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A Cost–Benefit Evaluation Server for decision support in e-business

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Abstract

Business organizations are often faced with decision situations in which the costs and benefits of some competing business specifications such as business offers, product specifications, or negotiation proposals need to be evaluated in order to select the best or desirable ones. In e-business, there is a need to automate the cost–benefit evaluation process to support decision making. This paper presents a general-purpose Cost–Benefit Evaluation Server (CBES) and its underlying Cost–Benefit Decision Model (CBDM), which models benefits in terms of costs and logical scoring and aggregation of preferences associated with products and services. The Server provides build-time tools for users to specify preference and cost information and a run-time engine to perform cost–benefit evaluations. A business scenario involving supplier selection and automated negotiation is given to illustrate the application of the Server and its four evaluation modes.

Keywords: Cost–benefit evaluation; e-Business; Decision support

1. Introduction

With the advent of the Internet, collaborative e-business has been attracting more and more attention from both academia and industry [22,24]. Various technologies are being developed to support collaborative e-business, such as customer relationship management [27], supply chain management [19,20], eMarketplaces [1,5], and automated negotiation and auction systems [3,18,21,32].

In e-business, a business company or person often faces a decision situation in which a cost–benefit analysis (CBA) of a business specification needs to be performed before an appropriate decision can be made or a proper action can be taken. By ‘‘business specification’’, we mean any business document that specifies terms and conditions of a business transaction, offer, or proposal. For example, in supplier selection, a buyer often needs to evaluate a number of supplier specifications that describe different suppliers’ capabilities in order to choose the best one from a list of candidate suppliers. In business negotiation, a company needs to evaluate a negotiation proposal of another company in order to determine the cost and benefit of an offer. In the decision to purchase, a company may receive a number of responses from different vendors after issuing a ‘‘request-for-quote’’. They need to be evaluated to determine their costs and benefits.

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A business specification may contain many terms and conditions. Their relative importance to an evaluator and their interrelationship will have to be taken into consideration in a cost–benefit evaluation. Also, a business specification may have different costs and benefits to different evaluators. Subjectivity is unavoidable in cost–benefit evaluation and, for that matter, in decision making. However, it is important to have a quantitative way to calculate the costs and to evaluate the benefits of the terms and conditions given in a specification so that an overall cost–benefit indicator (or value) can be assigned to it and be compared with the overall cost–benefit indicators of other competing specifications. A decision made based on the result of a quantitative evaluation and selection is traceable and justifiable because it can be shown how the best overall cost–benefit value is quantitatively derived based on the subjective opinion of the evaluator.

In order for cost–benefit evaluation to be useful in the context of e-business, we need (1) a structured way to present a business specification so that it can be more easily processed by computers, (2) a quantitative Cost–Benefit Decision Model (CBDM) to calculate costs and to capture the preferences of decision makers based on which cost–benefit evaluation of business specifications can be performed, (3) a Cost–Benefit Evaluation Server (CBES) capable of evaluating multiple business specifications concurrently, and (4) a scalable Internet-based information infrastructure to support collaborative e-business.

CBA is the comparative analysis of alternatives in terms of their costs and consequences [33]. It is one of the most common and popular evaluation techniques used to evaluate programs and products. Since Eckstein [12] first deployed CBA techniques for benefit estimations using market information, the scope of cost–benefit analysis has been extended to other application areas, such as health care-related economic evaluation [13,15,29,33], financial decision for business [2,7,19], government management and administration [4,8,9,14,28], and environmental damage assessment [6,17]. Researchers have introduced different models and approaches with different assumptions and values in the evaluation of costs and benefits to improve the service of CBA [4,10,13,30,33].

In these models, both costs and benefits are measured in monetary terms. Cost–benefit analysis is used to determine whether the benefit of a specification measured in dollars outweigh its cost and thus justify the allocation of resources to that specification. The cost–benefit ratio and the net benefit are commonly used as evaluation indices. The evaluation of business specifications in government management and administration model is based on the computer-supported process in which personal data records relating to many people are compared in order to identify cases of interest (or benefit) [4,14,28]. In regard to the valuation of benefit in some other models, the benefit is evaluated according to either what individuals would be willing to pay for the benefit or an individual's value that is measured by the discounted value over time [4,8,33]. The net benefit is the summation of all the comprehensive benefits, including outcomes that are monetary, quantitative, qualitative [6], and/or the estimation of future monetary benefits, if applicable [7,29,33]. Obviously, these evaluation systems are designed for specific purposes and cannot be generically applied. Moreover, the evaluation is too simple to handle specifications with hierarchical structures. The evaluation service implemented in AVICOM [2] and Indent [19] can deal with complicated business specifications with multiple alternatives, but either the evaluation system is predefined or the evaluation is by simulation, thus lacking flexibility. Also, users cannot directly interact with the cost–benefit evaluation tools. The CBDM [30], which is based on the concept of logical scoring of preferences (LSPs), provides a comprehensive cost analysis and an elaborate analysis of benefits expressed in terms of the decision maker's preferences. However, as a general model, it only allows a single value to be specified for each attribute in a business specification.

The business specifications that all the existing cost–benefit evaluation systems take as input can only have a single value for each of its attributes. None of them accepts a specification that contains an attribute having an enumeration of discrete values (ENUM type) or a range of values (RANGE type). Consequently, an evaluation system has to be invoked many times to evaluate all the business specifications one by one. For example, a company wants to buy a product and the purchase specification contains, among other attributes and values, the following attributes: {quantity={RANGE[800, 900]}; delivery_day = ENUM{7, 14, 21}}. In this case, the company would accept any