STANDARDIZATION OF SYSTEM AND SOFTWARE ENGINEERING IN UKRAINE

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The key results in the standardization of system and software engineering in Ukraine are outlined and rationales of the national standardization approaches in this field are presented. All the current national standards in software engineering are reviewed.

Keywords: *software, software systems engineering, standardization, international standard, national standard.*

INTRODUCTION

Nearly a hundred thousand companies in the world are working in the field of engineering systems and software [1, 2]. About 50 organizations in the world [2] are engaged in the standardization of users' and developers' activities of systems and software engineering.

The "Software Engineering" subcommittee (PK-7) of the Technical Committee "Information Technology" (TK-20) is set up in Ukraine for the standardization of system and software engineering. The base institution for the PK-7 is the Institute of Software Systems (ISS) of the National Academy of Sciences of Ukraine. The Subcommittee Chairman is the Academician of NAS F. I. Andon, Director of the Institute. For the development of software engineering standardization, PK-7 involves well-known experts and leading software development centers.

The activity of PK-7 is based on the works of E. L. Yushchenko, the founder of IT standardization in Ukraine, and on the theoretical developments of the Institute of Software Systems. The standardization of software system engineering is based on the model approach. The following four groups of IT-standardization models are developed in the ISS: conceptual, organizational-oriented, instrumentally-oriented, and models of general orientation. The methods of using each group of models and methods for their integrated use are created.

PK-7 focuses on the results of the international IT standardization and takes into account the national specifics, including the development of software engineering.

PK-7 laid the foundation for Ukrainian-language terminological standard for software engineering, including databases, quality of software and programming processes, and software assessment. The foundations of modern system of software documentation standards are laid and the system is being developed, a group of standards on the use of IT in information activities is implemented.

60 regulatory documents have been developed [3–47]. Along with [10, 32, 33], the national standards have been harmonized with ISO international standards. In case where a national standard is a direct translation of the international one, the designation of the latter appears in the national standard or is placed after the name of the standard.

UKRAINIAN NATIONAL TERMINOLOGICAL STANDARD IN SOFTWARE ENGINEERING AND DATABASE

Since the early 1990s, creating a terminological standard becomes a top priority of IT standardization. It was believed to be impossible to develop a national IT standardization without such a terminological system. E. L. Yushchenko was the editor of all term systems and a co-author of the standards [8–16].

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The base variant of the terminological system was developed in 1993–1995. It consisted of the national terminology standards [3–17] on programming, programming languages, databases, data organization and presentation, data preparation and processing, distributed data processing, quality maintenance, systems development, word processing, remote data and computer network processing, computer graphics, and data handling management. The basic version contains over a thousand terms. The terminological system systematically replenishes with terms as new national standards are developed. A standard term system includes now more than 1500 terms.

The terminological system is maintained to date. In 2005, the standards [4, 5, 8, 15, 16] were replaced by [17–21], which were developed by the Subcommittee PK-22 "Programming languages, their source environments, and system interface" (under the chairmanship of O. L. Perevozchikova, the Corresponding Member of the NAS of Ukraine).

BASIC STANDARDS FOR DATABASES

The standards [23–25], which define the concept and terminology for database schemes, the reference model for data management, and the structure of the system of vocabularies of information resources pertain to the fundamental standards for designing and functioning of databases. The standards [24, 25] are also interstate.

The standard [23] determines the data level, tools and interfaces of information systems and vocabularies of information resources used to control and document the information resources of object domains (OD). The vocabulary-directory of information resources as the DBMS (database management systems) infrastructure contains the information for one or more applications.

The basic concepts and terminology of the conceptual schemes and data bases that cover the development, description, and application of conceptual schemes and data bases, data handling, and description and implementation of data processing are presented in [24]. In the standard, the conceptual scheme is treated as a consistent set of assumptions that express OD-related statements. The items of the standard can be used to evaluate the DBMS.

The standard [25] establishes a reference model for data management. The reference model defines the common terminology and concepts related to data in information systems. Such concepts are used to determine the services provided by DBMS or data vocabularies.

The application domain of the reference model includes the processes that concern the management of constant data and their interaction with the processes that differ from the requirements of a particular information system.

FUNDAMENTAL STANDARDS FOR SOFTWARE ENGINEERING

The fundamental standards [26–30] found a list and order of life cycle (LC) processes of systems and software, the software categorization principles defined the requirements for software management. The standard [27] establishes a general scheme of the LC of software systems and formulates the requirements for processes and standards of life cycle of systems. The standard [30] is guidance on the use of [26].

17 software LC processes are divided into three groups: basic, organizational, and LC supporting [26]. The basic include: ordering, provisioning, development, operation, and maintenance of software; organizational include management, creation and maintenance of infrastructure, and training; LC supporting processes include documentation, configuration, quality maintenance, verification and validation, general revision, and audit.

The standard [28] describes the scheme for software classification depending on software functions, application domain, operation mode, software scale (small, medium, large), criticality, the class of users, software availability, data utilization, the necessary productivity, security and reliability requirements, computer platform, environment, and resources.

The standard [29] specifies items of [26] concerning the maintenance process. The standard imposes various types of support: correcting, warning, adaptive, and improving changes.

STANDARDIZATION OF THE QUALITY OF SOFTWARE, PROGRAMMING, AND SOFTWARE MEASUREMENT PROCESS

The quality of software tools and programming and software measurement processes are standardized in [31–42]. In particular, the standards establish the list of quality characteristics, the level of software quality evaluation (until the end of their development, regardless of the process, while in use), and commence the transition to quantitative estimation of software.

Six software quality characteristics are listed in the standard [31]: functionality, reliability, usability, efficiency, accompanishment, mobility. This stops the chaos in the understanding of what should be the basis for determining the quality of software.

The standards [31–34] became the first national standards for quality and testing. Enacted standard [38] established the requirements for measuring and evaluating the quality of software, in particular, the requirements for software evaluation by the developer, customer, and valuer separately. The standard [41] evaluated the actions and tasks in the process of measurement and [40] establishes detailed procedures and principles of measurement and rating evaluation.

The standard [37] (in nine parts) established an approach to the assessment of life cycle processes of software tools by an organization or on behalf of the organization in order to realize the state of its proper processes to improve them, to determine the compliance of the proper processes with established requirements or a class of requirements, to determine the suitability of the processes of another organization for a particular contract or a class of contracts.

This standard is also regarded as a model of maturity of the organization. Its development was preceded by a number of models of maturity, so the standard puts in order the aspects of activity in determining the maturity of enterprises.

The standard [42] contains the guidance on accomplishment of the requirements for quality management systems related to the software. The standards [37, 42] can be used to certify quality systems, and the rest to certify software products.

STANDARDIZATION OF PROGRAM DOCUMENTATION

Eight national standards [26, 29, 32, 36, 38, 43–45] regulating program documentation are in force now.

General questions of program documentation are considered in [26]. This fundamental standard refers documenting to LC supporting processes and defines it as recording the information created within the life cycle in performing a list of actions related to planning, design, development, production, editing, distribution, and maintenance of documents. A list of tasks that compose actions is set up.

The standard [32] contains requirements for documenting tests. The guideline for documenting computer programs [43] outlines a new profile approach, which is based on the documentation profile: tables of information units that describe the contents of documents in software lifecycle processes. The profile approach is noted for the orientation to the model of the whole or a part of the software life cycle documentation, not only on the models of specific documents as in Walsh models [49].

The standard [44] defines the process of creating all types of user documentation. The documentation plan occupies an important place. More emphasis is put on the users' documentation both paper and electronic.

The standard [36] sets forth the requirements for product description, user documentation, and instructions for testing, and [38] defines the schema and content of the documentation, necessary to describe the evaluation module which is used by experts in measurement methodology.

The standard [46] defines a minimum set of concepts and notation for a man to perceive the transition of states of software tools, [24] sets forth the requirements for documenting the software maintenance and provides for the creation of maintenance information in its absence as a part of improving maintenance.

Since the 1970s, the ESPD (Unified Software Documentation System) is a regulatory system of software documentation in Ukraine. The ESPD standards refer to the first generation of formal standardization. A positive feature of the ESPD is a systematic approach to documenting, which is absent in the current international standardization of documentation. Having studied the state and the needs of software documentation practice, modern methods of documentation, and international, interstate, and national standards of the United States, Great Britain, and Germany, PK-7 began to develop the first stage of a modern system of standards for software documentation. It is expedient to endue this system with many positive features: a systematic approach, focus on the profile method, extending the requirements for the documentation of all LC processes, targeting at any group of users of the documentation and any classes of programs, etc. The first stage of the system is composed, and the standards [43, 44] in fact have already begun to develop this system.

THE STANDARDS USED IN INFORMATION ACTIVITIES

This group includes the standards [23–25, 46, 47].

The standards [46, 47] set the formats for the exchange of bibliographic, terminological, and lexicographic data.

CONCLUSIONS

In developing the software engineering standardization system, Ukraine focuses on international and regional standardization. The country will develop first of all a standardization system for quality and documentation. Ukraine is among the top ten countries of the world in the number of certified programmers, and a breakthrough to software markets is quite possible. This requires a profound regulatory system harmonized with the international one, first of all, a regulatory system for software quality and documentation. In accordance with a trend of international standardization of software engineering, every third international standard is a quality standard, and every sixth is a documentation standard.

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