



Exposing and selling the use of web services—an option to be considered in make-or-buy decision-making



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ABSTRACT

The emergence of the web service market has enabled firms to choose between developing web services internally and purchasing them externally from web service providers. In general, these so-called make-or-buy decisions have been the object of intense debate in the IT outsourcing literature. However, characteristics of web services such as loose coupling and the current trend of digitalizing application interfaces enable new opportunities especially to non-software firms: when a firm decides to develop a web service internally (make-decision), it has the option of exposing and selling the use of this web service after its internal development (sell option). In this paper, we propose a normative approach for the valuation of such a sell option based on real option theory, taking into account the characteristics of web services. This approach enhances traditional make-or-buy approaches by additionally considering this sell option in decision-making. Our results are twofold: (I) the sell option has considerable impact on traditional make-or-buy decisions and makes the internal development of web services more attractive; (II) it is preferable to execute the sell option as soon as possible after completion of the internal development of the web service.

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1. Introduction

Service-oriented architectures have become the dominant design principle for application systems and enterprise architectures (e.g., [2,22,41,81,89]). This is due to the fact that web services (cf., [84] for their characteristics) promise to enable a flexible and cost-efficient execution of business processes because of their structure, communication, and interfaces that follow well-defined, general standards [82]. This trend is accompanied by an ever-increasing number of web services available on the web service market (e.g., platforms like programmableweb.com and appexchange.salesforce.com currently list over 15,000 web services). While some of these web services fulfill simple tasks like geo location, simple storage, or shipment tracking, those offering complex functionalities like customer profiling, online payment services, credit scoring, and data cleansing have also been on the increase. Additionally, there are web services providing complex functionalities which are used only within a business-to-business domain and hence are not available on public internet platforms.

Moreover, many of today's web services are denoted as cloud services, despite using web service standards (e.g., protocols like SOAP or REST) to provide their functionality. Considering the increasing importance of service-oriented architectures and the rise of the web service market, it is evident that the more service-oriented architectures are implemented within firms (e.g., [2,33,81]), the more the question arises whether a firm should develop web services internally or buy them from an external web service provider.

Enabled by the abovementioned general standards of web services, non-software firms that decide to develop web services internally (make-decision) have the additional option of exposing and selling the use of these web services through digital application programming interfaces (Digital APIs) on the web service market [1]. We name this additional option as *sell option* which represents a “long call option” according to option theory (cf., [36], p. 197). The new phenomena of exposing and selling web services is part of several digital transformation initiatives of non-software firms [65] and exposing applications including web services through Digital APIs evolved to be the core business of many IT service providers such as akana.com, apigee.com, and mulesoft.com that support non-software firms in their digital transformation initiatives. Several non-software firms already expose their web services through Digital APIs. For example, Amazon sells its goods through third parties via its Product Advertising API, which in turn is made available for other uses through the Amazon Web Services API [59]. In

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addition, Mastercard exposes own web services to enable retailers to do a fraud scoring for e-commerce payment transactions and to check the validity of given addresses in the United States and Puerto Rico [53]. UPS also offers a similar so-called Address Validation Street Level API to external parties [83]. In the banking industry, the so-called Banking Industry Architecture Network (BIAN) aims to enable, among others, banks to expose their web services by “developing their semantic service definitions on a consistent basis (...) to enable internal and commercial service-oriented solutions according to a standardized industry model” [12]. In an interview we made with the chief architect of BIAN, he stated that members of the network already use the BIAN service designs to define and specify their services and APIs for internal and external use. For instance, the Development Bank of Singapore recently went live with a web-service-based product for consumers that uses the BIAN service designs. However, he also stated that many BIAN members are at the beginning of their digital transformation initiatives, meaning that the potential of exposing and selling the use of web services is not nearly exploited.

This sell option is especially relevant for web services that support non-strategic business processes. This is supported by literature on IT outsourcing (cf. Lacity et al. [46] for a review on motives for IT outsourcing) that generally indicates that highly individualized and sophisticated web services that are core capabilities to execute core business processes are usually not subject to make-or-buy decision-making due to strategic reasons. However, non-strategic, standardized, and precisely defined business processes [20] are typically more suitable for outsourcing to enable firms to “focus on their core business” [46]. Thus, the sell option is especially relevant for web services that support these kind of business processes and could make it economically worthwhile to keep non-strategic and standardized business processes in-house (e.g., the online sales process of consumer loan contracts at a FSP described in Subsection 3.2), which may have been outsourced without considering the sell option.

Considering the new option of exposing and selling the use of web services in make-or-buy decision-making, we have to enhance traditional make-or-buy approaches by this sell option especially with respect to web services that support non-strategic and standardized business processes. Consequently, we state the following research question:

How to consider and evaluate the option of exposing and selling the use of a web service (sell option) in make-or-buy decision-making?

To answer this research question, we propose a normative approach based on real option theory that enhances traditional make-or-buy approaches by the sell option and apply this approach to a real-world example. Our results are twofold: (I) the sell option has considerable impact on traditional make-or-buy decisions and makes the internal development of web services more attractive; (II) it is preferable to execute the sell option as soon as possible after completion of the internal development of the web service. Especially result (II) contradicts the well-known result from real option theory that the option value increases in the option runtime (cf., [36], p. 387), but supports the intuition that a later launch of a web service on the web service market decreases value.

We structure the remainder of this paper as follows. In the next section, we first discuss related literature and illustrate the research gap. Next, we describe the problem context and deduce modeling issues. Afterwards, we present our approach to value the sell option. Subsequently, we apply this approach in a real-world example. In the penultimate section, we validate the proposed approach, point out limitations and directions for future research. Finally, we conclude with a summary of our findings.

2. Related literature

In this section, we first discuss the most relevant articles about make-or-buy decision-making regarding IT services and especially

web services. As real option theory represents the theoretical background to value the sell option and to enhance the valuation of the make alternative in existing make-or-buy approaches, we then briefly summarize articles that use real option analysis to value IT investments.

2.1. Make-or-buy decision-making

In the IS literature, make-or-buy decision-making is extensively discussed in the context of IT outsourcing (see [24,46] for reviews of IT outsourcing literature). Apart from a variety of empirical works (see [47] for an overview), a series of normative approaches to support make-or-buy decisions have been published in the last two decades (e.g., [85,87]). In the following discussion of make-or-buy literature, we focus on normative make-or-buy approaches for IT services (e.g., components, modules) or especially web services, as the sell option we consider in this paper is only relevant for IT/web services that are tradable on a market. For instance, Cortellessa et al. [21] investigate whether a firm should buy commercial off-the-shelf components or develop them in-house. They incorporate costs as well as quality attributes in a non-linear cost-quality optimization model and also consider the architecture of the intended software system. Jha et al. [37] propose a fuzzy bi-criteria optimization approach for the selection of commercial off-the-shelf components to maximize intra-modular coupling density and functionality considering make-or-buy alternatives. Zhao et al. [88] suggest an analytical model for make-or-buy decisions on software components, which focuses on solving a cost-minimization problem that also considers other factors such as time to market and system reliability. Tansey and Stroulia [78] propose an approach for an economic evaluation of a business process which can be composed of multiple web services. Even though, they do not explicitly propose a make-or-buy approach, but by considering both choices in their evaluation procedure, they implicitly evaluate a make-or-buy decision. Braunwarth and Heinrich [18] specifically emphasize how to balance costs and risks of web services in their proposed portfolio optimization model. This model allows the decision maker to value a set of internally developed or externally obtained (web) services and aims to analyze risks associated with these services by integrating the risks into the optimization model. Dorsch and Häckel [25] investigate the capacity-planning problem of a service provider for a certain business process wherein the service provider can choose between outsourcing and executing different process steps by itself. Therefore, they develop an optimization model based on queuing theory to minimize total operating costs where the service provider can choose between the two different models of capacity supply (i.e., dedicated and elastic capacity) and additionally the opportunity to use surplus capacity from an external service market. Matros et al. [54] investigate make-or-buy decision-making regarding cloud services. They provide a cost-comparison approach and a break-even analysis to determine whether the make or the buy choice is economically worthwhile for a specific service. Moreover, some scholars briefly mention that the internal development of web services enables the option of exposing and selling the use of web services to other business partners (e.g., [31,61,62]). However, they do not propose an approach on how to value this option to enhance existing make-or-buy approaches. To the best of our knowledge, no existing make-or-buy approach considers the sell option. We contribute to this literature stream by proposing such an approach and examining the consequences of the sell option on make-or-buy decision-making.

2.2. Real option analysis to value IT investments

The option to expose and sell the use of a web service after its internal development constitutes a managerial flexibility that has to be taken into account when evaluating make-or-buy decisions. The consideration of managerial flexibilities in IT investment decision-making in general (see e.g., [26,42,44,79]) and in the context of service-oriented architectures in particular (see e.g., [5,32,40]) are extensively discussed

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