projects that needed more than 4000 years and included nearly 3000000 lines of a code, which are carried out to Laboratories of Software design

NASA, showed that special attention to early quality control, allows to reduce the level of mistakes, but doesn't raise the general expenses on its development [3].

### Conclusions

Risks of refusals owing to Software defects are growing in other critical and business-critical areas: nuclear power, banking systems etc.

It occurs at the expense of an intensification of using so-called software processors that based on new information technologies. The solution of these tasks has to be aimed at providing high functional suitability of PC, with the help of the balanced way of improvement of the constructive characteristics of quality.

The effective system of ensuring quality of software means aims the set of the organizational and technical actions directed on the prevention of various security threats, their identification, localization and elimination. Creation of such system provides planning and realization of purposeful policy of complex

ensuring quality of systems and software products at all operational stages of the software that taking into account:

- verifications, testing and estimation of correctness of the program components, reliability, safety and efficiency of their functioning;
- organizations of maintenance and monitoring of software;
- ensuring maintenance and management of the configuration of software;
- attestation of quality and certification of software products.

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## АНАЛІЗ НАСЛІДКІВ НЕДОСТАТНЬОЇ ЯКОСТІ КОМП'ЮТЕРНОГО ПРОГРАМНОГО ЗАБЕЗПЕЧЕННЯ

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Проблему якості програмного забезпечення ускладнює велика кількість причин неполадок, які виникають у процесі його застосування, що значно збільшує витрати, пов'язані з його обслуговуванням. Недостатня якість програмного забезпечення є однією з причин людських жертв, катастроф, аварій, величезних фінансових втрат, несанкціонованого доступу до таємної інформації. Сучасні інформаційні компанії, банківські та фінансово-кредитні установи при розробці та експлуатації програмного забезпечення недостатньо уваги приділяють його якості. Така ситуація склалася внаслідок економії ресурсів (людських, часових, матеріально-технічних, тощо) на процесах оцінки та забезпеченні якості програмного забезпечення.

**Ключові слова:** комп'ютерне програмне забезпечення (просто програмне забезпечення), засновані на програмному забезпеченні проекти, заснована на програмному забезпеченні продукція, проводячи комп'ютерного програмного Забезпечення, якості програмного забезпечення (якість програмного забезпечення), дефектів програмного забезпечення, якісного рейтингу програмного забезпечення, комп'ютерних програм, інформаційні системи.

## АНАЛІЗ ПОСЛЕДСТВИЙ НЕДОСТАТОЧНОГО КАЧЕСТВА КОМП'ЮТЕРНОГО ПРОГРАМНОГО ОБЕСПЕЧЕНИЯ

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Проблему качества программного обеспечения усложняет большое количество причин неполадок, которые возникают в процессе его применения, что значительно увеличивает расходы, связанные с его обслуживанием. Недостаточное качество программного обеспечения является одной из причин человеческих жертв, катастроф, аварий, огромных финансовых потерь, несанкционированного доступа к секретной информации. Современные информационные компании, банковские и финансово-кредитные учреждения при разработке и эксплуатации программного обеспечения недостаточно внимания уделяют его качеству. Такая ситуация сложилась в результате экономии ресурсов (человеческих, временных, материально-технических и т. д.) на процессах оценки и обеспечения качества программного обеспечения.

**Ключевые слова:** компьютерное программное обеспечение (просто программное обеспечение), основанные на программном обеспечении проекты, основанная на программном обеспечении продукция, производство компьютерного программного обеспечения, качество программного обеспечения (качество программного обеспечения), дефектов программного обеспечения, качественного рейтинга программного обеспечения, компьютерных программ, информационные системы.