Information about Software Tools: Structure, Sources, and Contents

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Abstract—The content of the term software tools (STs) is discussed in the light of the current development trends in information and communication technologies. The list of possible classification areas of STs is presented that is critical to binding scientific and technical information (STI) to these areas. The main categories of objective representation of STs, available sources of STI on STs, and peculiarities of obtaining (retrieving) STI from these sources are characterized. A 28-group classification of STI about STs by contents (subject matter) is suggested. The areas where it is possible to utilize the suggested classification systems for describing and grouping STI units in databases and databanks are specified.

Keywords: software tools, scientific and technical information, information structure, information sources, information contents, terms of use, information and communication technologies, intellectual property rights, information security

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INTRODUCTION

Scientific and technical information (STI) is a major factor that influences the formation of the modern information environment, both in Russia and worldwide [1]. The current trend is the expansion and deepening of informatization of Russia and its regions [2], production activities of different organizations, universities and colleges included [3–5], and life-sustaining activities of individuals and groups of such objects [5]. As a result, we see an increasing volume of and demand for scientific and technical information about various aspects of the development, distribution, and utilization of software tools (STs), including assurance of their secure utilization and improvements in procedures of STI monitoring and analysis [6, 7], including patent [8, 9] and bibliographical [10] information.

At the same time, we see improvements in the Russian *information framework* of providing the user with scientific and technical information [11–15]. However, software tools are not distinguished as a separate part of STI in publications on management of STI generation, distribution, and utilization (e.g., [2, 6, 11, 16–18]). Meanwhile, the issues relating to the management of STI about software tools have significant distinguishing characteristics that are little covered in the existing publications. In particular, there is the critical issue of rapid *moral aging* of information about STs, which is caused, e.g., by market release of new versions of software. The main reason for developing and producing new versions of STs is the need for retaining or reinforcing a position on the highly competitive market for software tools. New versions of STs released by their developers are generally more applicable, easier (more intuitive) to utilize and adapt to new versions of operation systems (OSs), and *promote* the data about STs in the *information environment*. In addition, such factors are considered as the types and concerns of potential users of information about software tools, the sources where the user finds this information, user principles of selecting information by its classification characteristics, etc. The main purpose of this article is, therefore, to try to analyze potential areas and particularities of the classification of scientific and technical information about software tools under specifically Russian circumstances. That said, we considered the current Russian regulations and practices of buying and utilizing STs. The topics that are considered for achieving the desired purpose include peculiarities of interpreting the term *software tool* in the light of regulations that are in force, information utilized to classify STs proper, the main categories of objective presentation of information about STs, classification areas of scientific and technical information according to content (subject matter).

ANALYSIS OF THE CONTENT OF THE TERM SOFTWARE TOOL

According to GOST 28806-90 [19], *a software tool* means *an object consisting of programs, procedures,*

rules, and, if any, related documents and data about the operation of the information processing system. A comment is added that *a software tool means specific information that objectively exists as a cluster of properties of each tangible object that contains this information in a fixed form* and that *these properties play the critical role in presenting this information*. The interpretation given in this comment is too general and not sufficiently meaningful for practical use.

According to GOST [19] (with reference to GOST [20]), *a program* means *data intended to control specific components of an information processing system for implementing a certain algorithm*. This definition seems insufficiently meaningful as well. This is because most modern software tools installed on the computer are sets of a large number of functionally connected (complementary) files of various types (usually located in numerous directories with a complex hierarchy); data about STs are entered in operation system registers; STs are not necessarily intended for *information processing in the ordinary sense*.

According to GOST R 53622-2009 [21] (sub-item 3.8), *software (program, software tool)* means *an ordered series of instructions (codes) for a computing instrument, that is located in the memory of this instrument and describes the algorithm of controlling computing instruments and data handling*.

This definition is minimally correct because it does not differentiate a *program* from a *software tool*. Moreover, when a software tool includes *overlay structures*, it can happen that not the entire program but only a part of it is stored in the RAM at each instant. It is not quite clear why the term *tools* is first used in the singular and then in the plural.

According to p. 1 of art. 1255 of the Civil Code of the Russian Federation (CC RF), *programs for computing machines (computer programs)* and *databases* (DBs) are referred to different classes (categories) of objects when treated as protected intellectual property. The Code does not cover any possibilities of interaction between *computer programs* and *databases* and makes no use of the term *software tool*.

According to art. 1261 of the CC RF, a *computer program is an objectively represented cluster of data and commands intended for maintaining operation of computers and other computing devices in order to achieve certain results, including preparatory materials obtained in the program development phase and audiovisual output produced by this product*. However, in modern programming technologies data is differentiated from computer programs so that they can be utilized with different initial data sets. Moreover, *preparatory materials* are not usually treated by users and distributors as part of software tools in their practical activities.

The proposition justified in [22] is that *information* is a generic (more general) term with respect to *computer programs*.

On p. 1 of art. 1259 of the CC RF *composite work* that represents the result of creative effort by *selection or arrangement* is treated as a separate copyright object. On p. 2 of art. 1260 of the CC RF, databases (DBs) are referred to *composite work* and given the following definition: *a database means an objectively presented collection of independent materials (articles, calculations, statutory instruments, court adjudications, and other similar materials) systemized so that they can be found and processed on a computing machine (computer)*. Thus, databases in the juridical sense are confined mainly to their *information filling*, not to the peculiarities of structural hosting of information and/or groups of fields in tables with data and links among these fields.

Most Russian developers of STs that are interested in legal confirmation of their copyrights look to the range of objects that can be registered as intellectual property in the Federal Institute for Industrial Property. These objects are computer programs and databases. In fact, however, a large number of ST developments are integrated developments and include databases, programs that are intended for handling these DBs, other kinds of objects such as graphic, and sound objects. This situation is typical, e.g., for inquiry and communications systems (ICSs) of juridical and healthcare information systems, as well as information systems on building codes and regulations. In this case programs proper are usually treated as DB program shells.

We will define software tools as *objects that are intended for utilization on computers (computing devices) and consist of one or more electronic files. In the course of operation these files interact with each other via data and control. In addition, files related to software tools can belong to various types (not only executable) and be located in different (sub-) directories*.

Software tools in operation can interact with other STs (including OSs), information display devices (e.g., displays), information entry devices (keyboard, mouse, touch screen, tumblers, and buttons), peripherals (e.g., printers), and various sensors and actuators (which is typical, e.g., of microprocessor-based control systems).

We will assume that instructions, help, and tips (IHT) are parts of a utilized software tool provided that: (1) IHT are represented in electronic form; (2) they are stored either on the computer where the ST is installed, on the same laser disk as an executable program, or on the developer's server; (3) IHT can be retrieved either from the help system of the software tool, as a means of contextual aid, or by opening separate files included in the ST delivery package.

INFORMATION UTILIZED TO CLASSIFY SOFTWARE TOOLS PROPER

The classification of software tools is important in solving such tasks as *binding* information to separate computers, their groups and/or networks; structure information about STs; allowing an easy search for necessary STs in arrays of information by such criteria as functional purpose and terms of use, and analyzing streams and arrays of information stored in databases and databanks.

It should be noted that there is no uniform international numbering system for software tools as exists for books (ISBN) or periodicals (ISSN). The introduction of this system would make it possible to unambiguously identify STs and, therefore, create convenient opportunities for binding *STI units* to STs.

In fact, references to specific software tools in information materials usually contain the software name in the original language or translated into Russian. Additional data may include the version number, the ST packaging variant (this defines the set of modules and functional capabilities), and the name of the development company. These data are usually enough for unambiguous identification of popular software tools. It is supposed that other characteristics of STs can be found, when required, on websites of their developers or other Internet resources.

Software tools can be classified by various areas/characteristics/features. The information that fits the rubrics of the classification presented below is captured in the names and/or contents of units of STI about software tools. This information affects the range of sources where such units and/or their copies are found, including translations into other languages, and makes selective retrieval of data from databases and databanks of STs possible. The issues of constructing and utilizing descriptors for (sub-) groups of information that we consider are quite complicated and diverse.

Now, we will describe the main <u>classes (groups)</u> of information that characterize and can be used to classify <u>software tools proper.</u>

(A) The ST name common to all versions and configurations.

(B) The ST version is usually one number or two separated with a period.

(C) The ST configuration means a set of included components.

(D) The Company that owns *proprietary copyrights* to STs.

(E) The individual(s) who have developed the ST; in part 4 of the Civil Code of Russia they are treated as owners of personal non-proprietary rights (particular designers of software tools are actually not always known).

(F) The date of software tools. It is usually specified on the starting pages after the copyright mark (©) and the name of the copyright owner and consists of two numbers, i.e., the release year of the initial version and the release year of the version installed by the user.

(G) The size of software tools related to an ST version or a specific ST configuration (for installation software and STs installed on the PC or server).

(H) The number of ST localizations in different languages, which determines the amount of information delivered in different languages, including translations from source languages.

(I) The availability of the Russian ST version and the completeness of its localization, which may determine the contents of the information about the ST, particularly, the need for providing the Russian translation of menu items.

(J) The availability and range of ST versions in the national languages of Russia's largest ethnic minorities (which is rare and done mainly for language learning purposes).

(K) The main purpose and, possibly, auxiliary (alternative) applications of the ST.

(L) Variants of the ST utilization terms, such as utilization on the user PC only, on the server (for file-server and client-server applications), or in remote mode (as in the SaaS model).

(M) The functional autonomy of STs, including such categories as software systems (applied or service program packages), STs for autonomous use (utilities and service programs included), modules with a defined *target/subject purpose* that are included in the ST and licensed by copyright owners (third-party developers) for utilization, add-ins (or plug-in packages) to available STs.

(N) The developer-declared compatibility of STs with types and versions of OSs.

(O) The developer requirements for other STs installed on the PC with regard to their mandatory availability or the impermissibility of their installation/utilization.

(P) The minimal and recommended hardware requirements set by the developer on processor types, necessary RAM capacity, characteristics of display cards, displays and audio systems, necessary free space on the hard disk for installation and operational phases, required characteristics of the server and Internet access lines, etc.

THE MAIN CATEGORIES OF OBJECTIVE REPRESENTATION (EXISTENCE) OF INFORMATION ABOUT SOFTWARE TOOLS

We will classify the information by both the categories (with names underlined) and subcategories (italicized). The sequence of exposition is linked with the content (subject matter) of the categories. The considered categories of objects can be very different in significance for various groups of users.

Materials included in software delivery packages. These materials supplied for complex multipurpose software tools can be quite extensive and contain volumes with different names, including *Quick Start*, *User Guide*, *System Description*, *Function Reference*, *Alphabetical Reference*, *Project Cases*, etc. This type of information recorded on the laser disk included in the delivery package allows the use of color illustrations as screenshots and, sometimes, video clips (colored illustrations used in extensive printed training, information, and reference materials make software tool delivery much more expensive). When an ST is purchased on a so-called *group-license* basis, this set of documents is the only one for all of its purchased copies. The documents on the ST can also be stored in electronic form wholly or partially on the server of the developer (copyright owner) and the user can access this information using his individual login and password.

Paper books and leaflets that are written about software tools but not included in delivery packages. These works are printed by commercial publishers, editorial and publishing houses, colleges, and universities. There is a fierce competition among commercial publishers in the Russian market regarding training literature on STs. The competition extends to both the publication of new books (translated works included) and *promotion* of previously published works. Consequently, books about similar subjects for identical categories of users are sold. In addition, books that sometimes enjoy a higher demand (larger sale) than others because of more active advertising and lower prices may not have the best quality. The publisher's name and reputation can work as a brand that creates favorable conditions for successful sales of books on software subjects.

Except for the latest publications, the RU-part of the Internet is flooded with counterfeit copies of older books about commonly utilized software tools. This situation violates the proprietary rights of copyright owners [23] and curtails the demand for similar electronic and printed publications.

Scientific publications (mainly monographs) specifically about software tool development technologies are printed in limited editions, by colleges and universities included. The publication of these books is partially encouraged by the policy of Dissertation Advisory Committees. They often require that people who defend doctoral dissertations publish at least one monograph. At the same time, the practical application (utilization) of existing software tools is covered in a much broader range of scientific publications.

Some publications about software tools carry laser disks (flexi-disks in the past) as attachments. The disks contain fragments and demo versions of programs, subroutine libraries, colored illustrations, information for reference, etc. Thus, the necessary information is presented in a comprehensive manner and it is easier to directly utilize fragments of software tool codes and their libraries.

Another solution used by Russian book publishers is to upload auxiliary content on their servers and not record it on laser disks. As a result, it becomes possible to cut down the prime cost of publications and provide updates of auxiliary content for previously published books.

Most commercial publishers focus on selling their materials for 2 to 3 years, consider the risk of incomplete sales (not only due to quality of publications for sale but also because of market releases of new ST versions and rival books), and promote their books via corporate websites and websites of companies that integrate information on published books and provide *book-by-mail* services. To cut down transfer costs and inform the buyer about the arrival of ordered mail, orders are delivered not only via Russian Post offices but via numerous mobile phone outlets as well. Delivery by courier (e.g., in Moscow) and, less often, express mail are used as well.

With a high demand for particular books about software tools, publishers take such actions as additional printing and publication of the original, reworked, and expanded editions. The latter variant makes it possible to adapt book contents to newly released software tools and provides the demand for the current books when electronic copies of the older publications are illegally distributed via different websites, including those outside the .ru, .su, and .рф domains and, therefore, are beyond the jurisdiction of Russia. It can therefore be quite difficult to remove any materials that violate proprietary copyrights from such websites [23].

There are no Russian publishers that specialize in textbooks and work in the print-on-demand system. Lambert is the best-known publishing company of the kind, and it specializes mainly in training literature. Its representatives monitor the flow of scientific publications and regularly approach authors of journal articles of interest with a proposal to publish their books.

The moral aging of publications about software tools is critical to both individuals and legal entities. This process leads to a rapid decline over time in the demand for unsold stock of printed publications. In addition, the availability for sale and utilization of morally obsolete textbooks, guidelines on older ST versions can prevent the user from switching to new software versions, lead to incomplete utilization of the capabilities of new versions installed on the user PC, cut down the demand for and competitiveness of software-training courses provided by colleges, universities, other organizations, etc. It should be noted that the disposal of previously purchased books on paper and their withdrawal from company libraries can also be impeded by depreciation dates stipulated by accounting regulations. Moreover, most individuals

do not hurry to get dispose books gathering dust in their private libraries.

Usually, e-books about software tools are distributed over the Internet not by publishers themselves but by specialized firms. This form of distribution has such strong points as low overhead costs and, therefore, lower prices compared to paper counterparts, a shorter time needed to prepare publications for distribution (due to the absence of the printing phase), identical numbers of sent copies and paid orders (there is no problem with determining the optimal print run size), and the ability to enriching e-books with colored graphic work and even video clips. The weak point is that it is difficult to check for the absence of secondary distribution of e-books by recipients of prepaid orders and prevent this kind of distribution by technical (not legal) means.

To avoid filling their bookshelves with rapidly aging printed publications (including and specifically books about STs and IT), some Russian colleges, universities, and other organizations have now started to make contracts with publishers for granting to their employees and students remote Internet access to respective textbooks by individual user registration.

Non-periodical editions about software tools on laser disks and on paper. This group includes price lists, promotion leaflets and posters, including those specifically for IT shows; catalogs of software manufacturers (developers) and distributors, conference abstracts and other materials of conferences/seminars on STs, etc. Usually, these publications are less available than books and periodicals. In addition, information from non-periodical materials (especially prices) is prone to rapid aging.

Multimedia training courses in software tools are distributed mainly on laser disks and, moreover, without ISBN numbers (publications of this type experienced their peak popularity several years ago). These STs make it clear to the user (including by means of audio tracks) what actions to take in practical work; they *receive* and process results of user actions and utilize these results to define their own subsequent measures, including for the purpose of maintaining adaptive training mode.

Below we will emphasize several subcategories of printed and electronic periodicals about software tools.

Russian scientific and research and production journals that are either entirely dedicated to software tools or have a specialized section on the subject. In addition, ST utilization problems are covered to varying extents in articles from different areas (especially, technical and physic-mathematical) published in non-core journals.

The numerous foreign journals on ST subjects are generally characterized by a narrower profile than their Russian counterparts. In fact, the accessibility of information from foreign scientific and research and development (R & D) and production journals on STs

is restricted by such factors as linguistic barriers, the low number of Russian libraries that receive printed copies of these journals, the limited number of colleges, universities, and other Russian organizations from whose PCs it is possible to gain access to full-text electronic versions of articles from journals indexed in SCOPUS and other similar international databases with citations for academic journal articles [24].

Even if *Russian production and commercial periodicals* on ST subjects are published entirely in the Russian language, their content can only partially be Russian by origin.

As an example, hard copies of PC Week Russian Edition are published with colored illustrations. However, articles from the journal (including articles specifically about STs) are available on the publisher's website. The characteristic feature of its distribution is that registered organizations (but not individual IT specialists or lecturers) can receive hard copies of this journal free of charge.

Russian popular science journals on ST subjects are published in volume form and usually have laser disk attachments. These journals are intended mainly for beginning users of STs and numerous computer gamers.

In *mass media* ST subjects are covered mainly in pieces of news or, more rarely (only in certain publications) in concise reviews of particular IT fields.

In Russia the best known abstract periodical is the abstract journal (AJ) published by All-Russian Institute for Scientific and Technical Information of the Russian Academy of Sciences (VINITI RAS). It has a large number of topical series, including those specifically about IT and STs. However, materials from this journal are poorly accessible to the user: many organizations and even some major libraries have given up paid subscription to abstract journals to save money and space on their bookshelves.

Another type of periodical is bibliographical indexes, including indexes of ST subjects.

Certain information materials about software tools are found on various websites, including those that do not specialize in IT or STs. The actual availability of this information to the user is determined by his ability to work in web-search systems (WSSs), including the skills of choosing key search words and setting limits in selection filters, knowledge of URLs of key websites that may contain necessary information or groups of links to required websites.

Internet selections of materials about software tools are usually found in a structured form on specialized IT websites. Sometimes, onsite information search systems are utilized as well, including redirection of query results to a particular WSS and restriction of the search area to a given website.

Databases on software tools, which are available on the Internet and on laser disks, are divided in two

types. *Poly-type* DBs, i.e., those with objects of various types, include the core DB of VINITI and the DB of www.library.ru. They both have convenient program shells that provide enhanced opportunities for information searches. A possible alternative for scientific publications is the *cyberleninka* website http://cyberleninka.ru/, where articles are classified by subjects according to a rubrication that corresponds to the State Rubricator of Scientific and Technical Information (SRSTI).

Single-type DBs, i.e., those with objects of one definite type only, are divided in several subcategories.

DBs with installation software tools, including related comments. These DBs can be both recorded on laser disks and uploaded on the Internet and contain legal and illegal (counterfeit) copies of installation software tools. The latter copies are distributed together with hacking methods in the form of passwords, logins, cracks, illegal license enablers, etc. As a result of the fight against illegal software distribution, many counterfeit copies have already been removed from websites with .ru, .su, and .рф domain extensions at the insistence of copyright owners or copyright-protection organizations [23]. However, laser disks with counterfeit software tools are still found on sale, at least, at some Russian markets.

DBs for antivirus software tools with scripts (virus body fragments) and information for heuristic analysis units (for discovering viruses by behavioral features); *DBs for antispam filters and firewalls.* It is essential that firms and laboratories that develop antivirus STs and provide associated support form and utilize different databases with different principles of classification and names of discovered viruses. These DBs are difficult to adopt because many viruses are polymorphous in nature and (according to certain messages) can crossbreed with each other. Specialists from the above-named firms can expand these DBs by analyzing such data as messages sent by other firms for information exchange, files and other data sent by users who apply to these firms, automated transfers of spurious files by antivirus/antispam software from a user PC in online mode (given that this option was activated upon the installation of the ST).

The downloading of updates from these databases to the user PC or servers (including email service portals) usually takes place in automated mode. Thus, the user PC becomes an object of the common information environment, where bilateral protection against various information security threats is provided.

Other DBs with updates for software tools, e.g., operation systems and applied software. These updates can be installed on the user PC both in automated mode and by the user's consent.

DBs with information about periodicals on software tools, foreign periodicals included. In particular, one such database is an integral part of the information search system at www.elibrary.ru.

DBs with information about books on software tools. In addition to www.elibrary.ru, DBs with such data are found on the websites of organizations that sell electronic and printed books, on book-search websites, including searches for reading and downloading e-book copies (it should be noted that usually WSSs and search systems of such sites provide references to unlicensed copies as well), on educational and training websites, on the websites of major book publishers, etc. It should be noted that the utilization of unlicensed copies for self-education and training is treated quite tolerantly by many Russian Internet users, although they do not justify this practice.

Specialized DBs with reports on research and development works (including confidential and dual-purpose R & D works) that concern the design and utilization of software tools and development of add-ons for STs and also with applied program libraries. These DBs are maintained by several institutional and territorial STI bodies, large scientific organizations, donor foundations that distribute budget funds, on www.elibrary.ru, and on the websites of VINITI RAS, etc. The latter two websites are where most information users search for and find information about the availability (existence) of such reports. On the whole, most specialists and, even more so, students and postgraduates have little knowledge of this area of information: this is confirmed by the fact that references to reports on R & D are rarely encountered in scientific articles.

DBs with patent materials, including those with software tool algorithms. In particular, a DB with Russian patents is found on the website of the Federal Institute for Industrial Property. Other databases of this kind (foreign DBs included) are poorly accessible to Russian IT specialists for subjective and objective reasons.

The DB of computer programs and databases is publicly available on the website of the FIIP. It has a convenient storage and retrieval system, including searching by names and the summaries of materials. Computer programs and databases are not represented as categories in the advanced data search card at www.elibrary.ru. It should also be noted that a popular practice in the past was institutional registration of computer programs, e.g., in the fund of the Ministry of Education (now Ministry of Education and Science) of the Russian Federation. However, this registration was not public.

Thus, Russian users currently have no convenient tools for searching across numerous foreign designed STs.

DBs with dissertations defended in Russia (including on software-related subjects) are available on the website of the Russian National Public Library for Science and Technology (RNPLST) and on www.elibrary.ru. Libraries at large universities and some other organizations provide access to full-text dissertations in the databases of the RNPLST. Full-text versions of disser-

tations defended in Russia are also available on other websites, including websites of universities. In addition, some websites regularly offer commercial electronic delivery of Russian dissertations and author's abstracts, e.g., www.dissercat.com, where authors are also able to add their works to the free dissertations section. If we judge by the offers of works in foreign languages on the Internet we will see that there is a certain demand for theses in Belarusian and Ukranian, but not in English.

Deposition of works at VINITI and institutional depository organizations used to be quite a popular means of collecting and providing access to information. Presently, however, deposited theses are negatively treated by the High Attestation Commission (HAC) because of their scarce availability and poor quality control; this procedure is therefore rarely used by authors and only for large-volume works. However, deposited works are shown as a separate category in the DB on www.elibrary.ru, i.e., it is possible to search by deposited works alone. On certain conditions, Russian authors can also deposit their works about software tools at foreign depositories, e.g., www.arxiv.org.

On radio and television ST subjects are usually covered in news stories and the plots of TV series and movies, especially in science-fiction films. In the latter case, however, the information about software tools (especially related to the future) is often presented in a biased or distorted manner. This may significant affect the popular perception of software tools and the risks of their utilization, i.e., not by IT specialists.

CLASSES OF INFORMATION ACCORDING TO THE CONTENT OF MATERIAL RELATED TO SOFTWARE TOOLS

The systems of subject classification used for information storage and utilization in Russia [25] include: UDC (for articles, books, etc.) [26], LBC (for books alone), SRSTI (originally developed for STI alone) [25], IPC (for patents, utility models, etc.), specialties approved by the HAC to bring dissertation preparation and defense fields under regulation and for other purposes, postgraduate specialties approved by the HAC, etc.

In the past the main UDC used by authors of articles about the development and utilization of computer programs was 681.3.06; at present the main codes are 004.42 (Computer programming. Computer programs) and 004.45 (System software). The UDC does not contemplate any specification of software tools by subject purpose. However, application fields of software tools can be specified using a colon, a plus mark (+), or '.

Now, we will analyze the content-based classification of information about software tools. This classification includes 28 classes and has nothing to do with the classification considered in the previous section.

1. Information about the *behavior of the market for software tools* by all segments together, individual segments, individual STs, developer firms, particular countries, Russia included. It should be noted that the cost of paid IT market reviews that are sold on the Internet ranges from tens to hundreds of thousands of roubles; that is to say, they are virtually unaffordable to individuals.

2. Information about operations of particular software firms, which includes their losses, revenues, mergers, acquisitions, change of management, etc. In particular, this is published in the weekly newspaper *PC Week Russian Edition* and covered in news feeds on several websites.

3. Official information from developers of software tools, which includes the range of software tools and terms of their use, as well as publicity releases.

4. Information about the purpose and functional capabilities of software tools can be taken from various sources, such as the websites of ST developers, websites, catalogs, and promotional materials of ST distributors, textbooks and other training materials, specialized and popular science journals about ST subjects, and scientific publications on development and utilization of STs, etc.

5. Information about financial and regulatory terms of purchasing, obtaining, and utilizing software tools. Possible variants of purchasing STs.

(5.1) Equal level of payment for users of all categories.

(5.2) Different levels of payment for users of different categories, for corporate purchases of *group licenses* included.

(5.3) Different levels of payment for different terms of purchase: initial purchases, upgrades to new versions; and runtime license extensions. It should be noted that, originally, purchase of certain STs includes such terms as expenses for supplier-provided consulting and maintenance services upon the expiration of the supply contract period, regular payment for upgrades to new versions, etc.

(5.4) Paid corporate use but free home use.

(5.5) Shareware STs: if the user likes the program he will be asked to voluntarily pay some amount to continue using the program.

(5.6) STs supplied for free use only to certain types of organizations.

(5.7) Freeware, including creative commons software.

The types of information specified in p. 5 can be found on the websites of copyright owners and their partners involved in distribution of STs. It should be particularly noted that Russia has virtually no secondary market for STs, i.e., they cannot be resold to other users.

6. Information about the utilization period of software tools.

(6.1) Free trial versions of STs with a limited period of utilization and/or number of program runs.

(6.2) SaaS software with a limited period of utilization (e.g., Office-365, some antivirus STs, etc.).

(6.3) STs without an unlimited period of utilization that are installed on the user PC or server.

In fact, the market release of new versions of software tools often makes it necessary for the user to switch to these versions, which is needed, e.g., for compatibility with other users according to operational results/conditions.

7. Distribution kits proper, including demo, trial, and runtime versions. There are many countries where information about locations of counterfeit copies of distribution kits with related hacking tools is in heavy demand because of the established popular opinion and the high cost of many STs. In addition, this information can often be found by queries in WSSs.

8. Information about ST installation procedures, technical requirements for PCs, where it is planned to install the ST, and the need for joint utilization with other software tools. In addition to electronic and printed instructions from software developers, we will list the following information sources: hotline voice and video consultations for registered users; offline user consultation by e-mail; the ability to utilize tools for remote control and adjustment of software tools on the PC, i.e., so-called remote assistance; information from popular science journals on information and telecommunication technologies, computer games, etc., forums where users and specialists share experiences on software installation/utilization and troubleshooting and answer questions. The information from the latter source is unofficial and sometimes very useful.

Many users install software tools without reading the attached installation guides but make use of installation wizard tips, including screenshots and lists of possible actions. Modern installation wizards are quite intelligent and can be considered as service STs: they check the operation system and the installed software tool for compatibility, the sufficiency of the free space on the hard disk, the availability on the PC of other software tools that are needed for utilizing or cause collisions with the installed program and also estimate the need to temporarily disable antivirus STs for the installation period, etc. In addition, installation wizards can allow the user to choose a set of components to install on the PC and also automatically register the installed copy on the developer's or distributor's server, etc. Many installation wizards show user-critical information in their application windows in the process, which includes difference between the installed and the previous versions, useful tips, cases of use, etc.

9. Information about utilizing software tools in various domains of science, technology, production activity, and education [4]; adoption of STs and ST systems in corporate operations; and the utilization of STs in automatic and automated control systems.

10. Evaluation data about particular software tools and their categories/groups is important to users of different categories, including individuals and organizations that choose STs for purchase. Evaluations of software versions can vary over time because of releases of similar STs with improved functionality that are more convenient to utilize or less demanding on computer capacities; release of new versions of the same ST; flaws discovered in particular STs, etc. ST evaluations can be shown in different sources and at different times, and respective information must thus be included in descriptors of STI units. The evaluations of information about STs are characterized by different levels of importance to different users.

(10.1) The popularity of STs in Russia cannot be evaluated by the number of installed or sold licensed copies because some STs are utilized on the SaaS basis and many copies in use are unlicensed, especially on home PCs and laptops. Popularity can be determined by expert evaluation, by questionnaire surveys of specialists, online surveys included, by analyzing application of STs by companies, the outcome of ST sales in Russia (in the light of utilization of unlicensed copies), etc. ST popularity evaluations can be absolute, relative (e.g., per 1000 PCs, per 1000 people, etc.), and comparative (for STs with a similar purpose). It should be noted that the worldwide levels of popularity are often different from the figures for Russia.

(10.2) The ratio of actual aggregate periods of utilizing various STs in Russia, which is measured in clock hours (utilization popularity of STs). The leaders in this indicator are operation systems and office suites. However, there is no direct relationship between the levels of information about and the popularity of software tools. The main reason is that most users learn practical skills when utilizing their STs by the cut-and-try method, by means of embedded help tools, etc.

(10.3) Integral quality and functionality evaluations of STs, including comparative evaluations, are published by independent test labs and centers, particular specialists, etc. These evaluations are very different for different STs. In particular, this is true for evaluations of Russian STs. One of the reasons for this is the differences in testing procedures. Results of internet user voting on software quality are often unrepresentative because sometimes multiple voting by anonymous voters is possible and voting on STs not utilized by voters is biased. This information also reflects an important indicator of ST competitiveness: the ability for utilization together with other developments, including by means such as data transfer, object linking, etc.

(10.4) Complexity of ST utilization. The more complicated it is to utilize a ST, the less popular this software is and the more voluminous the documentation is.

(10.5) The amount of user-accessible information can be evaluated mainly by expert opinion. These evaluations can be derived for Russia in general, for different categories of users, and for particular organizations. As an example, the availability of information about STs for the students and lecturers of a particular college or university can be determined by such factors as the availability/quantity of trademark documentation, related textbooks, manuals, and other training literature in the college library, and the accessibility to e-books about an ST.

11. Almost all the training literature on software tools that is used in Russia is written in Russian and includes textbooks that are appropriate for ST users of different levels and specialties, problem and practice books. This literature is used by users of such main categories as pupils, college and university students, beginning computer users, advanced users (they need training literature for self-education and/or skills improvements), ST developers and implementors, employees at system integrator companies, etc.

Training manuals on STs (including ST utilization technologies and related topics) are either written by Russian authors or translated into Russian from original editions in foreign languages. One major means of promoting textbooks on the Russian market is signature stamps assigned by Educational and Methodological Associations (EMAs). Actually, EMA stamps are assigned only to a small number of publications.

Textbooks can be written about software tools in general or particular aspects (areas) of their utilization. In the latter case this literature often covers those features and capacities that are not explicitly covered by official guides from developer companies. In particular, we will note publications with such headings as *Hacks and Special Effects* in ***, *** *through Hacker's Eyes*, etc. (where *** means the name of the software tool).

12. Certain reference guides on software tools are intended for obtaining only specific references, not for systematic studies of material.

However, most STs have embedded contextual help options, reference and information modules with their proper systems of searching by keywords and subject rubricators; there are also many STs with modules like *map of new version features*. In addition, WSSs make it possible to efficiently search for consulting materials like *How to Perform Particular Operations*, including sample program codes. As a result, STs take less time to master and the attached documentation, especially reference guides, becomes less necessary.

13. National standards of higher education, some of which regard the training of specialists in develop-ment and utilization of software tools and the assurance of information security on their application.

14. Guidance materials on software tools, including training programs developed in colleges, universities, training centers, etc. At least some of these materials are available on the Internet, on the websites of some colleges, universities, training centers, etc.

15. Tools for assessing user expertise and skills in development and utilization of software tools. These test tools are usually delivered as software shells with DBs that contain test materials proper. Test STs can often be utilized only on PCs where software testers of expertise and skills are installed. Sometimes, tests with variable task content are utilized, e.g., by substituting in the test contents separate numerical values using a random number generator. Interactive test software tools can be the intellectual property of their developers and certain training centers utilized for user certification at authorized centers, form part of multimedia textbooks, be uploaded on websites for self-examination of user expertise and skills, etc.

Certain test tools require payment to obtain personal electronic or paper certificates. In addition, some developer companies (e.g., Microsoft) sell their customers trademark certification of mastery of their STs, either as a whole or of certain ST capabilities (modules). In foreign practice, specialists who have these trademark certificates can receive a considerable salary increase. It is essential that repeated certification is required every time when a new ST version is released. Although personal Microsoft certificates can be obtained in Russia (but only upon passing a test in a limited number of authorized centers), this practice enjoys little popularity. There are also other firms that issue software mastery certificates to IT specialists; sometimes, however, the certification procedure requires expensive training. Sometimes, the availability of this certificate with an employee is a necessary condition for operation of authorized centers, securing orders for certain IT developments, etc.

16. Olympic problems in programming and some allied disciplines. Russia regularly holds onsite and remote Olympiads with tasks on programming and algorithm development. Task statements without solutions are usually uploaded on various websites; moreover, there are online solution checks in the form of user-developed program codes via *solution extensions*.

17. Scientific information about ST subjects (articles, analytical surveys, monographs, conference abstracts, etc.) is available either free or on a paid basis. The bulk of worldwide information about software tools is delivered in English. To make it more available to the Russian reader, some books (not articles) are translated into and published in Russian. The awareness about Russian-language scientific publications on STs is raised by including article headings translated into English in these works (including titles, abstracts, keywords) and by translating certain mono-

graphs and entire scientific journals into foreign languages (which is done, in particular, by MAIK Nauka/Interperiodica). Supplementary material uploaded on websites of foreign journals in addition to articles proper often includes software tools that make it possible to conduct *what-if* analyses and service-simulating tests of considered processes and systems. In Russian-language journals such materials are still very rare.

A large number of scientific publications make it an important task to find articles related to certain software tools. In particular, this problem can be solved by full-text search by necessary STs due to the variability of software names in Russian and in English.

However, publications about STs related to a definite area of developments are much more difficult to find. The analysis by keywords may be inefficient for the purpose, while the automatic analysis of texts by contents is algorithmically complicated.

The RU-part of the Internet is currently full of ads offering preparation, followup revision, writing, and publishing of articles for journals from the lists of HAC and SCOPUS. However, customized copywriting on a paid basis does not produce new scientific knowledge but only enlarges the total number of articles. As a result, it becomes increasingly difficult for the user to gain access to original information, including that about STs.

18. Research, development, and production information about software tools, including that about their development and application, complexation for achieving synergetic effects during utilization, adoption of STs in corporate operations, etc. It should be noted that all the documents included in packages of STs developed abroad are not often in Russian.

19. Popular scientific information about software tools is intended mainly for beginning users and individuals who are employed in other fields and wish to have only a general idea of the abilities of software.

20. Information in abstracts. In Russia the term *abstract* is popularly associated not with the Abstract Journal published by VINITI RAS but with research papers written by students. These papers enjoy demand among college and university students, are uploaded on numerous websites, even without any information about the authors, are quickly discovered by web search systems, and are distributed both on a paid basis and free of charge. In addition, the Internet is full of offers to customize the writing of research and course papers, and even diplomas on determined subjects. The quality of student research papers on software tools is often not controlled at all. Thus, these works often contain inaccurate (corrupted), incomplete or biased data that clutters the information environment.

21. Patent information about software tools. In Russia licencing of original solutions in the field of ST developments is not customary. However, this licenc-

ing is in common use among software firms abroad to maintain a competitive market position. Software firms are sometimes acquired mainly for the sake of their patents.

Patents that protect proprietary developments are specifically indicated by certain software development firms in the main menu items, such as *program information*. In fact, it is quite difficult for most Russian IT specialists to obtain a summary of patents in a certain ST field; one of the reasons is that most of these patents are registered abroad. The relevance and possibilities of automated automated analysis of patent information by content have been covered in several publications (e.g., [8, 9]). However, the current developments in this area are not intended for searching across ST subjects. It should also be noted that market promotion of STs is complicated by protection of unpatentable trade secrets and know-how [27].

22. Information about registered computer programs and databases. In Russia these items of intellectual property undergo state registration at the Federal Institute for Industrial Property (FIIP) at the request of copyright owners (art. 1 262 of CC RF). This registration is essentially national rather than international. At the same time, computer programs are mentioned quite frequently in scientific articles and other materials. Sometimes, publications about these developments registered in the FIIP are included in reference lists in articles, books, etc.

23. Information about dissertations and their abstracts. In most specialties of the High Attestation Commission the development of software tools is treated as an engineering problem meant only to illustrate new scientific techniques and approaches suggested by postgraduate students. Only few HAC specialties are directly linked with software developments: 05.13.11 *Mathware and Software of Computing Machines and Computer Network Systems*; 05.13.18 *Mathematical Modeling, Numerical Procedures, and Software Systems*, etc. However, when it comes to defence of dissertations on many specialties (especially engineering and physics—mathematical ones), many Dissertation Advisory Committees actually make it a mandatory condition for postgraduate students to have software and/or DBs registered in the FIIT on their PCs.

24. Information about scientific and R & D and production events such as conferences, innovation shows, and computer exhibitions. Not all of these events are relating to the development and utilization of software tools alone. However, ST subjects are put on the agenda of numerous events, in the form of specialized sections.

25. News information about software tools. In terms of contents this partially overlaps the other rubrics. This information includes news about the development and release of new STs, modifications of existing STs, news about the activities of software

firms, news about market releases of new firmware, news about recent achievements in artificial intelligence and robotic devices based on STs. News feed data-capturing procedures are continuing to evolve [28].

26. Information about information security of software tools such as operation systems and information systems. In particular, this information includes data about cyber weapons, their uses, and predictions of their utilization; data about successful hacking attacks by individuals and groups of such people; data about damage from these attacks; data about attempted hacking attacks; data about information leaks, including leaks from e-mail and information systems; data about exposures/flaws discovered in STs (OSs included) and steps taken to minimize the risk of release of the respective threats; data about new types of viruses, characteristics of their propagation, and results of their actions.

27. Personal information about developers of software tools, IT consultants, etc. can be taken from various sources, such as Wikipedia, help sections in programs, scientific, R & D and production, popular science journals on STs, from specialized websites with personal info about scientists, and from the websites of certain colleges, universities, and research bodies and companies. This information can be useful in finding and surveying specialist profiles when it is necessary to ask these specialists questions, evaluate the feasibility of studying their works and significance of their opinions on STs, cultivate relationships with these people for research purposes, note the contributions of particular individuals in the software industry, etc.

28. Groups (topical collections) of hyperlinks to information materials about STs, including hyperlinks with valuable comments, can be the main or auxiliary functional part of a website.

CONCLUSIONS

1. We substantiated the feasibility of using the original definition of software tools that is free of certain weak points typical of other existing definitions.

2. We analyzed the totality of classification areas of software tools that are important for binding STI units to these tools.

3. We have considered the main categories of objective presentation of information about software tools and corresponding information sources.

4. We suggested a 28-group classification for information about software tools.

5. These classifications make it possible to provide efficient formation and maintenance of multifunctional databanks of information about software tools. These databanks can be utilized for selective location of information upon request and in content-based analyses of information about STs.

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