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The automatic understanding approach to systems analysis and design

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Abstract

An innovative approach is presented here as a possible paradigm shift for the new generation of information systems (IS). This is a first attempt in bringing automatic understanding (AU) to the attention of the IT community as a new possibility for the systems analysis and design. The novelty of this new approach is in the previously used method of AU in the area of medical image interpretation to a more general and needed area of systems analysis. It is our conjecture that the enhancement of traditional systems analysis via AU will not only contribute to the development of a new generation IS, but it may become the only way of attacking the problem considering the ever growing number of more and more complex IS with an expected development time 'for yesterday'.

The proposed AU approach is, in essence, different from other approaches such as, for example, those based on neural networks or machine learning. AU enables the determination of the meaning of analysed data, both numeric and descriptive. Cognitive methods, on which the AU concept and construct are based, have roots in the psychological and neurophysiological processes of understanding analysed data—as they take place in the brain of a competent and particularly gifted person.

Keywords: Systems analysis and design; Information systems (IS); Automatic understanding; Cognitive analysis

1. Introduction

There are more and more intelligent information systems (IS) being developed. The development time is expected to become shorter and shorter despite a growing complexity. IS have revolutionised the way we conduct business nowadays. Modern production, service, trading companies, banks, insurance corporations, and the dispatch industry, rely on IS, which are highly integrated in an organisation. However, they do not take significant advantage of the most recent advancements in artificial intelligence and cognitive science. This is regretful, since the use of AI and cognitive science could contribute significantly to IT innovations and may constitute a source of competitive advantage.

The premise for the formulation of recommendations for the development and implementation of cognitive analysis methods in IS can be summarised as follows (Laudon & Laudon, 2002; Meystel & Albus, 2002):

- The scope of a typical IS is extremely wide and it relates, among others, to trade, banking, production, services, logistics, and many other areas of application. IS, in each of these operations, is used by *everyone*, their use therefore cannot be a factor constituting competitive advantage.
- The main objective of an IS is to store and retrieve information for reporting purposes, which enables evaluation as to how a given company functions *currently* and what economic results were achieved in the past (both near or more remote). IS have been perfected for the purpose of decision making in line with the operation and management of a business unit, but they are not so good, for example, in terms of supporting strategic decisions, or for the development of a drastic reorganisation plan, or alterations to a company's mission. This is so since an attempt to shape a company's strategy, based on data supplied by most currently used IS, is comparable with the driving

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of a Formula I car where he/she can only see that section of road in his/her rear mirror. In other words, the road that he/she has already travelled.
- The tools and methods used to support economic short- and long-term planning (i.e., econometric models, simulation software, and forecasting methods) are useful but they have a major disadvantage. Each can support the *evaluation* of any idea that the user presents and describes. The generation of innovative ideas is not supported by these tools and methods. It is evident that the tools and methods currently used for information management can answer any question asked but they *cannot answer questions that have not been asked*.

The reason behind the inability of the generation of innovative ideas is that via the storing of data and processing the main focus is on the *form of data* and this does not get us near or close to the *content of data*. Simply put, the *meaning* contained in the data is not available through the analysis of the data form. The operation of a typical IS is based on two levels:

- the identification and automation of repetitive data storage and processing operations, and
- the identification of key decision-making problems and finding (possibly computing) information needed by the user to take decisions (Ogiela, 2005).

Both levels are important and necessary. Modern companies, if deprived of automatic data processing systems, simply could not exist since the amount of data generated during their typical, routine work is far larger than the perception and analytical capacities of company staff. Yet, it is nothing new that exact registers and the reporting of everything that takes place in a company is a prerequisite for efficient management. The amount and importance of data called for processing and analysis grow significantly when, for example, the Board of Directors decides to change the scope or type of business. The amount of data necessary to take into consideration, for all decision-taking processes is often overwhelming. Without efficient data analysis methods (i.e., OLAP), it is impossible to effectively manage or run a business and have a good command of it nowadays.

More ambitious tasks, such as a *strategic idea generation*, require a new approach. An automatic understanding (AU) is a natural way to go.

The details of the proposed approach are presented in Section 2. However, it is worth noting that we are aiming to develop an IS capable of using both the form and the *content* of business data stored and retrieved for analysis. To manage a business efficiently and, in particular, to find and implement new concepts, it is necessary to *understand* the situation of the business as well as that of the business environment (or of a given market segment). By understanding the micro- and macroeconomic situation well, one can have the basis to propose innovative changes, which may even turn out to be revolutionary in nature. However, the lack of understanding of certain signals and/or data could lead to disaster.

Certainly, there are some genius managers who understand all data available without any assistance. They are valued by their employers for their introduction of excellent business and organisational innovations and for their opening of new chapters in a given company's history. However, such business talents are rare and when they are found, they are extremely expensive. Therefore, while maintaining respect for the geniuses who can discover new horizons in business and show new paths in business, it makes sense to research technical tasks aimed at developing a system capable of simulating the business geniuses.

At first, such a plan seems unrealistic. How can you automate the work of a genius? The automation of something usual and daily lies within the scope of our possibilities but an exceptional talent is not subject to technical imitation and precisely due to its exceptional character! The latter is not so evident when we analyse the situation more carefully. Some time ago, people who could multiply multi-digit figures in their mind or who could sum up long columns of numbers were commonly respected. Today people gifted in this way are still rare and some psychologists still try to solve the nature of their genius. Yet it does not prevent us from using calculators capable of doing the same thing but faster and with a higher level of accuracy. The ability of understanding business data and processing them to foresee correctly future events still remains rare and precious, however, it does not mean that we are powerless. The new concepts, presented here, form a basis for the purpose of an AU of business data. It is worthwhile mentioning that aiming to construct such a method is an objective worth doing. Assuming that such a system can be built, using them will enable the execution of correct strategic decisions in complex and difficult business or organisational situations by managers who do not have such a capability on their own, since they may simply lack great business decision-making talents.

2. Cognitive analysis basis

From the viewpoint of psychological sciences, in the process of understanding any information obtained by a man, subject to cognitive analysis, there are three stages:

- *Registration*, *remembering* and *coding* the information obtained.
- *Preserving*—a latent stage of natural processes.
- Information *reproduction*—its scope covers the remembering, recognition, understanding and the learning of some skills anew (Ogiela, 2005; Ogiela & Tadeusiewicz, 2003; Tadeusiewicz & Ogiela, 2004).

Some features of cognitive processes on which we shall base our AU information model, the model analysed in this