# New language for conceptual design of complex systems in the era of post-covid and mass digitalization

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***Abstract*—This article focuses on the problems of using traditional languages in the work of the expert community, especially if the field of problem setting and design of complex systems, and on the steps taken nowadays and in the history by the world civilization to resolve them. The authors of the article believe that there has grown up a need in a new language, which, on one hand, would help to overcome the problems of translation, coordination of the conceptual apparatus, raising the effectiveness of communication between experts, and on the other hand, to make a breakthrough in the evolution of software development.**

***Keywords*—conceptual design, desing of complex systems, modelling notations, intelligent symantic systems**

## I. Introduction

The rapid development of computer technologies that combine high computing power and low costs has led to the penetration of these technologies into all spheres of human activity and thus led to widespread digitalization. This, in turn, creates a demand for the development of technologies, approaches and methods that allow faster design and development of software systems, with lower costs and with a higher degree of reliability. A number of technologies have been developed for the design of classic software systems in which both the data model and business logic are hard-coded into the system itself. The technologis for design and development of intelligent computer systems, including their semantic compatibility, are becoming more widespread.

With the increasing complexity and scale of the systems being created, more and more people should be involved in these projects and ensure their coordinated activities. This is undoubtedly facilitated to a large extent by the developed technologies for design of solutions, which, however, focus primarily on the system being developed. From the point of view of the actors involved in the process, the process itself as a whole remained unchanged - this is communication in one of the classical languages, discussion of certain issues, coordination, achievement of a common understanding of the problem being solved. And in this sense, this process is filled with difficulties in mutual understanding, establishing contact, communicating a particular point of view so that others can understand it, not to mention the need to translate from one language into another, if there is such.

Many existing technologies for the design of software systems can also be used for standardization and unification in solving a number of other tasks: design of a domain, design of business and organizational systems, design of a knowledge system, etc. Despite this, they are little used by the international expert community for such purposes, probably, because of their focus primarily on computer systems, and secondly, because of their contextual dependence and the need to harmonize basic terms and concepts in natural languages anyway. Amongst such design technologies one can mention business analysis, systems engineering, the theory of inventive problem solving, and others, directly aimed at the consistent analysis of problems and the search for solutions.

It is necessary to pay attention to a number of breakthrough developments in the field of semantically compatible intelligent systems that provide fast and high-quality design of intelligent systems of various scales and complexity. Within the framework of this direction, the world expert community is solving a number of problems: standardization of intelligent systems, unification of the principles of building knowledge bases, problem solvers and interfaces of intelligent systems, semantic compatibility of various types of knowledge, various models for solving problems, intelligent systems among themselves and intelligent systems with their users [1]. On the one hand, these technologies are characterized by a strict formalization of their apparatus and rules of use, which makes it possible to quickly computerize and automate the corresponding models. On the other hand, they are quite close to how people communicate with each other, if an attempt is made to formalize such a communication.

We believe that there is a real need for unification, on the one hand, the design technologies and conceptual design of computer systems, including intelligent systems, and on the other hand, the ways of communication between experts, coordination of tasks to be solved, which may result in the creation of a new language of international communication.

## II. Classic technologies for design of computer systems

Over the past 30 years, the world expert community has developed a number of notations, modeling tools and software systems design. The main groups of modeling standards are: descriptive models (IDEF0, OPM, SysML and others), analytical models and simulations (DIS, HLA, UML and others); data exchange standards, transformation models, general modeling standards and other modeling standards for specific areas: software development models, equipment design models, business process models [2]. The languages of system modeling

are distinguished separately. The rapid development of cyber-physical systems, in particular such paradigms as the Internet of Things and Industry 4.0, in which technical systems and humans are combined, reveals the limitations in the ability of classical technologies and modeling notations to meet the new emerging requirements of these new paradigms. The reason for this is the universality of these models and their focus on universal applicability, in which a number of details specific to a specific subject area are ignored. This also implies the duration of their update cycle, which does not meet modern technology development requirements.

Thus, one of the topical areas of research in the field of designing computer and information systems is the study of new languages of conceptual modeling and the development of tools for their active and widespread use [3]. It is discussed that the basis of domain-based conceptual modeling is metamodeling, which allows combining BPMN [4], ER [5], EPC [6], UML [7] and Petri Nets [8], [9] within one tool.

## III. Traditional language in conceptual design of computer systems

Moving to an earlier stage of the software development life cycle - to the level of conceptual design, problem statement, it should be noted that the traditional language (English, Russian, etc.) is still the means of design and coordination. Concepts are drawn up in the form of text documents in traditional languages, using certain schemes, or elements of notation. Traditional language, carrying both communicative and cognitive functions, has one drawback: all languages that exist today are linear, they are directly connected with time so that the information is revealed sequentially. All this leads to several problems in their use.

### *A. Problem of harmonizing of conceptual apparatus*

First of all, the effective work of the expert group is conditioned by the presence of an agreed conceptual apparatus and context among all its members. This includes not only the terms and meanings that stand behind them, but also the interrelationships of the terms with each other.

Especially when innovative things are discussed in an expert environment, it is necessary to form a conceptual apparatus ab initio, since it simply does not exist. This takes a long time due to the ineffectiveness of natural language, no matter what language to consider.

It should be emphasized that even experts who speak the same language do not always understand each other, especially if they are discussing new problems or innovative approaches. For example, in a discussion there may be situations when they use the same term, but each understands it differently. The worst case scenario is when the concepts of these terms do not intersect at all.

The face of the matter is that at the initial stage of its development, the traditional language was a simple means of communication in everyday life. But over time, languages have become a working tool of the expert layer. The level of complexity of the tasks being solved has increased significantly, but the main tool for solving them – the means of communication – has remained the same, which leads to the slow work of experts, the slow work of the government, and business, especially large ones, contrasted with the extreme dynamics of the modern world [10].

A good example – a group of highly qualified world experts for five years formulated fifteen basic terms in the field of information and cybersecurity. A lot has already changed during this time. In this case, it is obvious that the bottleneck is the language of communication.

### *B. Problem of translation between traditional languages*

Another problem of using traditional languages at an expert level, closely related to the first one, is the need to translate from one language to another. In this case, a partial loss and replacement of meaning inevitably occurs, which also leads to a loss of the effectiveness of the work of experts. Unfortunately, there are only a few qualified translators in the world who not only know both languages but also know the specifics of the subject area, thus able to convey not only the text, but also the specific meaning. At the same time, at the everyday level, the problem of translation from language into language can very soon be solved with the help of automatic translation systems. They have achieved quite acceptable results, are progressing rapidly, and the role of human translators will diminish.

Until recently, during the period of globalization, the world community used English as the language of international communication. However, the coronavirus pandemic that came in 2020 led to some reduction in global international communication and created the preconditions for the emergence of independent regional economic zones with their own civilizational model, relying on norms, ideas and traditions familiar to the most. Within each zone, the dominant national language common to the zone and the national languages of other peoples who have joined the zone will be used [11].

Since the economic and cultural interaction between the zones will be preserved, the need for international communication in the new world will remain. Cultural exchanges, tourist trips, joint scientific research, especially of a fundamental nature, and joint projects will remain. It will also be necessary to solve problems common to human civilization, for example, in the field of ecology.

English, which is now used as a means of international communication, is not suitable in this sense. It seems unlikely that all countries will officially and forever recognize the language of one of the zones as a means of international communication. Therefore, in the world of regional zones, English, like any other national language, is likely to be used as the main international language of communication for only a limited, albeit, possibly quite long, time.

### *C. Attempts to create an international language*

Earlier in world history, several attempts were made to create an artificial (planned) language of international communication. As conceived by their authors, such a language should be more logical, simpler and, accordingly, easier to learn than any ”foreign” language. It should allow one to get rid of the burden of ineffective historical layers inherent in any modern language. They hoped that it would be accepted by representatives of different countries as the second language of educated people. In the future, this will make their language international, and then universal.

The most famous and widespread planned language is Esperanto, created by the Warsaw linguist and optometrist Ludwik Zamenhof in 1887. According to various estimates, today it is spoken by from one hundred thousand to two million people - in the best case, only 0.03% of the world’s inhabitants. Nevertheless, only Esperanto can be considered an established planned language. The rest are linguistic projects, mostly within the ownership of small groups of enthusiasts. For more than two thousand years of described human history, linguists have counted about 1000 of such projects.

It is also necessary to pay attention to Latin. The Latin alphabet is the basis of writing in many modern languages. Throughout history, Latin has been used in conversations between diplomats because the parties did not speak their partner’s language. Latin is known not only as the language

spoken in the Roman Empire, but also the language that has long served as a source for the formation of international socio-political and scientific terminology.

## IV. Technologies for desing of intelligent systems

With the development of computer and computing technology, the increase in complexity of the problems being solved, the requirements for design and development technologies in terms of their flexibility and efficiency of modeling began to increase as well. A whole class of information systems has appeared, called semantic systems, in which, unlike classical systems, the data structure is determined by the data itself, and the algorithms for its processing are described by a number of statements, and not rigidly fixed in the program code of the information system. Since such systems are universal in relation to subject areas, their integral part is the presence of a structured description of the subject area - ontology.

Today there is a number of breakthrough developments [1], [12]–[14] in the development of flexible semantically compatible intelligent systems, which have great potential for solving the problem of coordinated communication between experts and the problem of conceptual design. The cornerstone of these studies is the idea of developing a universal language for representing the meaning of knowledge. It is noted that such a language should have the property of nonlinearity [1].

At the applied level, such a universal language describes not only the knowledge itself, but also its meaning through the definition of both information and meta-information. Due to such property it can cover a number of types of information content: specifications and descriptions of various entities, documentation and requirements for systems and their evolution, descriptions of domain areas, definition of tasks and classes of tasks, description of problems, description of solutions to these problems, description of ways to solve various typical problems, description of projects and concepts. If necessary, this language has the ability to expand the description of new types of knowledge, thus allowing it to be widely distributed for solving problems in various applied areas of computer systems. Semantic code SC-code (Semantic Code), presented in [15], refers to such a language.

## V. Prerequisites for the emergence of a new language of communication

### A. Environment of communication

Linguists note that the language is directly connected with the environment of communication and its distribution. For natural languages such environment is human community; for programming languages - this is a particular software development environment. Unsuccessful attempts to create an artificial language before are associated primarily with the lack of a proper environment for its dissemination, since we had only natural ways to communicate.

Today the Internet is such an environment for the whole world. Now any person has at least something: a smartphone, tablet or computer. The new communication medium is able to very quickly conquer the audience.If a new language could be attached to a computer program, then the entire population of the globe would be immediately covered. As an example, we can cite software from Microsoft, which is imposed all over the world.

We believe that the stage of conceptual design and problem setting in the software development can be used as a reference point. In addition to solving the abovementioned problems of aligning the conceptual apparatus and translation, this language can automatically become a means of the conceptual software design.

When programming was born, the task was set to use separate programming languages as languages understandable by the machine. The implication was that in the future, the computer will learn to understand natural language. And when they say ”high-level programming language”, they mean that it comes close to a natural language. We haven't made much progress, but the goal remains. It seemed that if a computer began to understand a language close to natural, both the programming process itself and the formulation of the problem would be simplified. But now we have come to understanding that natural language is not very effective. There are many ambiguities that are difficult for a computer to understand. Therefore, we need a new language, which at the first stage would be the language of communication of experts, but at the same time much more comprehensible to a computer. Then, perhaps, it would be possible to make a leap when the computer understands the language of communication, and the level of programming increases. As a process, it will become more natural, because a person does not need to learn a separate programming language, it is enough for him to conduct a dialogue in a new language. Indeed, this language may be closer to the IT environment where its lack is already obvious. Considering that the production of software in the world has become a massive process, the need for such language is increasing. It can help solve many problems in the era of mass digitalization.

## VI. Conclusion and further research

On the agenda is the task of creating, in the future, a new language of international communication, which, on the one hand, would be the language of communication for the expert layer, and on the other hand, would allow to effectively solve the problems of conceptual design of systems.

A number of open questions arise that need to be resolved when developing such a language. What well-known technologies, best practices and know-hows can the new language rely on? To what extent should existing artificial intelligence and machine learning technologies be taken into account and used in the development of this language? For example, the previously mentioned open semantic technologies for the design of intelligent systems. Or UML notations, IDEF0, No-code and Low-code technologies mentioned earlier in the article. To what extent the approaches that have shown their viability in the development of programming languages should there be used? Programming languages, keeping their basic corpus unchanged, are developing due to constantly updated libraries.

What alphabet to take as a basis? Use one of the existing languages as a prototype or start from scratch? Perhaps the eastern hieroglyphic writing could be taken into account. For example, Chinese characters may be closer to a new language of communication - they are already inherent in great visualization. Hieroglyphs are more like visual objects that are used in modern programming than words in English or Russian. Should the new language effectively use the elements of visualization?

In addition to applied issues, the conceptual questions arise too. What should be the methodological foundations for building a new language? For example, this could be systematization, systems thinking, the apparatus of models, the theory of business analysis, the theory of inventive problem solving, etc. What should be the contribution of other knowledge areas to the new language?

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# Новый язык международного общения в эпоху постковида и массовой цифровизации

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В данной статье речь идет о проблематике использования традиционных языков в работе экспертного сообщества, в особенности в области постановки задачи и концептуального проектирования сложных систем, и о тех решениях, которые предпринимаются и предпринимались ранее мировой цивилизацией для ее разрешения. Авторы статьи полагают, что в мире назрела необходимость в новом языке, который, с одной стороны, помог бы преодолеть проблемы перевода и согласования понятийного аппарата между экспертами, а с другой – совершить рывок в развитии программирования.

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