Application Of Artificial Intelligence Techniques According To The Process And IT Protocols Applied In Construction Project Process

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Abstract
This paper presents application of Process and IT protocols (Process and IT map). The application of this protocols is shown by forming process and IT protocol based on simplified procedure of construction project process which is coordinated with the new serbian planning and construction law. According to IT protocols Artificial Intelligence techniques, like Case-Based Reasoning, can be appropriate at the initial phase of design where the creativity is very important. Application and positioning of artificial intelligence tools at early design stages, suggested by IT Protocol, is shown. This approach stresses the importance of designing Integrated Database of realized Process and IT protocols and Construction Industry Knowledge Base.

Keywords

1. Introduction – Need For Construction Processes Redesign

There are three main elements in all definition of Business Process Re-engineering – BPR: Process, Redesign and Information Technologies – IT. According to Venkatranam (1991)"...BPR involving the reconfiguration of the business using IT as a central lever. Instead of treating the existing business processes as a constraint in the design of an IT infrastructure the business process itself is redesigned to maximally exploit the available IT capabilities".

IT will only achieve profound change if its introduction and use are linked to changes in the overall conduct of the design and construction processes. Development of appropriate Process and IT protocols can support an improved design and construction processes. Working within a process framework/process protocols context is becoming the norm in many manufacturing firms.

Process protocols can be defined as a way in which the processes involved in the designing and construction of a structure are arranged so as to produce an efficient, effective and economical way of undertaking the design and construction of projects. Process protocols can
help in the development of their equivalent IT protocols that position the technologies which enable and support the processes involved within the business environment (Aouad et al., 1998).

2. Objectives – Practical Application Of AI Technologies According To The IT Protocol

In year 2003 in Republic of Serbia implemented-passed Planning and construction law. According to construction project activities suggested in this law it is possible to form design and construction processes with twelve phases and appropriate process and IT protocols.

Main goal of this paper is to present possibilities of AI technologies according to their position in IT protocol. Practical application of AI technologies will be shown by presenting possibilities of Case Based Reasoning – CBR model as IT support in pre-design project phase.

3. Methodology

Process of IT and process protocols development is shown in diagram 1 (Cekic, 2002).

4. Process and IT Protocol

Process Protocol - (Process map), developed at University of Salford, UK (Aouad et al., 1999) which is based on the product development concept in manufacturing industry, is used as a basis for process protocols development according to the new Serbian construction and planning law. This protocol with twelve phases is shown in diagram 2.
Model breaks down the design and construction process into twelve distinct phases which are grouped into four broad stages, namely Pre-project, Pre-construction, Construction and Post-completion. Soft and hard gates ensure that major decisions are assessed and evaluated. The soft gate implies that decisions could be conditional, in that the project is not stopped for one or two non-critical activities, thus ensuring concurrency and reduced timescales. The hard gate indicates firm and final decisions regarding whether or not to proceed to the next phase within the process (Cooper et al. 1998).

After the study at University of Salford (Aouad et al., 1997), communications and networking will be a major topic in construction IT over the next ten years. Topics such as Artificial intelligence - AI, Artificial Neural Networks - ANN and Simulation are the least important for the progress of construction IT in the next ten years. This is mainly attributed to the slow uptake of these technologies by the industry and not to their potential. IT applied in IT protocols in this paper is coordinated with results of this study, but number and position of phases are based after the Serbian construction and planning law.

IT tools presented in IT protocols must be integrated to provide the right mechanism for a technology push of the process and will finally result in improved interface process which will take advantage of the technology and the new ways of performing businesses (Kaglioglou et al., 1998). All used IT tools in IT protocol is shown in Table 1.

<table>
<thead>
<tr>
<th>Table 1: IT tools in IT protocols</th>
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<tr>
<td>Process wide IT application: EDI, AI, Integrated databases, Internet/intranet, Document management</td>
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<td>Risk analysis</td>
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IT protocol coordinated with Serbian construction and planning law is shown at diagram 3.
Artificial intelligence is an area of science and technology whose main goal is the development of computer functions usually connected with human intelligence, like reasoning, learning, and problem solving (O’Brian, 1999). Possibilities of AI technologies, suggested in IT protocols, will be shown by developing and using CBR systems for eliminating smooth process flow blockage at the initial design phase of construction projects.

5. Application of Artificial Intelligence – Case Based Reasoning Model

One of the less well-known sub-fields of AI is Case-Based Reasoning-CBR. With CBR, past problems and their solutions are stored as individual case histories, and reasoning is based upon the retrieval and use of similar problem descriptions. In many research projects starting each design from scratch has been identified as one of the blocking sources of design process (BAA, 1994). Suggested workplan for IT supported elimination of this blockade is retrieval of quality historical design solutions using Construction Knowledge Base - CKB and CBR systems.

Integrated Project Database – IPDB is an integrated database containing all data from the conceptual, design, construction, operational and renewal project phases of construction project life cycle. All IPDB can be gathered and stored in CKB. Data from CKB can be interpreted using the Rough Sets Theory-RST, which is one of the latest mathematical approaches to definition and analysis of imprecise, unreliable and indefinite data (Pawlak, 1982).

Presentation of CBR model created by Cirovic and Cekic (2002) is shown in diagram 4. Result of the application of created CBR model based on RST (Cirovic and Cekic, 2002) is one potential solution for the specified current problem in preliminary design. Designer considers the proposed solution together with solutions, which in his opinion, present adequate design solutions, referring to his experience and knowledge, and are not proposed from CBR system. Also, designer proposes his own original solution using his intuition and knowledge. Designer, according to his experience and knowledge, makes the final decision about acceptance of the project solution. Solution suggested by CBR system could be considered as IT support for decision-making in preliminary design process.
6. Discussion

IT protocols can be considered as a support tool for generic design and construction process protocol based after the serbian construction and planning law. According to the developed IT protocol, Artificial intelligence – AI techniques including CBR, ANN, Fuzzy Logic - FL, Genetic Algorithms - GA i Knowledge Based Systems – KBS may be appropriate at the initial phase of design where creativity issue of design plays a mayor role.

Starting each design from scratch is identified in most research studies (and developed IT protocols) as one of main blocking sources for preliminary design process. IT supported elimination of this "smooth process flow" blockade can be based on CBR systems and CKB. Using the created CBR model will initiate larger integration of the design, construction and facility management processes. Construction phase and future operational use of buildings could be reached and considered during the preliminary design phase using IPDB based on accepted information and project standards. Created CBR model applied at CKB can shorten duration of preliminary design process. Although the application of created model is in the preliminary design phase, the results of this application are far-reaching and continue in the next phases of project life cycle, like the design and construction phase of the project.
6. Recommendations

Application of AI technologies shown in this paper represents an example of breaking barriers between all phases in design, construction and operational processes and can help in integrating information which will result in a more consistent and improved process.

Work at IT protocols are still at an early stage and should be used mainly as a stimulator of ideas regarding developing appropriate IT solutions for re-engineering design and construction processes. According to the local construction and planning laws, the number and position of phases in design and construction protocol may be different. Development of proposed Integrate project database and appropriate Knowledge Base with realised process and IT protocols can shorten duration of protocols design process and improve its quality level.

7. Conclusions

Construction industry can be considered as one of the latest bastions of traditional attitudes, methods and actions that cannot survive in modern business environment. Competition in this sector is becoming very sharp. In this dynamical situation it is clear that construction companies have to be strongly oriented toward the future. That is why it is very important to be more strategically oriented in IT management in construction industry, using process approach to activities. Above presented IT supports for initial preliminary design of construction project is one kind of process approach to activities. This paper presents application of AI technologies in initial phase of construction project by using appropriate IT tools (CBR systems) according to the IT protocol of design and construction processes. Development of process and IT protocols shall be a great support for any construction company (and construction industry) which could use them as competitive advantage for maintaining and expanding their positions in the market.

8. References


