Evaluating investments in portability and interoperability between software service platforms

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HIGHLIGHTS

- Design of a model for analyzing portability and interoperability of software service platforms.
- Simulation of the impact of interoperability and portability on provider revenue and user utility.
- Design of a method for evaluating investments in interoperability and portability of platforms.

ARTICLE INFO

ABSTRACT

Within a closed ecosystem, end-users cannot interoperate with other platforms or port their software and data easily without a cost for interface integration or data re-formatting. The customers of these closed software service platforms are locked-in. Potential customers, who are aware of this lock-in issue, are hesitant to adopt a closed software service platform, slowing down the wide deployment of the software service platform. This paper applies an economic perspective to investigate the value creation for providers and users at different levels of interoperability. For the analysis, a value creation model for software service platforms within a software service ecosystem has been developed. Simulations of the value creation model show that, even if investments in interoperability and portability are aimed at addressing user requirements, their impact also drives the providers' profitability. Furthermore, emerging providers require investing more than market leading providers, as they have less power to set de facto standards. The simulation results also show that there is an optimal level of investments, with respect to profit and return on investments. Overall, from these results, platform providers cannot only obtain an understanding on how investments in interoperability and portability impact cost, enable cost-effective service integration, and create value, but also design new strategies for optimizing investments.

1. Introduction

Software service platforms provide services as alternatives to on premise (traditional) software [1]. The crucial difference between on premise software and software service platforms is that these platforms can potentially support multiple user groups and not only consumer-scale or enterprise-scale applications worldwide [2]. In addition to this, software service platforms provide on demand a set of cloud services, which can be close to the hardware or very high-level application services (e.g., software services, application management services, or infrastructure services) [3].

These platforms provide technologies, which enable consumers to conveniently access computing resources as pay-per-use services. As the cloud service market offers a large number of alternatives to users and competition gets stronger, gaining additional users and retaining existing users becomes more and more important [4,5]. As a result, providers strive to support emerging service models and new requirements. Provision of similar or complimentary services over multiple cloud platforms is one of these requirements [6,7].

Although the benefits of software service platforms to users are significant, the adoption of software services comes with the risk of being locked into a platform [8,9]. For example, end-users (firms) that consider adopting cloud computing technology are concerned about owning a cloud implementation that cannot interoperate with other systems [10–12]. The lack of interoperability can be caused through the technological diversity of cloud service platform offerings (e.g., different virtualization technologies, different

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service interfaces, and development environments) [13,14]. Evidence for this situation was found by a 2011 IEEE report and a 2009 IDC survey [15,16], which state that organizations could not consolidate their IT systems within the cloud due to the lack of interoperability between cloud service platforms.

Therefore, in order to fully make cloud computing a widely accepted IT infrastructure, low data portability, low application portability, and low interoperability between cloud platforms should be overcome [8,13,14,17]. That means, moving data, applications, and virtual machine images from one cloud service platform to another need to be possible for basic (frequently used) services. Programmers need to be able to work with the programming language of their choice. Basic services of different service platforms also need to be able to access each other's services. These capabilities would create a cloud service ecosystem with different levels of cloud service platform maturity. It would enable end-users to choose among different service providers according to their needs (e.g., their performance requirements, geographic location, and cost). It would also enable end-users, who are dissatisfied with a service or lost their service due to the bankruptcy of a provider, find alternatives. Consequently, the high lock-in risk would have been lowered significantly [18].

This article addresses this problem by focusing on cloud service platforms, which provide software as a service and platform as a service. The lack of interoperability and portability of these types of software services cause a significant barrier to wider adoption and value creation [19,20]. This viewpoint of the problem is different from existing research, as this article considers economic aspects instead of technical aspects (e.g., standards building [3,8,13–15], architecture frameworks of interoperable clouds [9,18,21], and requirements of interoperability [22–24]).

The objective of this article is to validate the impact of high-level interoperability and portability on the value creation of software service platforms. This objective translates into the following four research questions: (1) What is the model that comprehensively describes the impact of interoperability and service portability on value propositions? (2) How does an increase in the level of interoperability and portability relate to the change in the value of platform providers and their users? (3) Does the maturity of a software service platform (i.e., emerging or market leading platform) make a difference in the impact of interoperability on the pace of adoption? (4) How do investments in interoperability and portability affect profit, net present value, return on investment, and discounted return on investment?

In order to tackle these research questions, we develop a value creation model for software service platforms, which shows the stakeholders and the value exchange between the stakeholders, based on the work by Gebregiorgis and Altmann [4]. Using this value creation model and system dynamics methodology, first, we analyze the relationship between the level of interoperability and portability and the value obtained by providers and users. Second, we use the model to investigate the role that interoperability plays in the adoption of software service platforms at different levels of platform maturity in the market. Third, we analyze the impact of investments in interoperability and portability, considering two platform maturity levels, two amortization periods, and different amounts of investments by providers. For the analysis, we calculate profit, return on investment, net present value, and discounted return on investment.

This article makes three contributions. First, the article presents a quantitative model of the impact of interoperability and service portability on value propositions of software service platforms, providing an economic perspective of interoperability and portability. Second, using this model, the paper determines the role of interoperability and portability in the creation of provider value and user value. The simulation results confirm that providers benefit

from offering interoperability due to an enhanced attractiveness of their service platform. Interoperability and portability enable cost-effective service accessibility, flexibility, integration, and creation of a software service ecosystem. Providers and users can innovate by easily combining software services in the ecosystem. Third, although all platforms benefit from interoperability and portability, market-leading platforms require less investment for achieving the same amount of interoperability. Fourth, in spite of the positive impact of investments in interoperability on the creation of user and provider values, providers need to carefully evaluate their strategies for investments. It has to be considered that profit, net present value, return on investment, and discounted return on investment exhibit a maximum for certain amounts of investments. This investment analysis could become the basis for software service platform providers, in order to design new strategies for optimizing investments.

The remainder of this paper is organized as follows: The next section provides an overview of software service platforms, their adoption challenges, their requirements for interoperability and portability, and the value exchange between the stakeholders of the software service platform. Section 3 describes the interoperability and portability model for software service platforms. Section 4 explains the simulation results. Section 5 presents a discussion of the results and concludes the paper with a summary, limitations, and an outlook on further research.

2. Software service platforms

2.1. Concept of portability and interoperability of IT service platforms

Many IT service platforms have been built as closed systems (i.e., not providing the ability to interoperate with other service platforms). Unique to these closed (proprietary) IT service platforms is that all platform components are provided by a single vendor. Although it guarantees that all the components can work together, it creates a high dependency of end-users on the vendor. This lock-in is the cause for a low adoption of IT service platforms [14,15]. A study by the IDC enterprise panel in 2011 identified that the issue of interoperable clouds is as important for their adoption as the issue of security [15]. Furthermore, a survey, which has been conducted by the World Economic Forum in 2009, indicated vendor lock-in to be the second most important concern about public clouds (with a value of 80%) in the European public sector [8,9,25].

The portability of services and the interoperability of platforms would ensure that end-users can port and combine services regardless of the platform, on which the services were deployed first. With respect to service developers, an interoperable, service-oriented IT service platform would be cost-effective, as, for example, they could keep their development environment [15,16]. If customers of IT service platforms are dissatisfied with the services offered or location, they have an easy way out from an IT service platform due to portability and interoperability. In detail, the definition of interoperability and portability are given in the following two subsections.

2.1.1. Portability

Portability is defined as the characteristic of a service and service component to be executed on a platform different from its first design and deployment environment [17,26]. In the context of cloud service platforms, service components comprise data, software, and hardware (both physical and virtual). The portability characteristic guarantees a component to have a common method of interaction to the underlying platform services. Therefore, the component always works in the same way, regardless of the cloud that could be public or private [21,27]. An IT service platform,