

# Cognitive Information Systems and Enterprise Engineering

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**Abstract.** The aim of the publication is the clarification of the meaning of the cognitive information systems that helps to conceptualize the primary areas of operation, in the world of enterprises with examples. It helps to understand the future, points to the potential benefits and highlights the importance of the development a methodology that efficiently helps and guide the EE society to implement CIS into EE and Enterprise Environment. The rapid change of world causes new challenges in the enterprise environment. Skills to manage the actual situation are rarely available in one single person or in one team, therefore one of the possible solution is to leverage the capability of a cognitive information system.

**Keywords:** Business Information Systems, Cognitive Information Systems, Information Systems Modelling, Business Process Alignment.

## 1 INTRODUCTION

The concept of Cognitive Information System (CIS) appeared as an intersection and shared area of Information Systems and Cognitive Science. Modelling, analyzing, and designing information systems in the most recent technological advancement makes it possible and – at the same time – requests for architectural and design principles that combine the development of technology and theories of Cognitive Science. We think of architecture of information systems within enterprises in the sense of Zachman [8] and TOGAF framework [4]. Zachman in our days called ontology, both of them are general methodology, therefore this would help to place the information systems in an enterprise environment, ensure theoretical background in this stage of the research. Archimate is a concrete software/IT architecture design methodology, meanwhile DEMO is a behavior model, focus on the functions and processes. DEMO is built on the PSI (Performance in Social Interaction) theory. [2]. In this theory, an enterprise (organization) considered as an interaction of social individual subjects. [1]. Cognitive Science offers the analysis of cognitive tasks, i.e. the investigation of the decision making, rea-

soning skills of the examined subject whilst the subjects treat the set of complex information [6]. The literature survey is restricted on the domain of the CISs in the enterprise environment.

## 2 LITERATURE SURVEY

An overarching viewpoint: the consideration in the interaction between humans and silicon agents (“computers”) does not constrain the investigation of *cognitive capability* only onto the human party but it involves the automated part of the system. Information interchange and interactions between the humans and machines (carbon and silicon agents) have need of cognitive capabilities: CISs are socio-technological systems, i.e. interactions between humans within the system environments and between humans and machines with the cognitive capabilities may happen as well, the information interchange can be characterized the way of the communication and use of the services provided by cognitive systems. The answer to the question what makes a system cognitive is the following according to Hurwitz:

*“Three important concepts help make a system cognitive: contextual insight from the model, hypothesis generation (a proposed explanation of a phenomenon), and continuous learning from data across time.”* [3].

Extending the definition based on the based on the examined publications, the ideal CISs, other than the predefined details which are, *contextual insight from the model, hypothesis generation (a proposed explanation of a phenomenon), and continuous learning from data across time*, should impact the carbon agent cognition, in a positive way, improving it, leveraging the synergy originated from the interactions between silicon and carbon agent. This synergy generated leverage expressed via cognitive resonance, where the cognitive resonance orienting the entire process to the automated data understanding meanwhile extracting the semantic information, which supporting the interpretation of the understanding. The concept of cognitive resonance is one of the attempts that try to make sense of the modelling activities in the most recent world of data analytics that uses tools out of data science. The other assumption is that the human (carbon agent) has a mental model that contains anticipated results, frameworks, organizing principles. Merging the above concepts, the cognitive resonance is a parallel and two facets process, once it is between silicon agent and carbon agent running parallel, and it run inside the process of understanding within the CIS, therefore it is a duplicate. The synergy extent the boundary of the carbon agent cognition meanwhile the output of the cooperation steps in a higher level.

### 2.1 Illustrative example of cognitive business operation and analyses

CIS is a tool to support the enterprise success providing business intelligence. Strengths of cognitive computing, the ability to generate value from volatile data. These are, for example, stock exchange data that change in a folia-like manner where processing speeds are key. Real-time analysis involves the part that, if not realized, the value of the data is lost or significantly reduced. Business streaming data is used to

influence customer decision-making at the point of sale. In the retail industry, data on sales locations are analyzed as we try to create it to prevent customer decision-making. The data is processed and analyzed at the point of engagement and possibly in combination with the venue data or social media information. Other industries also play an important role in the processing and analysis of frequently changing data, such as healthcare, telecommunications, medicine production, and even power plant management [3]. At the University Medical Center, Groningen, Netherlands based on paper based administration system showed that over a 5-month period there were 592 hospital admissions and 7,286 medication orders, 60% of those had at least 1 prescribing or transcribing error. These errors resulted in 103 adverse drug events that were preventable, resulting in 92 cases that experienced temporary harm, 8 cases that required prolonged hospital admission, 2 cases that were life-threatening and 1 fatality [7]. Based on the results of developing systems that reflect the physical, cognitive and social needs and goals of a person or team in the context of the technology, environment and culture with which they operate, positively impacted all of the negatives created by the paper based system [7]. Typical source of corruption the internal procurement, purchasing services, subcontractors, materials etc. CIS enables to close all gaps during the procurement process, ensures the best proposal acceptance via automatized evaluation excluding manipulated evaluation that creates a high risk. Developed or reengineered process requires setup of the proper monitoring system. Monitoring system includes control points for compliance purposes to be in line with the internal control processes and ensure audit readiness. Big Data Analytics and analyses from different sources with CIS, reduces the possibility of the noncompliance related to the corporate internal and external processes, standards and rules. Various metrics and KPI's are needed to ensure smooth operation, highlight possibilities for continuous improvement. CIS ability to analyze deviations, therefore, reveals the weaknesses and gaps within the processes. Analytics and measurement provides feedback for further development with various and concrete (agile practices) actions using different methodology of analytics like predictive, prescriptive etc. It provides information on impacts drivers and correlation within inputs and outputs and other factors. Those outputs get the attention paid by the management and calls for actions. Auditing End to End processes might highlight discrepancies on accounting process in relation of procurement. End to End process analyses would enhance the overall effectiveness, supporting the management decision to achieve the corporate goals in line with the corporate strategy with business intelligence. According to CRM Fundamentals by Scott Kostojohn, the customer experience is becoming more important to businesses as a differentiator; the sophisticated grow and increased demand did not pair with loyalty [5]. Lack of loyalty on the demanding customer needs high focus, tailored products and services, that analyses with CIS supports with its cognitive capability, as for example during implementation of CRM system or roadmap building, when a result of analyses reveals the drivers and KPI's, that make clear area of actions to the management. Extremism usually related to process gaps, which might call the attention of internal audit. Big Data analyses, unstructured information analyses are realized by CISs bring the toolset of Data Science on the scene. Process evaluation and process reengineering, decrease the complexity and number of

handovers, which supports the process of the continuous improvement. The cooperation within human and CIS across the process of continuous learning would help for the quick and flexible adaptation to the client need and environment challenges. In complex organizations breakdown of functions for work streams that works individually and time to time by milestones interlocks with the other work streams to harmonize the collaboration to achieve and share the best practices under Kaizen umbrella, which results better performance and higher quality of the outcome.

### 3 CONCLUSION

The research has plenty to do on defining the idea of CISs in economics, business administration, organization science, then it should formulate a reconciliation between the enterprise and cognitive architectures to leverage the tools of data science for business efficiency and effectiveness. This approach includes the provision for enterprise engineering guidelines based on the defined meaning of CIS, which may be applied during construction of CISs or their efficient integration into the business processes of organizations. The approaches of informatics that can be exploited on the common field of cognitive science and information systems are as follows: knowledge representation, ontologies, description logic, computational linguistic, machine learning, and computational intelligence, thereby CIS is a valuable tool for BPM and EE. The possibility what provides, supported by the CIS enable to extend the boundaries of the operation of the enterprise. These changes require continuous improvement; therefore, a business process improvement needs to adapt to the situation.

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