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Sustainable knowledge-based decision support systems (DSS): perspectives, new challenges and recent advance

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Guest Editorial

Sustainable knowledge-based decision support systems: perspectives, new challenges and recent advances

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1. Evolution of decision making and DSS

Evidence has clearly shown that excellent business performance can only be achieved based on the right decisions (Liu et al, 2013). The ability to make good decisions is the mark of successful and promotable business leaders and managers (Martinsons and Davison, 2007). Research on decision making can be traced back to preceding work in two main research streams: theoretical study of organisational decision making undertaken by Simon et al. at the Carnegie Institute of Technology during late 1950s and early 1960s (Simon, 1960), and technical work on interactive computer systems carried out by Gerrity et al. at the MIT in 1960s (Gerrity, 1971). Simon's three-stage human decision making process (i.e. intelligence, design and choice) is still one of the most widely cited decision models. However, Gerrity's work has identified a key issue with human decision making, that is, the fact that there are many constraints on effective decision making, for example, with limited information and limited decision analysis ability. Along with the fast IT advancement over 1970s and 1980s, it has been widely recognised that computers could be used to overcome many human limitations. Subsequently, decision support systems (DSS), defined as an interactive computer-based system to support solving decision problems, have been developed and widely applied in real world decisions (Shim et al, 2002). DSS was considered to be one of the most popular research areas in information systems during 1980s. Most notably, DSS have evolved from supporting individual decisions to supporting groups and then to supporting organisation-wide decisions (Liu et al, 2009). In addition, the types of decisions that DSS are able to support extend from operational to strategic decision making (Martinsons and Davison, 2007). A number of review papers can be found which have embraced the DSS success over the time (Keen, 1987; Eom, 1999; Carlsson and Turban, 2002; Shim et al, 2002; Liu et al, 2010).

However, DSS have entered into a relatively difficult time in 1990s, because DSS users were no longer satisfied by merely searching for information and obtaining analysis results from running a decision model (Liu et al, 2010). Based on experience in practice, decision makers gradually realised, apart from information and decision analysis, the human element was found to be lacking sufficient knowledge and expertise in order to make faster and more consistent decisions (Bolloju, Khalifa andTurban, 2002). In response to the new issue identified within human decision making process, many scholars and researchers invested a significant amount of effort to search for solutions, which resulted in the emergence of knowledge based systems (KBS), which is also termed as expert systems in America (Dhar and Stein, 1997). Since 1990s, KBS and expert systems have been playing an important role in the new generation of DSS, which led to the

development of knowledge-based decision support systems (KB-DSS) (Courtney, 2001). KB-DSS have been generally accepted as decision systems that contain a knowledge base and have a function of inference or reasoning on top of a classical DSS. A comprehensive review of KB-DSS is available from the guest editors' recent publication (Zarate and Liu, 2016). A Special Issue focused on technology perspective of KB-DSS is published earlier in the Journal of Decision Systems (Liu, Zarate and Ribeiro, 2014). However, the current issues of global sustainability and business performance improvement have presented brand new challenges to decision making and to KB-DSS.

2. New challenges

In recent years, business management has been facing new challenges because of the increasing importance of incorporating the issue of sustainability into the decision making process, which requires innovative measures and metrics to assess the business performance from triple bottom line of perspective, the environment, the social and the economic perspective (Denzer, 2005). It has been widely accepted that business performance is greatly influenced by the decisions made on the strategy, design, planning and control, and continuous improvement of all business operations (Chiou et al, 2011). Making the right decisions to ensure excellent business performance remains a challenging task because of the variety, complexity, uncertainty and dynamics of decisions (Liu et al, 2013). In literature, decision support for business performance management has been discussed in more or less a fragmented manner, e.g. using traditional decision methods such as decision trees, linear programming, analytic hierarchical process, analytic network process and other multi-criteria decision analysis methods. The methods have been employed mainly for classic economic performance management but are less frequently applied to measuring social and environmental outcomes (Chan et al, 2003).

Today in a highly competitive business environment, decisions need to be made more quickly with better precision, supported by proven knowledge and expertise, using state-of-the-art DSS technologies such as innovative KB-DSS, which can adapt to new decision environment surrounded by artificial intelligence, semantic web, social media, and "Big Data" analytics (Delibasic et al, 2016). Furthermore, the ultimate aim of developing and employing KB-DSS is to improve decision performance in real industrial/life decision cases (Zarate and Liu, 2016). A gap in literature exists especially in the area of exploring advanced KB-DSS which address the current environmental sustainability issues supporting the reasoning and learning capabilities of decision making and improving business performance in real industrial environment. This Special Issue intends to fill this gap by providing a collection of papers with empirical evidence from industries to make a concerted effort to discuss innovative KB-DSS that aims to help address all aspects of performance measures in business in a coherent manner.

3. Perspectives and recent advances

This Special Issue (SI) includes twelve papers addressing the new challenges presented to KB-DSS by the sustainability and business performance requirements. The SI represents the most recent advances in the topic from different perspectives, contributing to real industrial applications in wide variety of businesses. A number of state-of-the art knowledge management technologies are explored in the SI, including data mining, machine learning, rule-based reasoning, taxonomy, clustering, ontologies and other artificial intelligence (Dhar and Stein, 1997; Zarate and Liu, 2016). In terms of decision technologies incorporated, the SI has achieved consensus on utilisation of multi-criteria decision analysis, mainly because businesses need to address all three pillars of the sustainability (i.e. the environmental, economic and social dimensions) concurrently (Wang et al, 2012). The applications supported by KB-DSS reported in this SI can be classified in four clear streams: with four papers on sustainable supply chain and logistics, three papers on business process improvement and ecosystems, three papers in product, service and project development, and two papers on knowledge and information systems implementation. The following table gives an overview of the papers.

Table 1 Classification of the papers included in the SI

Theme	Paper	Lead author	Key knowledge management and decision methods/technologies
Sustainable supply chain and logistics	Decision Support Systems for Sustainable Logistics: A Review and Bibliometric Analysis	Fahham Hasan Qaiser	Review paper, covered wide range of methods and technologies
	Identification and Selection of ICTs for Freight Transport in Product Service Supply Chain Diversification	José Moreno-Jiménez	Taxonomy, technology tree, AHP
	Virtual Enterprise Formation in the Context of a Sustainable Partner Network	Eduard Shevtshenko	Fuzzy AHP, TOPSIS
	An intelligent approach to big data analytics for sustainable retail environment using apriori map reduce framework	Neha Verma	Big data analytics, apriori association mining
Business process and eco-system	A positive deviance approach to eliminate wastes in business processes: the case of a public organization	Pavlos Delias	Clustering, generalised regression
	Knowledge Sharing and Collaborative Relationships in Business Ecosystems and networks - a definition and a demarcation	Anna Wulf	Knowledge sharing, clustering and networking, organisational learning
	Decision-making framework with double-loop learning through interpretable black-box machine learning models	Marko Bohanec	Double-loop learning, machine learning, data mining, CRISP-DM
Product, service and project development	A semantic based decision support platform to assist products' eco-labelling process	Da Xu	Ontologies, SWRL, RDF, OWL
	An MCDM Project Portfolio Web-Based DSS for Business Strategic Performance Improvement	Carolina Martins	MCDA, Web-based DSS

	Development of an intelligent e-Healthcare system for the domestic care industry	Bennie Wong	Data mining, decision trees, apriori, rule-based reasoning
Knowledge and information systems implementation	ERP knowledge prioritisation for business performance improvement: perspectives of clients and implementation partners in UK industries	Uchitha Jayawickrama	ERP, AHP, knowledge prioritisation
	Effects of Conventional Method in Precast Concrete Building Maintenance: Towards BIM Implementation	Zul-Atfi Ismail	BIM

4. Concluding remarks

As guest editors, we are glad to have included in this SI a set of twelve high quality and interesting pieces of work, authored by experienced researchers from different institutions across all continents. Editing this Special Issue has been a great pleasure for us. We would like to thank a number of people who have greatly contributed to the successful completion of this SI. Firstly, we need to thank the Editors-in-Chief of IM&DS, Professor Hing Kai Chan and Dr Alain Yee Loong Chong, for giving us the opportunity to edit the SI with a topic we are passionate about. Consistent support and timely advice from Professor Chan over the SI editing process is highly appreciated. Thanks also go to colleagues in the Emerald Publishing for setting up the SI submission system through ScholarOne and advertising the SI Call for Papers online. Of course, we would also like to express our gratitude to the reviewers of this Special Issue, for their constructive feedback on the submissions. Last but not least, we wish to sincerely acknowledge the great help from our fellow colleagues on the EWG-DSS Co-ordination Board, namely Pascale Zarate, Fátima Dargam, Rita Ribeiro, Isabelle Linden and Jason Papathanasiou. They have offered their unreserved support to this SI from the initial topic design through review process to the final decision on the papers included in the SI. This SI would not have been possible without the wonderful support and help from all of them!

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