

Information Technologies to Support Decision-Making in the Engineering and Control

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Abstract—Goal: Classification of information technologies to support decision-making in the engineering and control systems. **Method:** systematic analysis of the types and methods of transformation of the information, including registration, storage, processing and presentation of information. **Result and conclusions:** It was shown that a variety of technologies are used for the engineering and control from human-computer interaction and information processing technologies and research to special technology and automated tools to implement them. **Emphasis is placed on system-targeted approach and automated interactive procedure for its implementation, developed by the authors of the article.**

Keywords—IT classification; control; emergence, engineering; information technologies; information system; model; system

I. INFORMATION TECHNOLOGIES CLASSIFICATION

At present there is no established information technologies (IT) classification. At the same time, in order to help choose IT for engineering and control, they need to be regularize some way.

The purpose of IT consists in information for use and analysis while making a decision. Therefore it is important during the classification process to take into account the types and ways of information transformations.

Therefore it is proposed a multilevel IT presentation (Fig. 1) based on bottom to top strata distribution of information methods, tools and equipment according to their degree of complexity – from the tools of human-computer communication, data collection, storage, retrieval and different ways of information processing to knowledge extraction and the new information emergence as a result of complex methods.

It is presumed in the classification that IT regularly change, new emerging technologies rely on and use existing technologies and existing technologies evolve and alter according to new IT methods, processes, tools and hardware.

At the first level of Fig. 1 are located human-computer communication technologies that provide information, presentation with coding, encrypting and testing.

On the next level can be seen technologies that provide information registration (gathering, input, etc.) and storage (databases and data storages). Also this level is used for technologies that originated in the Internet but are often used

as local – cloud technologies and multimedia. This is done according to declared classification principles of technology development for low- and high-level technologies.

Next levels are reserved for information processing technologies.

Initially come information search technologies followed by numerical and symbolic data, text and table processing technologies. The same level goes for IT transactions (OLTP) because the traditional sphere of OLTP-application features well-structured repeating tasks of order, material and other accounting that serve as a base for the account documents and progress reports treated like data processing

The next two strata include IT that provide more complex information processing and its preparing to the decision making. These strata include OLAP, ETL technologies, knowledge extraction technologies like KDD, Big Data and Data Mining, SADT methodology IT and imitation modeling IT on one level and enterprise and organization management systems IT that provide a base for various information systems design and selection on the other level.

According to the IT development history there can be distinguished a separate level for KDD and Data Mining combined with the united term Data Science (or datalogy), and this level can then be classified in detail

It is proposed an extended rendering of the various information systems creation technologies where technologies include not only hardware and methodology but also approaches, methods, information systems design procedures – Automated Management Systems {AMS} and Automated Information Systems (AIS), domain-specific information systems, corporate information systems, documental and factual information retrieval systems (IRS) etc, information system selection for various enterprises and organizations.

Separate strata can be formed for technologies that provide automation for complex information processing functions close to the human intellectual functions.

These technologies can be combined under a term «intellectual technologies».

However the terms used at technology origin are preserved on Fig. 1 because of appearance and development of new technologies of this kind. These terms are: Internet-technologies, intellectual technologies and nano-, bio-, info- and cognitive technologies also called NBIC-technologies.

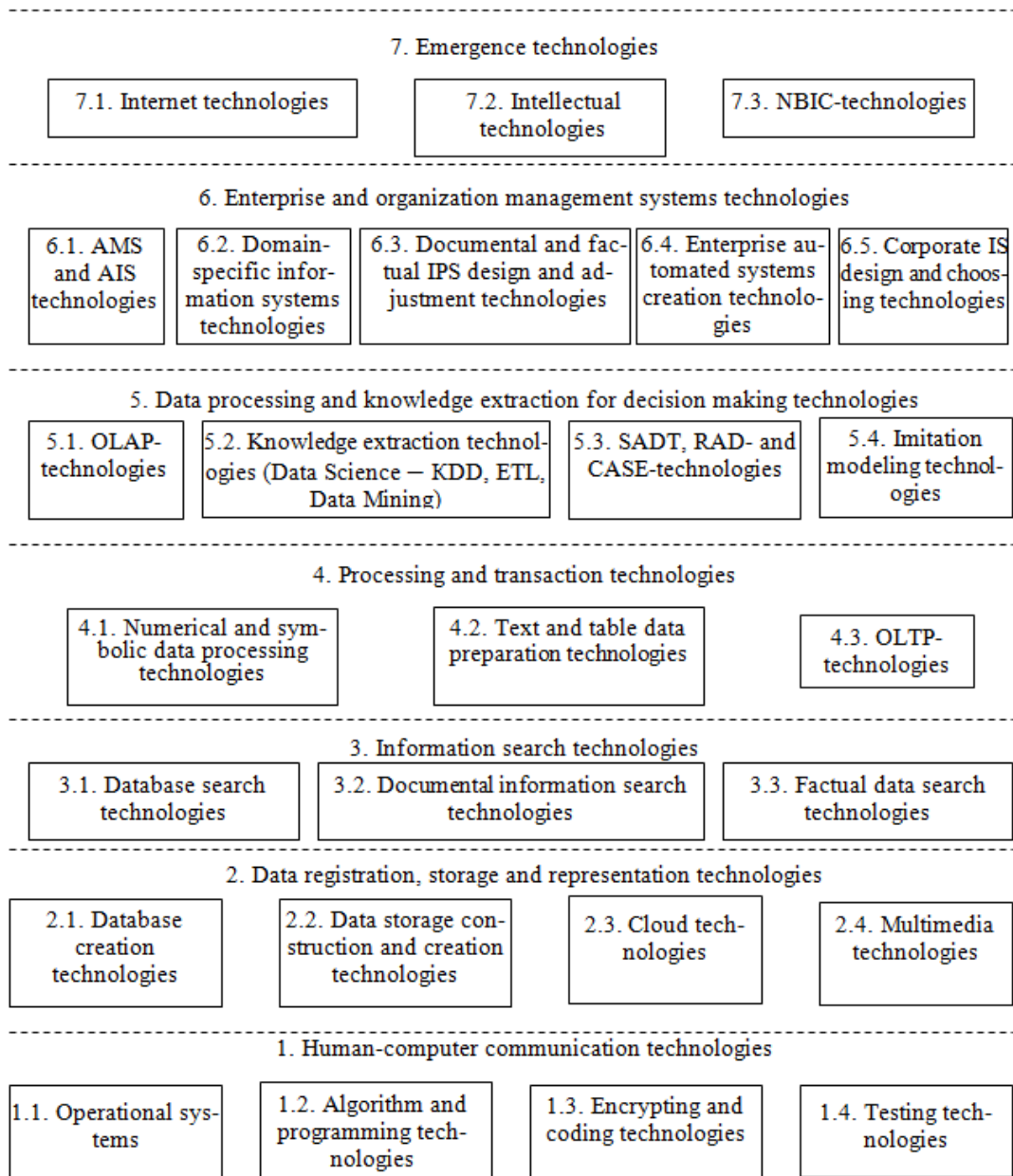


Fig. 1. Multilevel information technologies classification

There are different classifications for intellectual technologies.

The common feature for this technology level is complex technology usage including new IT presented on lower levels.

In particular, intellectual technologies are based on usage of the knowledge extraction technologies, decision support systems, expert systems, neural networks, idea-triggered networks and biotechnologies.

Such complex technology usage provides a «knowledge assembly for the united domain-specific model.

Internet-technologies also combine various low-level technologies – new programming languages, cloud technolo-

gies, multimedia, search systems, new text and table information processing tools that include not only text preparation but also text segments search and transfer tools.

The last feature enabled low-level technology development on basis of technology combination and conducted the spreading of documental information search idea, etc.

The NBIC-technologies often are called «convergent technologies». But mathematics generally treats the «convergence» term only as an approach so this leads to the new terms such as NBIC-technologies synergy or emerging technologies» [2].

II. INFORMATION TECHNOLOGY FOR THE ENGINEERING AND CONTROL

For the design and organization of the functioning of the control systems are using the almost all information technology, which classification in Fig. 1 and specified in Fig. 2: information technology for the creation of databases (DB) and data warehouses (DW), IT for search information, OLTP, OLAP etc.

Furthermore along with these technologies there is a need for new technologies and their realization automated tools which help on the conceptual design stage, i.e. during the structure design of the information system functional part, priority rating of information subsystems design, off-the-shelf software selection and decision.

This level includes the following technologies: automated conversational procedures for purpose and function analysis of management systems, automated conversational procedures for realization of complex expert methods, such as decision matrix method weighted multi-criteria methods, models of purpose impact degree evaluation for information system, etc. that allow automatic basis for information system composition and investigation of inter-level communication within information system architecture.

III. AUTOMATED DIALOGUE PROCEDURE

To analyze and formation of structures purposes and functions of the control systems used IP-technologies

structuring techniques and automated dialogue procedure for analysis purpose and function (ADP APF) for their realization, based on stepwise formation of structure. [3], [4]

In assessing the significance of the elements are used methods and automated dialogue procedure of the organization of difficult exper {ADP ODE} [4], [5]. For example, the method of paired comparisons in the modification of T. Saati, method of decisive matrix, which offered G.S. Pospelov, and its modification, methods, basic on the information approach of A. A. Denisov [6], takes into account diverse criteria – technical, economic, social.

Such tools are not finalized as perfect software systems at this moment, but there are several elaborated projects in Peter the Great Saint-Petersburg Polytechnic University [3–5].

When applying for EC design process approach for the implementation of CASE-technology and RAD-me-developed methodology of SADT and standards applying IDEFO and DFD, focused on the analysis of the processes (including business processes and the corresponding information flows. For computer implementation methodology SADT RWin automated tools are used, BPWin, ARIS, and others.

In order to identify the most critical in terms of consumption of resources of the elements, finding its most-the expediency of different composition is applied simulation models (eg. [7]).

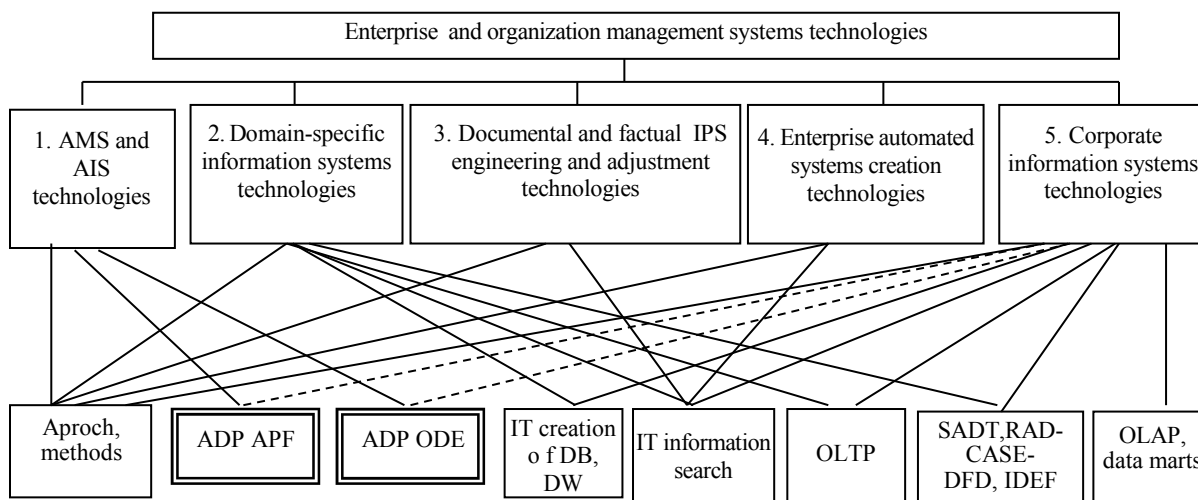


Fig. 2. Information technologies for control systems

IV. CONCLUSION

On systematic analysis of the types and methods of transformation of the information, including registration, storage, processing and presentation of information, we proposed classification of information technologies to support decision-making in the engineering and control systems.

Result and conclusions: Result and conclusions: It was shown that a variety of technologies are used for the engineering and control from human-computer interaction and information processing technologies and research to special technology and automated tools to implement them. Emphasis is placed on system-targeted approach

and automated interactive procedure for its implementation, developed by the authors of the article.

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