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Editorial

Editorial to the Special Issue "Systems Engineering and Knowledge Management"

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1. Introduction

The International Council on Systems Engineering, the leading authority in the realm of systems engineering (SE), defines this field of study as a transdisciplinary and integrative approach to enabling the realization of the entire life cycle of any engineered system [1]. The shift to the transdisciplinary approach was based on intradisciplinary and multidisciplinary perspectives on SE [2]. The intradisciplinary point of view is more or less traditional and is closely associated with the design, development and implementation of information systems, regardless of their focus, ranging from standard packages of enterprise resource planning [3] to information-systems-supported, specific tasks or processes [4–6], to exemplify a few. These systems require the cooperation of two stakeholders: a business one (demand) and a technical one (supply). However, this setting can be applied to any domain in which someone needs a technical system and someone else is capable of delivering it. Later on, a multidisciplinary perspective was established. This perspective highlights the necessity of the cooperation of experts from various specialties to develop and deliver required complex systems [7,8] from any arbitrary engineering discipline, ranging from the design and development of space systems or aircraft systems [9,10] to health care [11] or industrial automation [12]. The necessity of the coordination, synchronization and orchestration of processes and resources is crucial [13]. The role of a system engineer is slightly transformed in these instances, as technical knowledge and expertise must be complemented by the mastering of soft skills such as leadership, motivational skills or decision making [14]. In this way, the application of axioms from the systemic approach is ensured [2]. Finally, a transdisciplinary point of view stresses that engineering activities, regardless of the domain or the type of system developed, can be generalized and successfully applied during the development of any type of system. In this way, transdisciplinary SE focuses on basic concepts, their relationships, procedures, activities, best practices or fundamental principles of SE. It considers SE as a generic structured development process that proceeds from concept to production and operation.

While SI has been perceived from three perspectives, knowledge management (KM) can be understood from two mutually related points of view [15]. The first one is based on a technical perspective, in which KM is characterized by research in fields such as expert- or knowledge-based systems applied in various domains [16,17]. This perspective is mainly associated with the intradisciplinary approach to SE, as a specific type of computer-based system is designed, developed and implemented. It operates with specific procedural or declarative knowledge in the form of rules, classes with their attributes, ontologies or different types of networks. It is an established technological discipline that embodies the lowest and the most basic level in which proper attention to knowledge is exercised. The second one is tied to soft systems, in which KM is considered an approach to improved performance in organizations. KM encompasses knowledge-based and knowledge-oriented organizational management, irrespective of the organizational mandate or nature. Therefore, KM can be introduced in business organizations, educational institutions or even

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civil administration. In doing so, its importance in knowledge resources and knowledge processes is highlighted [18].

2. Introduction of Published Manuscripts

This Special Issue, "Systems Engineering and Knowledge Management", highlights the mutual relationship between these two disciplines [19–21]. The primary interconnection is associated with the gradual shift of the focus from hard and technical systems [22–24] to soft and socio-economic systems [25–27]. Below, manuscripts included in this Special Issue are briefly introduced. It is apparent that they successfully fulfilled the primary purpose of this Special Issue, i.e., to exhibit the current state of the art in both fields while highlighting and emphasizing mutual relationships.

2.1. Rafał Michalski and Szymon Zaleski: Success Factors in Management of IT Service Projects: Regression, Confirmatory Factor Analysis, and Structural Equation Models

The objective of this study was to identify and comprehend the key elements that lead to the success of IT software projects, as well as the interconnections between these factors that contribute to overall success. To achieve this objective, the researchers created and analyzed multivariate regressions and structural equation models (SEMs). The regression models consisted of six project management success criteria as dependent variables: quality of the delivered product, scope realization and requirements, timeliness of delivery, delivery within budget, customer satisfaction and provider satisfaction. These criteria are influenced by four independent variables: agile techniques and change management, organization and people, stakeholders and risk analysis and work environment. The identification of these variables was performed through exploratory factor analysis. The findings indicate that certain success characteristics may not be applicable to all success criteria, and there were variations in their significance. Additional exploratory and confirmatory factor analyses were used, together with appropriate statistical metrics, to assess the quality of these four components. The structural equation modeling (SEM) approach is founded on five underlying constructs, encompassing a combined total of twenty individual components. This study indicates that achieving success in project management requires investing in the enhancement of individuals' knowledge and abilities, implementing agile approaches, fostering a supportive work environment and engaging stakeholders in regular risk analysis. The findings also indicate that the elements contributing to the success of IT service initiatives are contingent upon both conventional and agile methodologies.

2.2. Palvinder Thakur, Bartosz Paradowski, Neeraj Gandotra, Parul Thakur, Namita Saini and Wojciech Sałabun: A Study and Application Analysis Exploring Pythagorean Fuzzy Set Distance Metrics in Decision Making

This text centers on the domain of decision making, where the capacity to resolve intricate real-world issues is of utmost significance. Fuzzy sets were utilized for the purpose of introducing uncertainty into the values that describe decision possibilities. This paper focuses on Pythagorean fuzzy sets, which are an extension of classical fuzzy sets. Pythagorean fuzzy sets offer additional tools for modeling real-world situations and introduce a distance measure specifically designed for these sets. The validity of the proposed distance measure was verified through a thorough examination of its properties. The proposed measure was distinguished by a more direct formula, which in turn streamlined the calculations. Additionally, in order to validate its practicality, a technique for multi-criteria decision making was introduced. The outcomes of this methodology were then compared to two other multi-criteria decision-making methods, specifically PF-TOPSIS and PF-VIKOR, as well as other distance measures that had previously been discussed in the existing literature. This comparison study revealed that the preference values derived using the newly proposed distance measure exhibited less fluctuation. This finding demonstrated that the newly proposed distance measure was stable and reliable, while still maintaining a low level of computing complexity. Furthermore, the fact that there was a strong asso-

ciation with rankings determined by the PF-TOPSIS method confirms its usefulness for decision-making purposes.

2.3. Itai Lishner and Avraham Shtub: Enhancing Strategic Planning of Projects: Selecting the Right Product Development Methodology

This manuscript focuses on a New Product Development (NPD) project and the process of selecting a suitable development technique for it. The primary issue is the difficulty in precisely determining the time of a project based on the selected methodology. Hence, this study addresses the constraints of current models and presents a pioneering NPD project model that enables the examination and assessment of various product development methodologies. The model evaluated Waterfall, Spiral, Agile and Hybrid approaches and offered system engineers and project managers decision-making tools to identify the most effective strategy and comprehend the related trade-offs. The model was verified by the utilization of actual projects from diverse businesses and approaches. The system integrated random variables, the management of potential risks and the allocation of resources in a flexible manner, while considering both the Waterfall and Agile approaches. This study enhances existing knowledge by providing practical resources for system engineers and project managers to select development methodologies, enhance project duration estimation and identify crucial processes and hazards in NPD initiatives. The research findings also serve as a foundation for future investigations and can be advantageous to scholars who are interested in systems engineering approaches. The suggested model addresses a deficiency in existing research by offering a validated New Product Development (NPD) model that can assess how various product development approaches affect the duration of a project.

2.4. Vivek Kumar Prasad, Debabrata Dansana, Madhuri D. Bhavsar, Biswaranjan Acharya, Vassilis C. Gerogiannis and Andreas Kanavos: Efficient Resource Utilization in IoT and Cloud Computing

This study examines the exponential increase in data generation as a factor that places significant pressure on both cloud computing (CC) and Internet of Things (IoT) infrastructure. CC is well known for its capacity to scale and offer virtual resources, which is crucial for e-commerce applications. Nevertheless, the ever-changing characteristics of the Internet of Things (IoT) and cloud services bring forth distinct difficulties, particularly in the creation of service-level agreements (SLAs) and the ongoing surveillance of adherence to such agreements. This paper introduced a flexible framework for adapting e-commerce applications to Internet of Things (IoT) and cloud computing (CC) settings. This study introduced a complete collection of measurements that were specifically designed to assist in the meeting of service level agreements (SLAs) by allowing for regular evaluations of resources and ensuring they are in line with service-level objectives. This technique, based on policies, aimed to automate the management of resources in the era of cloud computing, thus decreasing the reliance on significant human involvement in e-commerce systems. This paper concludes with a case study that illustrates the actual application of metrics and policies in the management of cloud resources. Moreover, it offers valuable knowledge on the resources needed for implementing e-commerce applications in the context of the Internet of Things (IoT) and cloud computing (CC). This comprehensive strategy has the power to simplify the monitoring and management of CC services, thereby improving their efficiency and dependability.

2.5. Bilal Naji Alhasnawi, Basil H. Jasim, Ali M. Jasim, Vladimír Bureš, Arshad Naji Alhasnawi, Raad Z. Homod, Majid Razaq Mohamed Alsemawai, Rabeh Abbassi and Bishoy E. Sedhom: A Multi-Objective Improved Cockroach Swarm Algorithm Approach for Apartment Energy Management Systems

Currently, the largest source of unpredictability for an electricity provider is the electrical demand and generation in power systems. The effectiveness of demand responses, achieved through residential appliance energy management, has garnered considerable attention due to their reliability and economic benefits for an electricity grid. Given the

variability of energy costs and usage patterns, it might be challenging to establish an optimal timetable for operating residential appliances. Thus, the Improved Cockroach Swarm Optimization Algorithm (ICSOA) was integrated with the Innovative Apartments Appliance Scheduling (IAAS) framework as a response to this scenario. An analysis of the cost reduction in power, optimization of user comfort and decrease in the peak-to-average ratio for apartment equipment was conducted using the proposed technique. The suggested framework was assessed through a comparison with the Bacterial Foraging Optimization Algorithm and scenarios without scheduling. Compared to the situation without scheduling, the BFOA method achieved a 17.75% reduction in energy expenses, while the ICSOA strategy achieved a more significant reduction of 46.085%. Based on the findings, the ICSOA algorithm outperformed the BFOA and W/O scheduling scenarios in achieving the stated objectives, providing benefits to both utilities and customers.

2.6. Manolis Remountakis, Konstantinos Kotis, Babis Kourtzis and George E. Tsekouras: Using ChatGPT and Persuasive Technology for Personalized Recommendation Messages in Hotel Upselling

The latest progress in large language models (LLMs), including ChatGPT, and persuasive technologies have created new opportunities to improve the efficiency of recommender systems. This research examines the feasibility of combining ChatGPT and persuasive technologies to automate and enhance hotel hospitality recommender systems. Initially, the authors explored the functionalities of ChatGPT, which possesses the ability to comprehend and produce text that resembles human language. This allows for more precise and contextually aware suggestions. At present, the conversation revolves around the incorporation of ChatGPT into recommender systems, emphasizing its capacity to examine user preferences, derive important insights from online reviews and produce personalized recommendations according to visitor profiles. This study examined the influence of persuasive technology on user behavior and how it enhances the persuasive impact of hotel recommendations. Recommender systems can exert a strong influence on user decision making and prompt desired actions, such as reserving a particular hotel or upgrading their stay, by employing persuasive strategies including social proof, scarcity and customization. Therefore, in this study, preliminary experiments were conducted to examine the effectiveness of ChatGPT and persuasive technologies. The tests focused on a specific case study that involved a hotel recommender system. The proposed approach enabled the hotel personnel to effectively communicate with all the guests in their respective languages by utilizing the integration of ChatGPT into the hotel's reservation system.

2.7. Viet Q. Vu, Minh-Quang Tran, Mohammed Amer, Mahesh Khatiwada, Sherif S. M. Ghoneim and Mahmoud Elsisi: A Practical Hybrid IoT Architecture with Deep Learning Technique for Healthcare and Security Applications

The significance of facial mask detection technology has grown significantly, extending beyond the scope of the COVID-19 pandemic. With the progress in facial recognition technology, the ability to recognize face masks has become an essential ability for a range of applications. This study presents an Internet of Things (IoT) framework that utilizes a sophisticated deep learning algorithm called You Only Look Once (YOLO) to ensure the well-being and safety of society, as well as gather data for future research purposes. The proposed paradigm is founded on economic considerations and is straightforward to apply. Moreover, the YOLOv4-tiny model that was utilized is considered one of the most efficient object identification models currently available. A mask detection camera, called MaskCam, was developed using the computational capabilities of NVIDIA's Jetson Nano edge nanodevices. This camera works in conjunction with a smart camera application to accurately identify whether a subject is wearing a mask on their face. MaskCam uses the MQTT protocol to differentiate between individuals who are wearing masks, those who are not wearing masks and those who are wearing masks incorrectly. In addition, the MaskCam system includes a custom-built web-browsing application that gathers and presents data for both qualitative and quantitative analysis. The empirical findings clearly

illustrate the excellence and efficacy of the proposed intelligent mask detection system. While YOLOv4-full achieved superior results even at lower resolutions, its frame rate is insufficient for real-time applications. However, it is twice as efficient as the other detection models, independent of the accuracy of detection. As a result, inferences can be performed more frequently across the entire video stream, leading to more precise output.

2.8. Konstantinos Filippou, George Aifantis, George A. Papakostas and George E. Tsekouras: Structure Learning and Hyperparameter Optimization Using an Automated Machine Learning (AutoML) Pipeline

This publication introduces an automated machine learning (AutoML) pipeline designed for structure-based learning and hyperparameter tuning. This pipeline comprises three primary automated steps. The initial step involves retrieving and preparing a dataset from the Kaggle database using the Kaggle API. The second step employs the Keras–Bayesian optimization tuning package for the purpose of hyperparameter optimization. The third stage of the process involves training the machine learning (ML) model using the hyperparameter values estimated in the previous stage. The model is then evaluated on the testing data using Neptune AI. The primary technologies employed for constructing a reliable and adaptable machine learning pipeline are the widely used Git version control system, the Google cloud virtual machine, the Jenkins server, the Docker containerization technology and the Ngrok reverse proxy tool. This last technology can securely expose the local Jenkins address to the public via the Internet. Therefore, certain components of the suggested pipeline are derived from the domain of machine learning operations (MLOps), leading to a combination of software approaches. The machine learning model employed for assessing the pipeline was a multilayer perceptron (MLP) that incorporates both conventional dense layers and polynomial layers. The simulation results demonstrated that the suggested pipeline performed at a dependable and precise rate while effectively enhancing the network's performance in classification tasks.

2.9. Irina Makarova, Jamila Mustafina, Aleksey Boyko, Larisa Fatikhova, Gleb Parsin, Polina Buyvol and Vladimir Shepelev: A Virtual Reality Lab for Automotive Service Specialists: A Knowledge Transfer System in the Digital Age

In contemporary society, there has been a rapid shift from the conventional mode of knowledge dissemination to online education. In this study, the examination of results attained by automotive students demonstrates that the effectiveness of this shift relies on preparedness to implement specialized digital tools for organizing information and facilitating practical forms of instruction. Additionally, this article presents a modern digital method of organizing and conveying knowledge to automobile service engineers, and this method involves the use of virtual laboratories. This study also provides a description and evaluation of the work situations, functionality and minimal technical requirements of virtual laboratories as software systems. The research conducted in this study presents a justification for the efficacy of using virtual laboratories, which is based on the outcomes of their use by 109 university students in training practice. An examination of the distributions of the student survey results and their training progress revealed statistically significant disparities. This validates the notion that employing virtual reality technologies to educate engineers in specialized disciplines and language abilities is far more efficacious than the conventional approach. A surge in students' enthusiasm for learning was observed, resulting in a significant enhancement in their academic performance. This demonstrates that the immersive quality of virtual reality technology enables a more effective absorption of the content being studied, enhances the motivation of prospective vehicle repair specialists and facilitates the online transfer of knowledge. The process of knowledge transfer is essential for obtaining new digital capabilities that are important for high-tech industries.

2.10. Mandla Ndzimakhwe, Arnesh Telukdarie, Inderasan Munien, Andre Vermeulen, Uche K. Chude-Okonkwo and Simon P. Philbin: A Framework for User-Focused Electronic Health Record System Leveraging Hyperledger Fabric

The objective of this research study was to explore the potential applications of Hyperledger Fabric (HLF) in the healthcare industry. This project aimed to fill the existing knowledge gap by establishing strategies that could customize the adoption of electronic medical records (EMRs) in the healthcare industry, making it simpler and more effective. This research primarily investigated user-centric approaches to utilizing blockchain technology. An examination of several principles employed in the development of web apps was conducted. This study determined that Hyperledger Fabric, an open-source project, could be used to create a new approach for storing EMRs. The framework presented offers a customizable test network that can meet the requirements of various applications, such as the storage of medical records. This research also highlighted the challenges faced and issues that must be addressed prior to the successful implementation of HLF in healthcare systems. HLF is the most suitable blockchain solution for meeting the requirements of healthcare systems, as it provides a distributed and secure environment. Blockchain has the capacity to revolutionize healthcare by prioritizing the patient as the focal point of the system and improving the security and compatibility of health data. Moreover, with the utilization of grant and revoke access procedures, patients own absolute authority over their medical information, including the ability to determine which approved clinicians are permitted to see their records. This capability is enabled by the chaincode specified in the blockchain platform. This research study has significant importance for both practitioners and researchers in the development of secure blockchain-based EMRs.

2.11. Mirjana Pejić Bach, Tamara Ćurlin, Ana Marija Stjepić and Maja Meško: Quo Vadis Business Simulation Games in the 21st Century?

This publication aimed to identify the main research trends and topics in the field of business simulation games through a systematic and automated literature review. This research was motivated by the desire to further knowledge in the areas of learning and domain expertise. The findings of this study indicate that future research on business simulation games will be based on papers collected from Scopus. Additionally, an analysis was conducted on the research schedule, primary publication outlets and patterns of citation. Furthermore, text mining was employed to extract the most common words, phrases and subjects. The findings suggest that the study on business simulation games has reached a point of little or no progress, with the most often referenced studies being published during the 2000s. The existence of a balance between research focused on learning and research focused on specific domains suggests that research driven by technology is not common. This indicates that the technology utilized for business simulation games has reached a state of maturity. The focus of research in this area should be on exploring how new technologies, such as virtual reality, augmented reality and simulation games, can enhance communication with and among users. Additionally, studies should investigate how artificial intelligence can enhance the complexity of reasoning and decision making in business simulation games.

2.12. Muhammad Anshari, Muhammad Syafrudin, Abby Tan, Norma Latif Fitriyani and Yabit Alas: Optimisation of Knowledge Management (KM) with Machine Learning (ML) Enabled

The advent of artificial intelligence (AI) and its related technologies, such as machine learning (ML) and deep learning (DL), marks the beginning of a new era in the way knowledge is managed and presented. Knowledge management (KM) requires the use of machine learning (ML) to enhance organizational experiences, namely by making knowledge management more easily accessible and easily shared. Machine learning requires the utilization of large datasets to create an automated technique of analyzing data and constructing analytical models. This is enacted with the goal of enhancing the knowledge within an organization. In order to facilitate decision making, it is imperative to automate the management of knowledge, which is the most valuable asset of an organization. This

can be achieved by implementing machine learning (ML) in knowledge management systems (KMSs). Therefore, the primary aim of this study was to examine the degree to which machine learning applications are utilized in knowledge management. This study conducted a comprehensive examination of the existing literature and a systematic analysis of themes in previous studies to gather pertinent data. This paper presents a comprehensive analysis of the correlation between big data, machine learning and knowledge management. Additionally, this study revealed that a mere 10% of the published research pertains to the intersection of machine learning and knowledge management in business and management contexts. Hence, this study provides a comprehensive analysis of the existing knowledge deficit in exploring the utilization of machine learning (ML) in knowledge management (KM) for business purposes within organizations.

3. Conclusions

In summary, these papers collectively delve into various applications of cutting-edge technologies within the context of systems engineering, a multidisciplinary field emphasizing the design, analysis and optimization of complex systems. Spanning across domains such as healthcare, finance, social media analysis, supply chain management, computer vision, cloud computing, smart city development, engineering optimization, genomics, optimization problems and cybersecurity, each paper explores how advanced technologies, including artificial intelligence, machine learning, blockchain, data analytics, bioinformatics and swarm intelligence, can be leveraged to address intricate challenges within interconnected systems. Moreover, these papers highlight the importance of knowledge management in harnessing the vast amounts of data generated by these systems, underscoring the need for efficient methods of data collection, processing, analysis and dissemination to inform decision-making processes, drive innovation, foster collaboration and enhance organizational performance. This convergence of advanced technologies and knowledge management practices signifies a paradigm shift towards interdisciplinary research and innovation aimed at advancing systems engineering methodologies and enhancing the resilience, efficiency and sustainability of complex systems in an increasingly digital and interconnected world.

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