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# Artificial Intelligence-enabled Enterprise Information Systems

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## Introduction

The fourth industrial revolution has marked the end of the industrial automation era of simple and repetitive human tasks. Then, it opened a new arena for efforts of mimicking human intelligence with a clear objective. This arena facilitates i) machine-driven decision-making, ii) seamless machine-to-machine communication using the formalisms easily expressed and understood by humans, iii) solving problems driven by uncertain and unknown variables, and iv) other activities that require more complex considerations and actions which humans typically implement in the past. With Artificial Intelligence (AI), Enterprise Information Systems (EIS) are becoming increasingly capable of sensing and perceive (even reach beyond the human cognitive horizon), analyse, or understand and respond, based on the acquired understanding. This combination was made possible using big data, significantly improved algorithms, and sufficient computational power to train and run those algorithms with vast amounts of data.

In this Special Issue, the concept of AI EIS enablement (Zdravković et al., 2021) is introduced to provide the umbrella for a new way of thinking, architecting, designing, developing and using the EIS. It is put on the top of the widely discussed data-enablement, sometimes in the context of so-called sensing enterprise. This enterprise continuously listens to its internal and external environment using the technologies such as sensors, embedded electronics and multi-agent

systems. Although today's hype on AI is driven by the performance of complex deep learning architectures and models, both symbolic and non-symbolic AI applications were considered to reflect the equal importance of challenges and opportunities for logic-based and data-based methods.

The Special Issue was advertised on the website of the publisher and by email. Also, the authors of the selected papers from the special session with the title '(Industrial) Internet-of-Things for Smart & Sensing Systems', organized at the 8<sup>th</sup> International Conference for Information Society and Technology (ICIST 2018) were invited to submit the extended versions of those papers to the Special Issue. Twenty submissions have been received, and after several rounds of reviews and revisions, 6 manuscripts were accepted for publication. Those manuscripts are shortly presented in the following section.

## **Discussion**

In some domains, many diverse factors for business decisions cannot be represented by the effective analytical, deterministic models. The complexity of data is one typical reason for that, while in some cases, the strong impact of uncertainties makes it even impossible to build accurate predictive models for the support to decision making. Modern supply chains are one example of such a situation. Their planning is largely based on forecasts, which are often driven by very general assumptions and simplifications and thus, they are inaccurate. Supply chains are extremely complex, and their operations are continuously disturbed by the variability in demand, different incidents, etc. The issues caused by this variability and other uncertainties involved in supply chain planning has not been successfully addressed in the past, either with symbolic or non-symbolic AI methods. (Oger et al. 2020) have worked on the comprehensive model for understanding uncertainties and opportunities in supply chain capacity planning. They proposed a new conceptual

framework for decision making for supply chain capacity planning that is developed around the concepts of purpose, people, decision-making process, and information system. The framework has been designed, implemented, and validated in two industrial experiments with success.

A lot of productivity promises of the modern enterprise information systems today are wasted in bottlenecks caused by the lack of interoperability of different modules. Finding the delicate balance of benefits and drawbacks in the spectrum from tight integration to losing interoperability within one EIS is an extremely difficult challenge for the enterprise to excel in both productivity and flexibility. Symbolic AI methods that facilitate the so-called semantic interoperability of systems are today the most promising way to address the above challenge in the long-term sustainably. An interesting case study to support this statement was provided by (Marković and Gostojić 2020). They proposed the machine-readable documents as messages with which semantic interoperation between systems (for example, those of buyer and seller) would be seamless. The documents are automatically assembled (even inferred) using the knowledge base, consisting of rules from the legislation and document templates. The proposition was successfully validated in the case of service contracts.

Big data availability enabled the breakthrough also in how the product development processes are perceived and implemented today. The industries now use vast data and models collected and developed for product conception, design, development, testing, exploitation, maintenance, and even scrapping to meet the continuously changing and evolving user requirements. (Li et al. 2021) proposed the improved V framework for product development by adding advanced data analysis and AI methods in the pipeline. Thus, the model-driven aspect of the product design process introduced by the V framework is not complemented with data-driven functional development.

The methodology and framework were tested in the case of the development of a damage control system-based mission system.

While many of the AI applications aim at significantly improving the existing functions, the advance in the specific AI areas has opened the avenues of opportunities for new functions that have not been considered before. Such new functions are very often found in the marketing domain, in specific, in market research. The power of vast social media data about the existing and prospective customers can today be unleashed for uses in market segmentation and targeting by using modern Natural Language Processing methods driven by AI. Sentiment analysis and opinion mining are the tools for the above. However, those techniques rely on so-called language models, which are not yet developed for many local languages. Grljević, Bošnjak, and Kovačević (2020) have provided methodology and a case study for creating a corpus for sentiment analysis on the Serbian language. Their case study was related to opinion mining in the higher education domain.

Another breakthrough, jointly achieved by the advances in computational power availability, reliable sensing technologies and algorithms, can produce very complex real-time analysis of different phenomena. Real-time analysis facilitates near real-time response and, consequently, the huge benefits of flexible behaviour of different systems and the prevention of different risks. This is especially important for the health-related risks from environmental phenomena. (Tešendić et al. 2020) have presented a clear case on how the mix of the advances mentioned above can prevent health risks by proposing the system for airborne pollen detection. The proposed system is built around the airborne particle monitor sensors and CNN (Convolutional Neural Networks)-based algorithms to classify full spectra of allergy relevant airborne pollen types.

The massive rate of digitalization of society, driven by data, algorithms and computational devices, comes with the cost. Security and privacy challenges are significantly increasing. Fast developing

legal frameworks put those challenges at the top of the list. The most effective security risk prevention measure is dealing with software vulnerabilities. Siavvas et al. (2020) have presented an effective approach in using Technical Debt indicators to indicate software security risk by using Machine Learning algorithms.

## References

- Grljević, Olivera, Zita Bošnjak, and Aleksandar Kovačević. 2020. "Opinion Mining in Higher Education: A Corpus-Based Approach." *Enterprise Information Systems*, November, 1–26. <https://doi.org/10.1080/17517575.2020.1773542>.
- Li, Qing, Hailong Wei, Chao Yu, and Shuangshuang Wang. 2021. "Data and Model-Based Triple V Product Development Framework and Methodology." *Enterprise Information Systems*, January, 1–33. <https://doi.org/10.1080/17517575.2020.1867900>.
- Marković, Marko, and Stevan Gostojić. 2020. "A Knowledge-Based Document Assembly Method to Support Semantic Interoperability of Enterprise Information Systems." *Enterprise Information Systems*, July, 1–20. <https://doi.org/10.1080/17517575.2020.1793389>.
- Oger, Raphaël, Matthieu Lauras, Benoit Montreuil, and Frédérick Benaben. 2020. "A Decision Support System for Strategic Supply Chain Capacity Planning under Uncertainty: Conceptual Framework and Experiment." *Enterprise Information Systems*, July, 1–45. <https://doi.org/10.1080/17517575.2020.1793390>.
- Siavvas, Miltiadis, Dimitrios Tsoukalas, Marija Jankovic, Dionysios Kehagias, and Dimitrios Tzovaras. 2020. "Technical Debt as an Indicator of Software Security Risk: A Machine

Learning Approach for Software Development Enterprises.” *Enterprise Information Systems*, September, 1–43. <https://doi.org/10.1080/17517575.2020.1824017>.

Tešendić, Danijela, Danijela Boberić Krstićev, Predrag Matavulj, Sanja Brdar, Marko Panić, Vladan Minić, and Branko Šikoparija. 2020. “RealForAll: Real-Time System for Automatic Detection of Airborne Pollen.” *Enterprise Information Systems*, July, 1–17. <https://doi.org/10.1080/17517575.2020.1793391>.

Zdravković, Milan, Hervé Panetto and Georg Weichhart. 2021. "AI-enabled Enterprise Information Systems for Manufacturing". *Enterprise Information Systems*.