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Using quality function deployment to conduct vendor assessment and supplier recommendation for business-intelligence systems

Chih-Hsuan Wang *

Department of Industrial Engineering & Management, National Chiao Tung University, 1001 University Rd., Hsinchu 30013, Taiwan

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ABSTRACT

Business intelligence (BI) has been recognized as an important enterprise information system to help decision makers achieve performance measurement and management. Generally, typical BI users consist of financial analysts, marketing planners, and general managers. However, most of them are not familiar with BI's core technologies. In order to help corporate executives better assess BI vendors, evaluation criteria are separated into marketing requirements (MRs) and technical attributes (TAs), respectively. In particular, a fuzzy MCDM (multi-criteria decision making) based QFD (quality function deployment) is proposed as follows: (1) fuzzy Delphi is used to aggregate the performance scores of BI vendors, (2) fuzzy DEMATEL (decision making and trial laboratory) is conducted to recognize the causalities between MRs and TAs, and (3) fuzzy AHP (analytical hierarchy process) is employed to recommend optimal BI systems. For better benchmarking, the strengths and weaknesses of three competitive BI vendors (i.e. SAP, SAS, and Microsoft) are concurrently visualized through displaying a line diagram (in terms of TAs) and a radar diagram (in terms of MRs). More importantly, experimental results demonstrate that supplier assessment and supplier recommendation have been successfully accomplished.

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1. Introduction

In recent years, rapid advances in information technologies, such as data warehousing and data mining, coupled with urging requirements on performance management and corporate diagnosis embarks the popularity of business intelligence (Chen, Chiang, & Storey, 2012). Different from the wave of "operational" enterprise resource planning (ERP), "strategic" business intelligence (BI) started to emerge as an umbrella in mid 1990s to cover software-enabled business planning, business analytics and integration with the area of big data. Specifically, the need to adopt ERP results from business process reengineering (BPR) while the main reason to implement BI originates from the concept of decision support systems (DSS). Referring to Eckerson (2003), the main benefits of adopting BI for an organization are summarized in Fig. 1 for reference.

According to Gartner's report (Ravi, 2012), Fig. 2 demonstrates the top five key players in the BI market, including SAP (21.6%), Oracle (15.6%), SAS (12.6%), IBM (12.1%) and Microsoft (10.7%). Obviously, different players have their relative strengths and weaknesses on handling large volumes or high-dimensional big data, dealing with data velocity, data variety (structured and unstructured), and data visualization (dashboards and scorecards). As we know, SAP and Oracle already owns a huge market base in the ERP (enterprise resource planning) field. In addition, SAS is a well-known statistics package provider and Microsoft is the dominant player in the operating systems of personal computers. Today, owing to huge investment on enterprise resource planning (ERP), supply chain management (SCM), customer relationship management (CRM), and product lifecycle management (PLM), enterprise software selection has become much more important than before (Turban, Aronson, Liang, & Sharda, 2007). In particular, choosing software platform is quite different from buying products or services in many ways because software needs to be "maintained", "updated", and "repaired" (Büyüközkan & Feyzioğlu, 2005; Motwani, Subramanian, & Gopalakrishna, 2005).

In choosing an enterprise software package and planning for the overall project, managers or executives need to answer the following questions (Ngai, Law, & Wat, 2008; Tsai, Lee, Liu, Lin, & Chou, 2012a, 2012b): (1) Why do you want to implement BI? (2) What are your business requirements? (3) What is your expected ROI (return on investment)? However, during the process of software implementation and customization, they are often frustrated in integrating legacy systems, identifying key performance indicators, and constructing a causal system to perform corporate diagnoses.

* Tel.: +886 3 5712121x57310; fax: +886 3 5722392.
E-mail addresses: chihwang@mail.nctu.edu.tw, chihswang@gmail.com

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Therefore, Turban, Sharda, Aronson, and King (2008) suggested considering the following questions prior to implementing the BI systems: (1) reporting what happened in the past, (2) analyzing why it happened, (3) monitoring what is happening now, (4) indicating which actions should be taken and (5) predicting what will happen in the future.

Needless to say, technical features are more easily measured than non-technical (marketing) features when assessing software/platform vendors. For convenience, a brief comparison between various information technologies is described in Table 1. In reality, typical BI users involve financial analysts, marketing planners, and general managers (Elbashir, Collier, Sutton, Davern, & Stewart, 2013). Usually, most of them may not have sufficient MIS/IT backgrounds. Based on the theory of TAM (technology acceptance model), software users do not care about whom they buy from, but they concern more about perceived usefulness and ease-of-use (Amoako-Gyampah, 2007; Chang, Hsu, & Shiau, 2014). In order to highlight the importance of non-functional features, a QFD (quality function deployment) based framework is implemented in this context to consider two distinct aspects: marketing requirements (MRs) and technical attributes (TAs).

More importantly, this paper presents an integrated framework to help business planners conduct vendor assessment, supplier selection and product (software) recommendation. In particular, several critical issues are addressed as follows:

- By taking the interdependences between MRs and TAs into account, the importance weights of MRs and TAs are derived accordingly,
- To carry out supplier selection, the relative strengths and weaknesses of the competitive BI vendors are visualized and displayed in terms of MRs and TAs,
- User preferences for MRs are incorporated to conduct supplier recommendation in an unsupervised manner for accommodating the inexperienced BI users.

The remainder of this paper is organized as follows. Section 2 introduces vendor evaluation based on quality function deployment. Section 3 introduces the proposed framework composed of fuzzy DEMATEL, fuzzy Delphi, and fuzzy AHP. A real example to benchmark three representative BI vendors is illustrated in Section 4. Conclusions and future works are drawn in Section 5.

2. QFD based supplier assessment and software recommendation

By means of the quality function deployment (QFD), this study attempts to conduct supplier evaluation and recommendation in terms of two aspects, including marketing requirements and technical attributes. Quality function deployment (Akao, 1990) originated in Japan has been widely applied to numerous areas for product development, concept evaluation, service design, and competitor benchmarking. Generally, the QFD is characterized by a set of marketing requirements (MRs) associated with technical attributes (TAs). Typically, the conventional QFD consists of the following four phases (Büyüközkan & Feyzioğlu, 2005; Wang & Chen, 2012): phase one translates marketing requirements into technical attributes; phase two translates technical attributes into part characteristics; phase three translates part characteristics into manufacturing operation, and phase four translates manufacturing operations into production requirements.

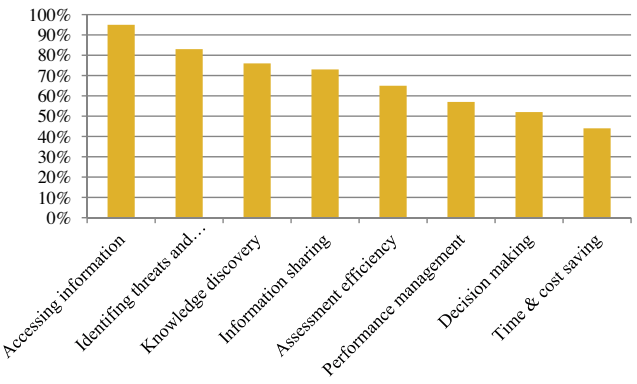

Fig. 1. The benefit items of business intelligence.

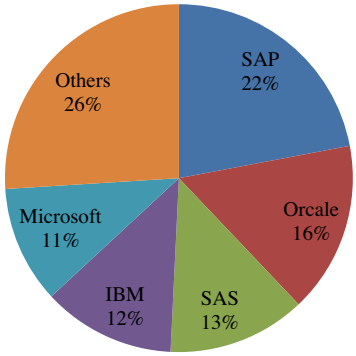

Fig. 2. The key players in the BI market.

As shown in Fig. 3, the conventional QFD prioritizes the weights of MRs and TAs, independently, without considering the interdependences or the correlations among themselves. For evaluating the benchmarking competitors, marketing assessment (in terms of MRs) and technical assessment (in terms of TAs) should be considered in an interdependent manner. In order to relate TAs to MRs, the whole process is conducted below (suppose there are "m MRs" and "n TAs"):

$$R'_{ji} = \frac{\sum_{k=1}^{n} R_{ki} \times \gamma_{kj}}{\sum_{j=1}^{n}\sum_{k=1}^{n} R_{ki} \times \gamma_{kj}}, \tag{1}$$

$$Ps_{CRi} = \sum_{j=1}^{n} Ps_{TAj} \times R'_{ji}, \quad 1 \leqslant i \leqslant m \tag{2}$$

where Ps_{CRi} and Ps_{TAj} are the performance scores of MR_i and TA_j, R_{ki} (R'_{ji}) stands for the (normalized) dependences between MR_i and TA_j, and γ_{kj} denotes the correlations among the TAs.

2.1. Vendor assessment (supplier selection)

In general, vendor assessment and supplier selection can be sequentially separated into three steps: (1) determining the importance weights of evaluation criteria, (2) deriving the performance scores for the competing alternatives, and (3) sorting the competing suppliers according to the importance weights and performance scores (Araz & Ozkarahan, 2007; Chai, Liu, & Nagi, 2013; Chen, Lin, & Huang, 2006). In order to make a compromise decision among the conflicting criteria or multiple objectives (Erol, William, & Ferrell, 2003; Kumar, Vrat, & Shankar, 2004; Lin, Lin, Yu, & Tzeng, 2010), evaluators usually adopt the MCDM (*multi-criteria decision making*) based schemes that consists of MADM (*multi-attribute decision making*) and MODM (*multi-objective decision making*). Typical MCDM methods for conducting the task of supplier selection include AHP (analytical hierarchy process), ANP (analytical

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