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EDITORIAL

Systems Design in The Emerging Digital Age

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The landscape of engineering systems design has been changing in the context of recent pervasive digitalization trend and the fast development of smart cyber-physical systems or smart connected systems powered by Internet of Things. Many traditional products no longer stand alone, and they are becoming smart devices and connected with others in networks. As a result, the service quality, availability, reliability, safety, and security of those connected systems will impact each other. But more importantly, the connectivity offers opportunities for those systems to provide intelligent services, leads to synergy from the connected systems, and triggers innovative applications and business models (Huang, 2017; Huang et al., 2016; Khaitan and McCalley, 2015; Porter and Heppelmann, 2015). The increasing complexity of systems operational environment and profound impacts make systems design in the digital age become much more complex and challenging.

Systems design, in a broader sense, aims to satisfy the needs and requirements of stakeholders and the operational concept (OpsCon) by defining system requirements, creating and specifying alternatives of logical architecture, physical architecture and interfaces, analysing and selecting optimal architecture(s), and creating and specifying engineering details for realizing the selected architecture(s). The concepts, principles, methodology, models and methods of systems design have been evolving for decades (Abran et al., 2004; BKCASE Editorial Board, 2017; Blanchard and Fabrycky, 2010; Buede and Miller, 2016; INCOSE, 2015; Simon, 1996, 1988, 1969; White, 1998). The evolution of the discipline is based on the practice of many specific fields of engineering systems design, such as software engineering (Boehm, 1988, 1981; INCOSE, 2015; Sangiovanni-Vincentelli and Martin, 2001), control system (Johnson, 1989; Noura et al., 2009; Tanaka and Wang, 2004), embedded systems (Henzinger and Sifakis, 2007; Kopetz, 2011), manufacturing systems (Wu, 2012), and many others. As discussed earlier, in the new landscape of smart connected operational environment, the complex interactions and their impacts between the system in design and external systems in the operational environment pose many challenges to engineering systems design. Among those challenges, security is perhaps the most significant and widely concerned issue (Humayed et al., 2017; Sadeghi et al., 2015); beyond technologies, human users frequently become the cause of security incidents, thus being a critical factor to the cybersecurity of an organization and associated digital systems. More generally, human factors have become an important consideration of systems design (Nemeth, 2004; Stanton et al., 2017; Woodson et al., 1992). Moreover, the introduction of digital systems,

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smart connected devices in an organization will trigger new applications and business process innovation (Porter and Heppelmann, 2015).

This issue of the Journal of Integrated Design and Process Science presents four research papers and each of them reflects some interesting aspects of systems design. The first paper, written by Ronchieri and Canaparo, focuses on system reliability and analyses the literature on software reliability metrics. As stated in the paper, techniques and models are the other two elements besides metrics that contribute to measuring system reliability, which represents an important aspect of the quality of a system. In the second paper, Øvrelid and Halvorsen study how lightweight IT, which belongs to techniques, can support process innovation under a healthcare system. The third paper, written by Sols et al., emphasizes the important role of timely technical reviews to the success and efficiency of a system from a management perspective. Last but not the least, in the fourth paper Zhang and Yang investigate the impact of human factors on cyber security.

The first paper of this issue, "Metrics for Software Reliability: A Systematic Mapping Study", presents a Systematic Mapping Study on software reliability. The authors follow a five-phase procedure and every phase is carefully analyzed to identify, structure and classify the literature that use metrics for software reliability. 128 papers are selected as primary papers for further analysis, most of which propose new models, metrics or techniques. Afterwards, their research findings are achieved based on the primary papers, including the publication status from 1980 to 2016, the applied techniques, and research topics over the past ten years within the field of software reliability. Moreover, the most frequent metrices for assessing reliability are identified and summarized in a table. This research may be used by designers and engineers as a valid reference to work on the reliability of software systems.

The second paper is entitled "Supporting Process Innovation with Lightweight IT at an Emergency Unit". As illustrated in the title, this work investigates the role of light weight IT in supporting process innovation within the field of information infrastructures. Empirical evidence is given by an analysis of the data collected from a two-year project in an emergency unit in Oslo, including interviews, observations, and various documentations. Electronic whiteboards and smart mobile phones are the considered lightweight IT in this case. After identifying the challenges and the three development phases of the project, Melão and Pidds (Melão and Pidd, 2000)'s four perspectives are used to develop the arguments from a business point of view. The authors demonstrate that lightweight technology can improve logistics and message interaction within and between health units with a series of analysis.

The third paper is entitled "Lessons Learned from Technical Reviews in Systems Engineering Management — Recommendations to Practitioners". This paper aims at increasing the likelihood of project success by enabling effective and efficient execution of technical reviews throughout the system's life cycle. A review of the main formal technical reviews is presented where the concepts, goals, and outcomes of technical reviews are discussed. Six pitfalls that may lead to a failure in yielding the intended value of technical reviews are identified. Afterwards, examples from the Spanish defense sector are given and explained where the mentioned pitfalls actually happened. From the experience gathered in previous projects, which is also denoted as "lessons learned", thirteen recommendations are proposed for systems engineering managers to take better use of technical reviews.

In the fourth paper, entitled "Impact of Cross-Culture on Behavioral Information Security", the authors conduct a survey to investigate the effect of the three cross-culture dimensions, defined by Hofstede, on behavioral information security. The significances of the main effect and interaction between the three cross-culture dimensions, namely Individualism versus Collectivism (IDV), Uncertainty Avoidance Index (UAI) and Indulgence versus Restraint (IND), are examined by applying ANOVA to the collected data. The results indicate that cultural differences, represented by different combinations of the three cultural dimensions in this case, can affect how individuals act when dealing with information security issues. Cross-culture factor is one of the human factors that should be carefully considered which may contribute to a reduced information security risk of a certain system.

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