

Guest Editorial Preface

Special Issue on Critical Management and Technical Issues of Data Center Systems

Jorge Marx Gómez, Carl von Ossietzky Universität Oldenburg, Oldenburg, Germany

Manuel Mora, Autonomous University of Aguascalientes, Aguascalientes, Mexico

Rory O'Connor, Dublin City University, Dublin, Ireland

Mahesh Raisinghani, Texas Woman's University, Denton, USA

This 23th issue of the International Journal of Information Technology and the Systems Approach (IJITSA), corresponds to a special issue on Critical Management and Technical Issues of Data Center Systems. The objective of this special issue was stated as: “to encourage in the Information System community the interest and engagement in doing high-quality research on critical management and technical issues found, lived and expected to be solved in thousands of Data Centers spread worldwide.”

Data Centers (and Data Center Systems) have become a relevant organizational asset for generating valuable information resources and providing Information Technology and Communication (ICT) functionalities to local and remote internal or external end users (Marx et al., 2017).

In the last decade, with the explosion of web-based and inter-organizational systems for these type of end users, in large and medium-sized organizations with international operations, the Data Centers Systems now are considered mission-critical assets whose availability, performance, power efficiency, security, continuity, and overall effectiveness must be guaranteed in order to avoid critical downtimes (Arregoces & Portolani, 2003; Bilal et al., 2014). Industry reports (ENP, 2011) indicate that 1-hr downtime costs in Data Centers installation varies from US \$10,000 to US \$6,000,000 to organizations providing services such as: ATM, cellular services, airline reservations, on-line shopping, package shipping, credit card authorizations, and brokerage operations. Additional to direct financial costs, organizations can also suffer negative impacts from a data center's downtime on: image by business disruption, end-user productivity, IT productivity, and third-party operational delay (ENP, 2011). Thus, Data Centers installations are currently key organizational assets, and their high value proposition in ensuring business continuity operations has been highlighted.

However, the planning, design, implementation, operation and control, maintenance, evolution, and disposal (when the useful data center's life has been reached) of Data Centers, in modern times represents a complex intertwined net of processes (Holtsnider & Jaffe, 2012). The explosion of ICT has introduced both critical technical engineering problems and challenges for Data Centers managers (Alaraifi et al., 2013). In turn, the economic, and socio-political environmental international issues have also introduced managerial challenges for Data Center managers regarding green IT initiatives, IT service management initiatives, IT managerial cost reduction, provision of effective valued IT services, timely release of IT services, and assuring a high IT service availability and continuity status (Galup et al., 2009). In particular, the conceptualization of Data Centers as service systems (Mora et al., 2009; Törhönen, 2014) and the link with the design of IT services (Mora et al., 2015) as well as their final implementation in Data Centers is missing in the literature.

Furthermore, traditionally the knowledge sources on data center processes have come from the ICT industry. Thus, there is a wide knowledge gap between the academic and industry sectors on critical management and technical issues on Data Centers at present. This is due to the explosion of ICT, the high costs for having laboratories type Data Centers in the academic environments, the lack of textbooks on Data Centers, and the scarcity of undergraduate and graduate courses on these topics (Gusev et al., 2014; Memari et al., 2014). Nevertheless, we consider that knowledge with rigor and relevance must be produced from both academia and industry. ICT academia has published research on IT service management process frameworks, cloud computing performance models (Bilal et al., 2014), and other related issues. On the other hand, ICT industry has advanced with green IT metrics (Wang & Khan, 2011), maturity models (Singh et al., 2011) and best practices for software development such as DevOps (Kim et al., 2015) where data center engineers are included for a fast and correct software release (Kliazovich et al., 2012).

Hence, updated, integrative, scientific and practical knowledge is required to address critical managerial and technical issues on planning, designing, implementing, operating and controlling, maintaining, evolving, and migration or disposal of Data Centers Systems.

Thus, in this special issue we selected the best 5 papers from the pool of received ones which addressed some of the critical managerial or engineering issues found in Data Centers.

The first paper entitled, *Introducing ITIL Framework in Small Enterprises: Tailoring ITSM Practices to the Size of Company*, and authored by Abir El Yamani, Khalifa Mansouri, Mohammed Qbadou, and Elhossein Iloussamen at the University of Hassan II, Morocco, proposes a systematic method for tailoring the ITIL process framework to small and medium-sized enterprises (SME) by using a Design Research paradigm. The authors establish such a need due to ITIL (and similar ITSM process frameworks) are hardly successfully implemented in SME by multiple economic, technical and organizational barriers. The authors use also decision-making techniques (AHP and TOPSIS) for supporting its framework design and test empirically your tailored ITIL with a single SME. Quantitative metrics and subjective opinions from the SME's participants in the adaptation of the ITIL framework were collected. This research qualifies also like a kind of Action Research, and despite a single empirical case is reported, the design and empirical test by using the systematic tailoring method offers valuable insights for ITIL practitioners at SMEs. This paper also contributes to propose effective and efficient solutions to critical issues found in Data Centers from SMEs with the adequate implementation of ITIL processes.

In the second paper, entitled *Exploring ITIL® implementation challenges in Latin American Companies*, Teresa Lucio-Nieto and Dora Luz Gonzalez-Bañales, respectively at both Universidad Iberoamericana and Customer Care Associates company, and Instituto Tecnológico de Durango, Mexico, explored empirically the ITIL implementation challenges through a snow-ball sample of 169 Latin American companies (mainly in Mexico country and complemented with enterprises from Colombia, Brazil, Guatemala, Ecuador, and Dominican Republic). This non-probabilistic sample was analyzed as technological (36%) vs non-technological (64%) ones, and by size (small (less than 100 employees: 19%), medium-sized (101 to 500 employees: 17%), large (501 to 1,000 employees: 13%), and very large (more than 1,001 employees: 51%)). Authors indicate that the participants were mostly professionals related to IT activities, from managerial to operational the 82%, and the remainder 18%, were people engaged in business managerial activities. The authors found several very relevant insights on: ITIL benefits, implementation challenges, key actions, and IT-Business strategic and investments issues. This paper, thus, contributes also to improve our understanding on critical issues experienced by enterprises engaged in current or forthcoming ITIL implementations, which lately rely on Data Center operations.

In the third paper, entitled *Business Continuity Management in Data Center Environments*, Holmes E. Miller, at Muhlenberg College, USA and Kurt J. Engemann, at Iona College, USA, report a conceptual research paper where reviews thoroughly Business Continuity Methodologies (BCM) and its suitability and need of being applied in specific on Data Center systems. The authors indicate the BCM are used by enterprises to respond to natural disasters, man-made disasters, and accidents,

and thus, Data Center Systems, being new critical organizational assets, must develop their specific Continuity Plans. In particular, the authors discuss BCM for colocation and cloud-based Data Center architectures. Finally, the authors report how the Ordered Weighted Average (OWA) methodology can enhance a Business Continuity decision-making process for analyzing risk profiles of decision makers. This paper contributes also to this special issue by addressing a critical situation faced by Data Centers nowadays as their exposition to major disaster risks.

In the fourth paper entitled Towards Benefiting both Cloud Users and Service Providers through Resource Provision, Durga Sivan at Karunya Institute of Technology and Sciences, India, Mohan Sivan at Al Yamamah University, Saudi Arabia, and Dinesh Peter, and Martina Nittala, both at Karunya Institute of Technology and Sciences, India, provide a plausible solution for obtaining optimized simultaneous solutions for both Cloud Users (CU) and Cloud Service Providers (CSP) through the application of the nature-inspired optimization Heart Algorithm. The authors state that CU pursue to minimize response time and maximize Quality of Service Metrics mainly, while that CSP pursue to minimize cost and energy, and maximize resource utilization and revenues. Thus, the authors elaborate a simulation model (with the Cloudsim toolkit) and collect several performance metrics (execution time, resource utilization, mean time of response, and resource cost). The simulation results suggest an improvement regarding competitive methods reported in the literature. Thus, this research contributes to this special issue addressing another critical issue found in Data Center Systems.

Finally, in the fifth paper entitled A QoS-Enhanced Model for Inter-Site Backup Operations in Cloud SDN, Ammar AlSous and Jorge Marx Gómez both at Carl von Ossietzky University of Oldenburg, Germany, address the critical issue on Inter-Site Backup in the context of Cloud Services. The authors establish that Backup operations are critical and mandatory to be performed in any Data Center, and in particular they realize that dedicated or shared connection lines between Data Centers (or the Data Center and the Cloud provider) can generate sub-optimal utilization rates. Additionally, reconfiguration of Backup services in the used network demands more managerial work. Thus, given the emergence of virtualization techniques, the authors explore the utilization of Software-Defined Networks (SDN) models to achieve both Customer and Cloud provider Quality of Service (QoS) metrics. The authors propose and test a simulated SDN model by using Mininet toolkit for supporting an Inter-Site Backup process. The collected metrics served to identify emergent challenges to tune optimal SDN due to the interaction of multiple non-controllable factors from the user's perspective. The authors, consequently, propose the utilization of machine learning techniques (in particular automatic generation of fuzzy decision rules) which help automatically to reconfigure and select best paths on the SDN for achieving the optimal QoS expected metrics. This paper contributes also to this special issue exploring a complex real problem found in Data Center Systems.

Hence, we consider that this 23th IJITSA special issue on Critical Management and Technical Issues of Data Center Systems, contributes –as all published past issues– to advance our scientific and practical knowledge of structures, mechanisms, and plausible solutions on relevant theoretical and real problems found in the fields of Information Technology, Software Engineering, Systems Engineering and/or Philosophy of System Sciences, from an interdisciplinary systems paradigm (Mora et al., 2008). High-quality research papers that contribute to this aim are welcome in this journal. Finally, we (Guest Editors, Editor-in-Chief and Associate Editors of IJITSA) express our sincere gratitude to paper's authors, reviewers, and IGI editorial staff, for their valuable participation and assistance.

Jorge Marx Gómez
Manuel Mora
Rory O'Connor
Mahesh Raisinghani
Guest Editors
IJITSA

REFERENCES

- Alaraifi, A., Molla, A., & Deng, H. (2013). An empirical analysis of antecedents to the assimilation of sensor information systems in data centers. *International Journal of Information Technologies and Systems Approach*, 6(1), 57–77. doi:10.4018/jitsa.2013010104
- Arregoces, M., & Portolani, M. (2003). *Data center fundamentals*. USA: Cisco Press.
- Bilal, K., Malik, S. U. R., Khan, S. U., & Zomaya, A. Y. (2014). Trends and challenges in cloud datacenters. *IEEE Cloud Computing*, 1(1), 10-20.
- ENP. (2011). Understanding the cost of data center downtime: an analysis of the financial impact on infrastructure vulnerability [White paper]. Emerson Network Power.
- Galup, S. D., Dattero, R., Quan, J. J., & Conger, S. (2009). An overview of IT service management. *Communications of the ACM*, 52(5), 124–127. doi:10.1145/1506409.1506439
- Gusev, M., Ristov, S., & Donevski, A. (2014). Integrating practical CISCO CCNA courses in the Computer Networks' curriculum. In *Proceedings of the 2014 IEEE Global Engineering Education Conference (EDUCON)* (pp. 499-506).
- Holtznider, B., & Jaffe, B. D. (2012). *IT Manager's Handbook: Getting your new job done*. Elsevier.
- Kim, J., Meirosu, C., Papafili, I., Steinert, R., Sharma, S., Westphal, F. J., . . . Manzalini, A. (2015). Service provider DevOps for large scale modern network services. In *2015 IFIP/IEEE International Symposium on Integrated Network Management (IM)* (pp. 1391-1397). IEEE.
- Kliazovich, D., Bouvry, P., & Khan, S. U. (2012). GreenCloud: A packet-level simulator of energy-aware cloud computing data centers. *The Journal of Supercomputing*, 62(3), 1263–1283. doi:10.1007/s11227-010-0504-1
- Marx-Gómez, J., Mora, M., Raisinghani, M., Nebel, W., & O'Connor, R. V. (2017). *Engineering and Management of Data Centers*. Germany: Springer. doi:10.1007/978-3-319-65082-1
- Memari, A., Vornberger, J., Marx Gómez, J., & Nebel, W. (2014). A data center simulation framework based on an ontological foundation. In *Proceedings of the Proceedings of the 28th EnviroInfo 2014 Conference*, Oldenburg, Germany, September 10-12 (pp. 1-8).
- Mora, M., Marx, R., O'Connor, J., Raisinghani, M., & Gelman, O. (2015). An Extensive Review of IT Service Design in Seven International ITSM Processes Frameworks: Part II. *International Journal of Information Technologies and Systems Approach*, 8(1), 68–88. doi:10.4018/jitsa.2015010104
- Mora, M., Raisinghani, M., O'Connor, R., & Gelman, O. (2009). Toward an integrated conceptualization of the service and service system concepts: A systems approach. *International Journal of Information Systems in the Service Sector*, 1(2), 36–57. doi:10.4018/jiss.2009040103
- Singh, H., Reuters, T., Azevedo, D., Ibarra, D., Newmark, R., & O'Donnell, S. (2011). *Data center maturity model. Technical Report*. The Green Grid.
- Törhönen, V. (2014). Designing a Software-Defined Datacenter [MSc Thesis]. Tampere University of Technology, Finland.
- Wang, L., & Khan, S. U. (2013). Review of performance metrics for green data centers: A taxonomy study. *The Journal of Supercomputing*, 63(3), 639–656. doi:10.1007/s11227-011-0704-3