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Investigating the Market Success of Software-as-a-Service Providers: the Multivariate Latent Growth Curve Model Approach

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Abstract
Software-as-a-Service (SaaS) Cloud computing as the next stage of internet evolution provides all the computing resources as services over the Internet. In the SaaS cloud computing research area, there are many studies from the user's point of view, but there is relatively little research on the supplier's success strategy. The purpose of this study is to empirically analyze the factors that determine the market competitiveness necessary for SaaS cloud computing providers to survive in the mid to long term. We presented application dimension and technology maturity as SaaS idiosyncratic factors and show how these factors influence the business performance of SaaS providers through a differentiation strategy and low-cost strategy. Using a multivariate latent growth curve model, this study analyzed 199 strategic business units of SaaS cloud computing providers in Korea for three years. Our results find that SaaS cloud computing idiosyncratic factors did not significantly enhance the software providers' business performance in the early stage. However, they significantly affected the growth rate of their customer base and financial performance as the SaaS technology became mature over time. In addition, this study identifies a set of business, strategic, and technical considerations to guide the practitioners' decision-making process for selecting an appropriate SaaS cloud computing model.

Keywords Software-as-a-Service · Application dimension · Technology maturity · Latent growth curve model · Business performance · Longitudinal study

1 Introduction

Cloud computing as the next stage of internet evolution provides all the computing resources as services over the Internet (Shankar & Duraisamy, 2018). It has been incorporated for more than five decades of research and development in virtualization, distributed computing and software area (Habjan & Pucihar, 2017b). Cloud computing became a computational paradigm as well as service provision architecture (Shankar & Duraisamy, 2018). There are three service provision models of cloud computing, namely software-as-a-service (SaaS), platform-as-a-service (PaaS), and infrastructure-as-a-service (IaaS) (Hedman & Xiao, 2016). SaaS cloud computing provides a comprehensive model to encompass the diversity of PaaS and IaaS (Xiao-tao et al., 2016). It brings salient benefits for startups and SMEs(small and medium enterprises), such as reducing initial costs and facilitating innovation without upfront investments in technological infrastructure and expertise (Alotaibi, 2016). Both Internet firms and traditional companies which experience changes in the industry value chain are faced with developing new business models through digital transformation. The role of the information system for digital transformation is characterized by the evolution of the IT infrastructure, the expansion of inter-organizational information systems and digital platforms, and the development of new IT capabilities. As one of the digital transformation implementation methods, the SaaS cloud computing is emerging (Delmond et al., 2016).

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The critical success factors in the global business environment is for the company to be able to adapt quickly and effectively to changes. Companies should adopt strategic technologies such as SaaS cloud computing to implement Digital Transformation which is an objective process that responds to changing business environments (Schwertner, 2017).

Existing research on the SaaS cloud computing has investigated various issues from client perspective. It includes adoption intention (Gangwar et al., 2015; Schneider & Sunyaev, 2016),industry specific cost benefit analysis (Kim et al., 2017; Oliveira et al., 2014), economic and structural impact of adoption (Hentschel et al., 2019), and governance related issues associated with cloud-based solutions (Al-Ruithev et al., 2016; Winkler & Brown, 2014). The profound influences by cloud computing are also present on the vendor side (Hedman & Xiao, 2016). However, providers' perspective empirical research is quite limited, with most of it focusing on technical related issues (Morgan & Conboy, 2013). For software vendors the providing corporate solutions through cloud implies profound strategic changes in their value-creation logic (Boillat & Legner, 2013). They face the challenge of efficient service models provision to achieve competitive advantages on the software market (PuciharHabjan & Pucihar, 2017a). SaaS cloud providers need to identify the success factors to facilitate cloud computing adoption and redesign their current business model Habjan & Pucihar, 2017a; Labes, Hanner, & Zarnekow, 2017).

In this idea, this paper investigates the success factors of SaaS cloud computing in the software market by longitudinally examining the providers' customer and finance performance over three-years. We introduced the SaaS cloud computing providers' performance model, then draw application dimension, technology maturity, as well as business strategies as the idiosyncrasies influencing customer and financial performance from the existing references. For time-series analysis, this research employed a multivariate latent growth curve model (LGCM) to empirically assess longitudinal changes in SaaS providers' business performance. We also identify a set of business, strategic, and technical considerations to guide the client decision-making process for selecting an appropriate SaaS cloud computing vendor.

2 Theoretical Background

2.1 Enterprise Cloud Service and SaaS

Enterprise Cloud Service (ECS) is a specific service with Service Level Agreement (SLA), which can be accessed and delivered through the internet. It contains the infrastructure, platforms and software resource which are IaaS, PaaS and SaaS respectively (Varghese & Buyya, 2018). IaaS is a foundation model that encapsulates the cloud-based servers and data storage infrastructure. PaaS plays a role of a service provider virtualizing the software application platform, and allocating it as a pool of resources. Meanwhile SaaS cloud computing incorporates a specific software into a service in which users access the various applications through terminal devices (Sui & Sui, 2018). SaaS cloud computing is the most popular cloud computing model rather than IaaS and PaaS model (El Kafhali & Salah, 2018) (Hackney & Tassabehji, 2016). It rose as the dominant information technology service delivery model. SaaS cloud computing is recognized as an innovative technology capable of providing operational and financial benefits to firms (Oliveira et al., 2019).

Including SaaS cloud computing, innovative technology adoption normally follows a specific implementation dimension (Nolan, 1979). Although current SaaS cloud computing covers the entire business dimensions (Chan & Cho, 2009; Jaiswal et al., 2009), in the initial stage, it lacked the understanding on the corporation core competency features. Thereby SaaS cloud computing was implemented in the small and medium sized enterprise (SMEs) with low dimension of business integrity and complexity (Patnayakuni & Seth, 2001). Thereafter, SaaS cloud computing were gradually distributed to the corporation core functionalities with business process knowledge and vertical expertise (Hazard, 2006). Recently, SaaS cloud computing diffused to the large corporations' the procurement, logistics, and supply chain management area with high integrity and complexity dimension (Dubeyet al., 2007).

2.2 SaaS Application Dimension

The application product characteristic has been used as the major measurement criterion to evaluate business performance that increased from IS adoption (Massetti & Zmud, 1996). From the IS perspective, this application dimension has a relationship with both application complexity and system integrity (Hanseth & Ciborra, 2007). This study regards the application dimension explained by the system integrating capacity as the product (application) characteristic. We postulate that it influences upon strategies and business performances of SaaS cloud computing providers. An application that can integrate a complex or wider dimension of a business process will lead to more efficient coverage of a niche market and to more specialized service toward customers through the firm's differentiation strategy.

As is the same case with SaaS cloud computing, it shows that innovative technology adoption typically follows a specific implementation dimension (Nolan, 1979). Various diffusion theories have been introduced to explain the innovative product adoption stages. In this research, we used the application dimension to measure SaaS cloud computing application capacity as the innovation technology integrating clients' business processes (See Table 1). Under the SaaS cloud computing context, Gallardo et al. (2018) proposed the application fit dimension of SaaS cloud computing based on the Rogers diffusion of innovation theory. The SaaS cloud computing application is divided into three dimensions: (1) task level fit, (2) company level fit, and (3) value-chain level fit. The concept is similar to the IS dimension by the organizational integration level from the 'functional integration' to the 'industry integration' suggested by Tan (2001) or Leem and Kim (2004)

2.3 SaaS Coud Computing Maturity

Technology maturity is an assessment of a firm's facilitating conditions that influence system success, ranging from unfavorable to optimal (Triandis, 1980). Technology maturity resembles perceived ease of use (DeLone & McLean, 1992; Lucas, 1975) and is related to IS utilization and performance (Gebauer et al., 2007). Characteristics of a mature SaaS cloud computing solution include simple setup procedures, easy content presentation, navigation structures, user guidance, and a comfortable user interface (Kern et al., 2002; Patnayakuni & Seth, 2001).

From the perspectives of hosted application market, SaaS cloud computing is segmented into three stages of multi-tenant technology based maturity model (Ouyang et al., 2018; Wang et al., 2018). The first generation of SaaS cloud computing refers to the ASP stage. Software vendors in this stage host and manage packaged applications to tenant or client either through the Internet or a dedicated line and offer a price strategy consisting of a one-time license and setup fee or a monthly, periodic subscription (Sandanayake & Jayangani, 2018). The ASP model had great potential for SMEs due to the low cost of system setup and maintenance (Lee & Kim, 2007). Each tenant has its own customized instance of an application on the host's servers, but offers very few of the benefits of a SaaS solution (Ouyang et al., 2018).

Second generation SaaS cloud computing offer web-based deployment with relatively small setup fees and lower maintenance costs compared to traditional on-premise enterprise software solutions. The primary difference between the first to second generation SaaS cloud computing is that the latter partially incorporates a 'one-to-many' application sharing environment meaning that one instance of the software is made available to multiple clients. However, each tenant is provided with options to configure how the application looks and behaves to its users (Ouyang et al., 2018). The third generation of SaaS cloud computing is known as the web service stage and facilitated the commercialization of SaaS cloud computing solutions (David, 2006; Norton, 2006). The web service stage employs a multi-tenant business model where software components are distributed individually or in groups to support specific work functions. A single instance or component is hosted that serves every tenant with possible configuration of certain features and allows resource sharing between tenants. SaaS cloud computing application is scalable to a large number of tenants (Ouyang et al., 2018; Wang et al., 2018), and facilitates high performance, fast system updates (Anthes, 2008), secure access, reliability, and availability (Choudhary, 2007).

In the traditional software market, both vendors' trust and market power are major factors for customers to choose their software based on the perspective of the software as a conventional packaged product. However, in the SaaS cloud computing market, since software is usually packaged as services and delivered through the Internet, clients are less likely to depend on the SaaS cloud computing vendor. The only lock-in effect for the SaaS cloud computing customer may be the nature of up-to-dated technical and application support provided by the vendors (Chan & Cho, 2009). This would enhance clients' dependence on SaaS cloud computing and create switching costs that inhibit a change in their outsourcing decision. It can also be argued – as the SaaS cloud computing industry

Table 1 Perspectives of application dimension

Application Dimension	Venkatraman (1994)	Tan (2001)	Leem and Kim (2004)	Gallardo et al. (2018)
Low	Localized exploitation	Functional integration	Functional integration	Task fit
	Internal integration	Cross-functional integration	Process integration	Company fit
	Business process redesign	Process integration	Business integration	
	Business network redesign	Business process redesign	Industry integration	Value-chain fit
High	Business scope redefinition	Business scope redefinition	Role-model generation	

(Note) Grayed cells are not included as a research topic because the SaaS applications surveyed in this study had yet to reach this stage matures – that vendors continuously need to make greater efforts to allow customers to re-adapt their software rather than switching to that of another vendor.

2.4 SaaS Cloud Computing Provider's Strategy

2.4.1 Relationship Among Application Dimension, Technology Maturity and SaaS Provider's Strategy

There have been numerous researches on motivators for adoption of SaaS from a user perspective. Wu et al. (2011) presumed that SaaS adoption is a trust issue involving perceived benefits and perceived risks (Wu et al., 2011). Garrison et al. (2012) focused on three IT-related capabilities— technical, managerial, and relational—characterized as a major potential source of competitive advantage for deploying cloud computing (Garrison et al., 2012).

This study focused on the competitive differentiation strategy among providers in the SaaS market rather than the motivation for users' adoption of SaaS. Boillat and Legner (2013) investigate the shift from on-premise software to cloud services with the perspective of enterprise software vendors. The study builds on the conceptualization of business models, which systematically explores cloud computing's applications for software vendors' value creation logic. In particular, they studied the impact of cloud computing on the construction of enterprise software vendors' business models and the interrelated dimensions of customer value propositions and financial flows (Boillat & Legner, 2013).

Gallardo et al. (2018) divide business applications into three categories: (1) task level fit, (2) company level fit, and (3) value-chain level fit. The above categorization is very relevant to understanding SaaS cloud computing adoption and they suggested two successful strategies for SaaS cloud computing providers: Reducing Implementation Complexity and Increasing Collaboration Capabilities (Gallardo et al., 2018). Ma and Kauffman (2014) proposed a model of software-as-a-service (SaaS) in a competitive marketplace and claimed that competing vendors must make for pricing and quality strategy (Ma & Kauffman, 2014). Other studies have shown that product characteristics influence differentiation strategies (Cavusgil & Zou, 1994; Glueck, 1972), and application characteristics influence enterprise performance (Massetti & Zmud, 1996). Based on the above researches, the wider support of application in actual business transaction and task of clients can be expected to bring about positive effect on the customer acquisition of SaaS providers (Dubey et al., 2007)..

Technological evolutions are another crucial factor for corporate strategies (Khandwalla, 1976). As Miller (1988) argued that the differentiation strategy was appropriate, one in the volatile technological environment, the maturity of SaaS cloud computing technology - progressed from ASP to the web-native application and web-service - brings about a positive effect on differentiation strategy of SaaS cloud computing providers. Web-service characteristics in higher SaaS cloud computing technological maturity lead software vendors to develop more customized applications and enhance the application's degree of the differentiation (Choudhary, 2007).

Cloud providers may follow in general two alternative ideal-typical strategies to become a successful player on the market (1) low prices or (2) making their product more valuable/unique than others (Penzel et al., 2017). Other studies on relationship among application dimension, technology maturity and SaaS provider's strategy are summarized in Table 2.

Relationship Between Strategy and Performance The importance of environmental dynamism stems from the fact that both the rapid rate of technological change and the increasing speed of diffusion of new ideas and technologies pose severe challenges to new ventures (Zahra & Bogner, 2000). In the dynamic than in stable environments, technological differentiation and shortening the product development cycle are more important (Hagedoorn, 1993). Dynamic industries, such as software, usually encourage the development of radically new products and technologies (Ali, 1994; Zahra & Bogner, 2000) to capture premium market segments or preempt competitors' entry (Utterback, 1996).

Developing and introducing radically new products is expected to improve financial performance by enabling the vendors to repeatedly target premium segments, build high market shares (Buzzell & Gale, 1987), and achieve market leadership (Golder & Tellis, 1993; Zahra & Bogner, 2000).

Software vendors may enjoy mass-production owing to the innate characteristics of the web-based software distribution which enable the SaaS cloud computing vendor to offer the multi-user support represented by the term "one-to-many model". In this way, the SaaS cloud computing business model decreases the production cost (Jaiswal et al., 2009). The nature of differentiated technology and application support provided by vendors can retain and expand customers (Chan & Cho, 2009). While in a stable environment market followers gain revenue, in a dynamic environment, the company releasing low-cost and differentiated new products experiences the increase of customer acquisition and financial performance. (Zahra & Bogner, 2000).

Ma and Seidmann (2015) suggested that the SaaS provider should invest in reducing both its lack-of-fit costs and its service price in order to gain competitive advantage against MOTS providers (Ma & Seidmann, 2015). Guo and Ma (2018) found that the SaaS is able to enter the market and make a profit even if its quality is inferior to the incumbent perpetual software, and its continuous quality improvement leads to switch users from the incumbent perpetual software vendor to the SaaS vendor. As a counter strategy, it is found

Table 2 Research on the relationship between AD, TM, and strategy

Concept	Research results	Authors
Application Dimension	• Product characteristic → differential strategy (product uniqueness, supply chain diversification)	(Cavusgil & Zou, 1994) (Glueck, 1972)
	• Application characteristic → business performance	(Massetti & Zmud, 1996)
	• Utilizing IS → more excellent advantage	(Bergeron & Raymond, 1992) (Iacovou et al., 1995)
	• From task fit to value-chain fit → SaaS adoption	(Dubey et al., 2007)
Technology Maturity	• ASP is similar to the licensing model → no incentive effect	(Choudhary, 2007) (Greschler & Mangan, 2002a)
	• Technological evolutions → corporate strategies	(Patnayakuni & Seth, 2001) (Khandwalla, 1976)
	• SaaS's pay-as-you-go or total usage measurement model → rental fee down	(Sundararajan, 2004)

that the perpetual software vendor adopts one of three different strategies: (1) an entry deterrence strategy, (2) a market segmentation strategy, or (3) a sequential dominance strategy (Guo & Ma, 2018). Huang et al. (2015) studied the effectiveness of a hybrid pricing strategy for a cloud computing services vendor that mixes fixed-price reserved services with spot-price on-demand services. They found that the vendor can offer damaged and undamaged services, set interruption risk as a quality differentiator, and price to maximize profit (Huang et al., 2015). Aforementioned studies emphasize the importance of pricing and quality differentiation strategies through analyzing the competitive strategies between SaaS providers and perpetual software providers. Considering these strategies, we investigate the relationship between differentiation strategies and performance from a competitive perspective among SaaS providers.

This study is based on Michael Porter's generic strategies, which include overall cost leadership, differentiation, and focus. Porter's framework proposes that firms must choose whether to serve broad or narrow market segments and whether to seek advantage through low costs or perceived uniqueness (Kim et al., 2004). Many subsequent studies have validated Porter's strategy theory. In particular, Kim et al. (2004) concluded that generic strategies were effective in e-business and that integrated strategies which combine cost leadership and differentiation would outperform cost leadership or differentiation strategies.

Firoz Suleman et al. (2019) suggests that although cost leadership strategy can generate higher performance, pursuing a differentiation strategy can be more worthwhile and sustainable for pure online firms compared to cost leadership strategy (Firoz Suleman, Rashidirad, & Firoz Suleman, 2019). They demonstrated that Porter's generic strategies are a valid and viable model for genuine online firms that operate in the current e-business environment.

3 Research Model and Hypotheses Development

3.1 Latent Growth Curve Model for Longitudinal Changes

Challenges in longitudinal change measurement include incomplete follow-up from participants over time, changing variables that impact the trend at different points in time, and correlations among multiple measurements taken from the same subject over time. To help address these challenges, latent growth curve modeling (LGCM) has gained widespread acceptance as a powerful approach for the description, measurement, and analysis of longitudinal changes (Lance et al., 2000). LGCM is an appropriate approach for this study since our objective is to evaluate the longitudinal market success factor changes of SaaS cloud computing vendors. LGCM is a linear growth function that describes each sample's longitudinal development slope as well as captures individual differences in these trajectories over time (McArdle & Epstein, 1987; Meredith & Tisak, 1990). The former is known as a "within-subjects model" while the latter is called a "between-subjects model". The within-subjects model can be expressed as a two-factor linear growth model with individual p ($p = 1, 2, \ldots, N$) assessed at time t ($t = 0, 1, 2, \ldots, T$) on an observed outcome variable Y

$$\text{Within} - \text{subjects model}: Y_{pt} = \eta_{ip} + \eta_{sp}\alpha_t + \varepsilon_{pt} \quad (1)$$

Where Y_{pt}: the measure of the response variable y for individual p at time t,

η_{ip}: the intercept for individual p,

η_{sp}: the slope for individual p,

α_t: the measure of time t,

ϵ_{pt}: the residual for individual p at time t.

The following equations describe the variables explaining why some samples start at a low or high level and the variables explaining why some samples change more or less than others.

$$\text{Between} - \text{subjects model} : \eta_{ip} = \alpha_{\eta_i} + D_{\eta_{ip}} \quad (2)$$

$$\eta_{sp} = \alpha_{\eta_s} + D_{\eta_{sp}} \quad (3)$$

Where D: deviation of mean score, i.e. $\eta - \alpha$.

Equation (2) is the initial status parameter (intercept construct), and Eq. (3) is the growth and change rate parameter (slope construct). α_{η_i} and α_{η_s} are the group mean of the average intercept value and the average slope value, respectively. D indicates the residual between the individual p and the group mean in the average intercept value and the average slope value which is presented in the path diagram in Fig. 1. η_{ip} and η_{sp} are enclosed in ellipses because they are latent variables. η_{ip} represents the intercept variable in Fig. 1 and η_{sp} represents the linear trend (the slope) in Fig. 1.

The basic of multivariate growth curve models is the bivariate parallel process model. It essentially brings two growth curves together to capture concurrent and related processes of development. The multivariate LGCM is useful not only for validating the time trend of research variables, but also for verifying causal relationship changes among variables (MacCallum et al., 1997). It postulates the serial processes of development wherein growth curve development precedes the other in time.

3.2 Research Model

This study combines two LGCM models – showing the number of customers and financial performances as SaaS cloud computing providers' business performance – into the multivariate LGCM and verifies their relationship changes by the effect of the time elapsed and various predictors. The research model in Fig. 2 couples two LGCM variables composed of a pair of constructs, which are the intercepts (or initial status: CP-I and FP-I), and the slopes (or change status: CP-S and FP-S) constructs. Besides, a pair of three repeated measurements at each time point (CP1-CP3, FP1-FP3) is connected to the intercept and slope constructs.

According to Meredith and Tisak (1990), the intercept variable's factor loadings were set to 1, while those in the slope variable were zero initially at times 1 and 2 at the last time point. Meanwhile, the path coefficients between two intercept variables (from CP-I to FP-I) and two slopes variables (from CP-S to FP-S) show the relationship changes over time between two corporate performances. Figure 2 also postulates that SaaS cloud computing providers' business performances are determined by (or aligned with) the application dimension and the technology maturity, as well as the firm strategies. The particular theoretical perspective adopted here is the principle of strategy-environment co-alignment (Aldrich, 1979; Porter, 1998; Venkatraman & Prescott, 1990), which states that the 'fit' between strategy and its context (technological and product characteristics) has significant implications for firm performance (Cavusgil & Zou, 1994; Dos Santos et al., 1993; Pfeffer, 1994). In contrast to previous studies that postulate direct links from context characteristics to firm performance (Cooper & Kleinschmidt, 1985; Madsen, 1987), the proposed conceptualization posits that the firm strategies mediate these

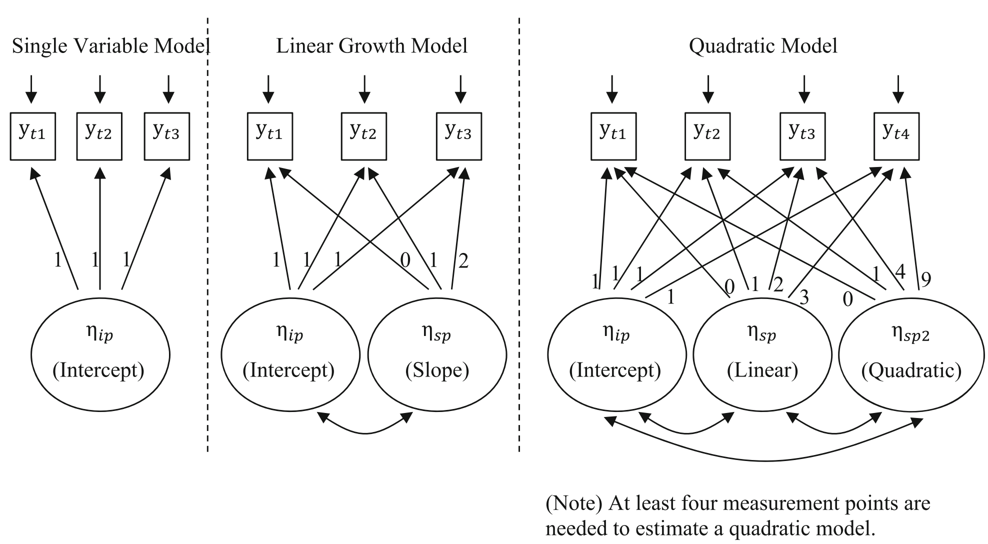
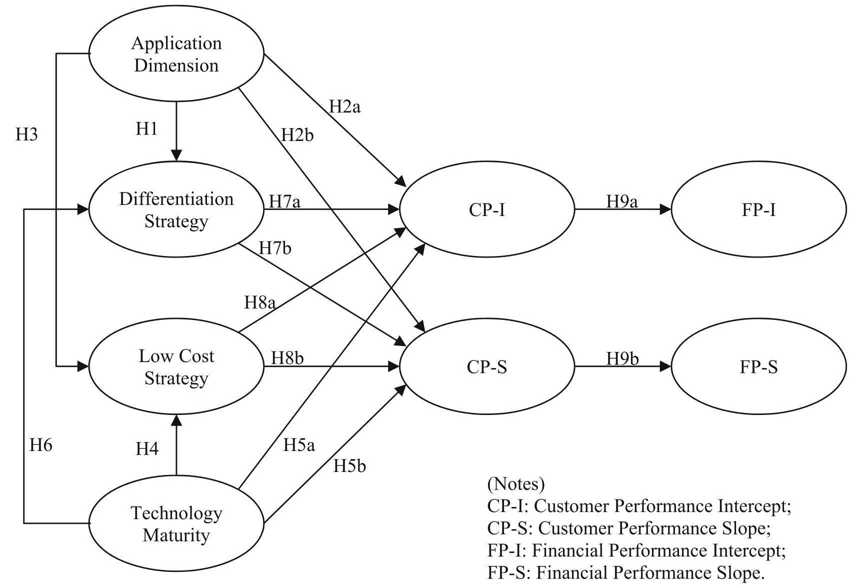


Fig. 1 Conceptual LGCM path diagram

Fig. 2 Research Model



links. This research highlights the central role of firm strategies to co-align the various perspectives of strategy-environment and subsequently to achieve positive performances.

3.3 Hypotheses Development

A high level of system integration capacity improves customer service and improves inter-corporate relationships. Effectiveness and efficiency of job operations are improved when information collected through SaaS cloud computing is integrated with internal IS applications. Not to mention individual work productivity is improved (Lee & Lim, 2003). Hence, we hypothesize:

H1: The high degree of SaaS cloud computing application dimension is positively associated with the differentiation strategy practice.

H2a: The high degree of SaaS cloud computing application dimension is positively associated with the increase of customer acquisition.

H2b: The high degree of SaaS cloud computing application dimension is positively associated with the increase of customer acquisition growth trajectory.

H3: The high degree of SaaS cloud computing application dimension is negatively associated with the low-cost strategy practice.

The technological evolution of SaaS cloud computing is an important factor for corporate strategies. In a volatile technological environment, the maturity of SaaS cloud computing technology – which progressed from ASP to the web-service – brings about a positive effect on the differentiation strategy of SaaS cloud computing providers (Danny Miller, 1988). For example, web-service technologies alleviate software versioning issues that hinder differentiation strategy practice compared to the prior maturity stage. There is no competition between the present and future versions of software because the vendors automatically upgrade to up-to-date technologies. Thus individual brand-new technologically advanced features can be released as soon as they are completed, whereas the existing IS software requires them to be withheld until a new version of the software is completed (Choudhary, 2007).

Compared to the previous stages, web-service stage systematically resolved technical problems deteriorated efficient multi-user support indispensable for high-leveled economy of scale. The web-service application has a multi-tenant business model which is based on a microservice architecture. It is a very specific variation of a service-enabled architecture and more focused on agility. It can provide significant value in improving SaaS cloud computing customization (Balakumar & Kavitha, 2018).

We propose that SaaS cloud computing solutions reach the higher maturity phase over an extended time period, and this ultimately makes SaaS cloud computing more attractive in the software market. Whereas many SaaS cloud computing companies were marketing themselves as full SaaS cloud computing vendors, they turned out to be SaaS cloud computing "pretenders" meaning that they were still in the early stages. This misrepresentation of technology maturity creates failures in implementing a successful SaaS cloud computing business model. Based on the reasoning above, we hypothesize:

H4; The high degree of SaaS cloud computing technology maturity is positively associated with the differentiation strategy practice.

H5a: The high degree of SaaS cloud computing technology maturity is positively associated with the increase of customer acquisition.

H5b: The high degree of SaaS cloud computing technology maturity is positively associated with the increase of customer acquisition growth trajectory.

H6: The high degree of SaaS cloud computing technology maturity is positively associated with the low-cost strategy practice.

Substantial R&D investments in maintaining state-of-the-art facilities and excellent researchers are especially crucial for building the company's technological competencies, the keys to sustained profitability, and the growth of market share (Bogner & Thomas, 1996). On the one hand, prominent partners that can endorse the focal firm and endow valuable resources may enhance its market performance (Lavie, 2007). Nevertheless, not all types of network resources create value. Whereas ties to prominent partners with abundant marketing and financial resources enhance market performance, technology and human network resources fall short of creating value. This result is surprising given prior indications that partners' size and innovativeness lead to revenue growth (Lavie, 2007; Stuart, 2000).

Multilateral competition among partners enhances the firm's market performance. This outcome is ascribed to the firm's ability to arbitrate among competing partners and control resource allocation decisions, which improve its appropriation capacity. Although the network resources accessible from similar partners may add limited value, multilateral competition increases the firm's relative share of that added value (Lavie, 2007).

We therefore hypothesize:

H7a: The high degree of the differentiation strategy is positively associated with the increase of customer acquisition.

H7b: The high degree of the differentiation strategy is positively associated with the increase of customer acquisition growth trajectory.

Traditionally, corporations adopt mixed strategies, which can pursue differentiation and low-cost strategies at the same time, given the mass customization with the economy of scale features of the modern product (Perera et al., 1997). It is believed that companies are more likely to outsource when the perceived cost benefit is high (Williamson, 1981). Thus, clients could obtain a cost benefit regarded as a cost advantage by adopting the SaaS cloud computing business model (Jayatilaka et al., 2003). SaaS cloud computing providers' low-cost strategy has a long-term influence not only on customer acquisition and but also on the expected life span of a solution (Chan & Cho, 2009; Currie & Seltsikas, 2001). By synthesizing these, we propose the following hypothesis:

H8a: The high degree of low-cost strategy is positively associated with the increase of customer acquisition.

H8b: The high degree of low-cost strategy is positively associated with the increase of customer acquisition growth trajectory.

The performance indicators, such as customer acquisition and revenue growth, are considered generally as corporate performance (Kotler, 2007). According to the proponents of the Balanced Scorecard (BSC) approach, if companies are to improve their financial capabilities continuously, they should first achieve better performance from the perspective of their customers. The customer's performance has been proven to be the decisive antecedent for financial performance, as customers can recognize whether the company provides the best customer value, and thus, their level of satisfaction can be increased accordingly. Customer satisfaction and perceived profitability facilitates a market share growth in which the financial performance can be achieved. Furthermore, according to the product life cycle theory in the introduction stage, firms cannot make enough profit from a customer increase due to the cost occurrences for forming and promoting a distribution network as well as solving the technical problems of brand-new products. However, with entering the growth stage, the promotion cost is diversified into the sales volume. The service cost decreases further as the producer's learning effect increases. Accordingly, revenue gradually grows (Kotler, 2007; Weber, 1976). Then, the causal relationship between customer performance and financial performance will be reinforced as SaaS cloud computing diffuses in the market. Therefore, it is hypothesized as follows:

H9a: The customer acquisition increase is positively associated with the increase of revenue.

H9b: The customer acquisition increase is positively associated with the increase of revenue growth trajectory.

4 Research Method

4.1 Measure Development

4.1.1 Application Dimension and Technology Maturity

In this research, the application dimension represented the scope of the client business domain where SaaS cloud computing application could be utilized (OpenGroup, 2006). Application dimension was operationalized by Gallardo et al. (2018) and Leem & Kim (2004)'s applicational integrity levels with necessary modification. In the questionnaire, firms chose their application level of dimension on a four-point Likert scale from 1 (low) to 4 (high), which were (1) task fit, (2) process fit, (3) business fit, (4) value chain fit. The technology maturity was defined as the degree of the perceived performance fulfilling users' requirement according to the technology development stage (Gebauer et al., 2007; Kishore et al., 2004). We operationalized it with the concept of the maturity stages followed by Ouyang et al. (2018). Accordingly, firms were asked to rate their applications' technology maturity level from 1 (low) to 3 (high), which are: (1) ASP, (2) web-native application, (3) web-service application. The two exogenous constructs above employed one-item measurement. Although the use of multiple indicators for each construct is desirable since this allows measuring the psychometric properties of constructs, there is strong evidence to suggest that a single-item construct is as good at capturing the nature of the phenomenon in question as several-item instruments (Gardner et al., 1998). To measure relatively newly-developed application dimensions and technology maturity by this study, additional items may provide little incremental value while reducing the quality of respondent' responses (Drolet & Morrison, 2001).

4.1.2 Firm Strategies

Measure development of firm strategies were divided into the degree of differentiation strategy and low-cost strategy practice (Dess & Davis, 1984; Miller & Friesen, 1986). The differentiation strategy broadly captures the firm's various attempts to differentiate itself from its rivals. We verified those items with the existing references by checking whether SaaS cloud computing providers actually utilize those indicators in their strategic activities. As a result, we took three measurement items such as the application uniqueness (referring an application aims to differentiate within just one or a small number of target industry) (Porter, 1998), supply channel diversification (regarding whether SaaS cloud computing vendor had diversified supply chain) as well as the number of specialized expertise (Kotler, 2007). The number of specialized expertise was codified with 5-point Likert scale by using the mean of 3 years' values.

Meanwhile, we used categorical variable to measure channel diversification and application uniqueness. Those variables took the value of 1 if the application was designed for the specific industry only, or if the application was distributed from the multiple distribution channels, and 0 otherwise. According to Muthen (1983), developing categorical indicators is indispensable in the social science context since in the real-world, particularly small numbers of categories with non-equidistant scale-steps are usually dichotomous or binary. SEM allows the combined application of dichotomous, ordered polytomous, and continuous indicators in the single latent variable (Muthen, 1983). The low-cost strategy was measured with an item of asking the application price, which was operationalized by unit-cost (Kaplan & Norton, 1996). We measured the SaaS cloud computing solution price with installation fee plus subscription fee (Choudhary, 2007; Greschler & Mangan, 2002b; Patnayakuni & Seth, 2001). The Solution prices were also changed - even if being slightly - in some corporations during the survey period. Thus, this study measured them by reconstituting it with reversed 5 points Likert scale through using the mean of item values. Reliability coefficients using Cronbach's alpha coefficients for the differentiation and low-cost strategy were 0.602, and 0.757 respectively.

4.1.3 SaaS Cloud Computing Providers' Business Performance

We captured two aspects of SaaS cloud computing providers' business performance, which were customer acquisition (represented by the number of SaaS cloud computing subscribers) and revenue growth (measured by Korean a currency unit 'Won') from 3 years of repeated measures. Customer acquisition was defined as the measures in absolute terms at which a business unit retains or maintains an ongoing relationship with its customers (Kaplan & Norton, 1996) while revenue growth illustrated sales increases over time. The log transformation of company revenues was used to avoid the heteroscedasticity problem of the dataset, the unbalanced effect of the distribution (Ang & Straub, 1998). Reliability coefficients using Cronbach's alpha coefficients for the customer and financial performances were 0.946 and 0.953.

The above key constructs and operationalized metrics are summarized in Table 3.

4.2 Data

Our research subjects were the entire population of the SaaS cloud computing providers, and their line of applications registered in the database in CNK (Commerce net Korea, http://www.cnk.or.kr) in Korea. Data was obtained from the series of 'the survey on ASP/SaaS cloud computing industry in Korea'. Those governments commissioned surveys were performed to elicit information on various aspects of SaaS cloud computing industry regarding the number of clients, market size, number of service models, perceived outlook for market, and bottleneck problems. The unit of analysis in this research is the 'SBUs (strategic business unit)' in each software provider. Each SBU is the business entity of performing individual products and independent strategy (Govindarajan, 1988).

Questionnaires were sent to the CEOs. They took the questionnaires to their staff or department in charge if they lacked sufficient knowledge. They were solicited

Table 3 Summary of key constructs and operationalized metrics

Constructs	Operational metrics assessed	Sources
Application Dimension	• Application integrity levels of dimension ① task fit ② process fit ③ business fit ④ value chain fit → Four-point Likert scale from 1(low) to 4(high)	(Gallardo et al., 2018) (Leem & Kim, 2004)
Technology Maturity	• The degree of the perceived performance, fulfilling users' requirements according to the technology development stage ①ASP ②Web-native ③Web-service → Three-point Likert scale from 1(low) to 3(high)	(Ouyang et al., 2018)
Firm Strategies	<Differentiation Strategy> • Supply chain diversification ①Yes ②No • Application uniqueness ①Yes ②No • Application uniqueness Five-point Likert scale by using the mean of 3 year's values <Low-cost strategy> • Application price (installation fee + subscription fee) → reversed 5 points Likert scale through using the mean of item values	(Miller & Friesen, 1986) (Dess & Davis, 1984) (Porter, 1998) (Kotler, 2007) (Muthen, 1983) (Marsan, 2003) (Varghese & Buyya, 2018) (Sui & Sui, 2018) (Shao et al., 2015)
Business Performance	<Customer acquisition> • The measures in absolute terms at which a business unit retains or maintains an ongoing relationship with its customers → 5 points Likert scale through using the interval of item values <Revenue growth> • Sales increases over time → 5 points Likert scale through using the interval of log-transformed data	(Marsan, 2003) (Kline, 2010)

via phone by a contact person from professional research institution of them cooperated with survey on condition of not clarifying sensitive data such as revenue or customer information. The response rate had been 100 %. This was not surprising given that Korean SaaS cloud computing providers had a motivation to complete the questionnaires administered by CNK with Korean government, because Korean government had aggressively driven the small businesses with less than 50 employees to adopt IS using SaaS cloud computing as a key business innovation enabler. The database is composed of 327 solutions with 175 firms. However, we have restricted our attention to the sub-sample of SaaS cloud computing applications spending three consecutive years in the market to fulfill the terms of LGCM analysis (Bollen et al., 2004). Several number of applications which did not meet the assumption that the application dimension and technology maturity are exogenously determined in year 1 and they would not change over the studied period were excluded. Some applications were acquitted during the survey period or were not publicly traded for the whole time period. Moreover, after removing observations with missing values, we were left with a sample of 199 solutions, which constituted our final longitudinal data set. Details of the sample firms' characteristics are shown in Table 4.

5 Analysis and Results

Generally, the multivariate LGCM analysis process is divided into unconditional and conditional model analysis (Bollen et al., 2004; Kline, 2010). In the unconditional stage, we compared preciseness of fit between the constraint model and the linear growth model to validate whether the variance in the linear growth model showed the true variance. Then we measured the means of intercept and slope variables within a single LGCM. The means tell us the average mean and slope for the group (Muthen, 1991). In the conditional model analysis, we augmented the LGCM measurement model with putative predictors and outcomes, and evaluated the theoretical structural relationships. Then, we established and validated the causal relationships in the model (Lance et al., 2000).

5.1 Descriptive Statistics

We used AMOS 25.0 and SPSS 25.0 to perform the SEM-based multivariate latent growth curve modeling. Table 5 shows the descriptive statistics for the independent and

Table 4 Characteristics of SaaS providers in this study

Characteristics	Frequency	Percentage
Vendor Type		
Pure SaaS vendor	35	17.6
ISV or Software vendor	96	48.2
System integration company	36	18.1
Hosting company or ISP, Hardware provider	1	0.5
Telecom company	31	15.6
Annual Sales (in Thousand US dollars)		
< 10	48	24.1
10 – 79	51	25.6
80 – 399	44	22.1
> 399	56	28.1
Firm Size (Number of full-time employees)		
< 3	51	25.7
3 – 6	44	22.1
7 – 14	56	28.1
> 14	48	24.1
Number of Clients		
< 20	47	23.6
20 – 99	53	26.6
100 – 799	49	24.6
> 799	50	25.1
Application Dimension		
Function integration for individual use	16	8.0
Process integration within department level	113	56.8
Business integration within corporation level	48	24.1
Industry integration between corporations	22	11.1
Technology Maturity		
Application service providing	35	17.6
Web-native application	133	66.8
Web-service application	31	15.6

dependent variables. The absolute value for the skewness and kurtosis of these variables are less than 3 and 10, respectively. This indicates that the data are normally distributed.

5.2 Unconditional Model

Following the recommendations of Muthen (2001), we developed two unconditional latent growth models for customer acquisition (model 1a) and revenue growth (model 2a) to identify the functional form of SaaS cloud computing vendors' business performance growth (Muthén, 2001). In these models, we set the loadings of three repeated measurements in the intercept construct 1.0, representing the growth curve at the starting point, while the loadings of the slope variable were 0, 1, and 2 for three time points representing the linear growth model. To test whether the three repeated measurements of customer and finance performances were not the same and changeable at each time point, we developed a constraint model (model 1b and model 2b) in which all the factor loadings of the latent variables were constrained to be equal. The finally accepted path diagram of the unconditional latent growth model is presented in Table 6. In terms of model fit ratios such as CFI and NFI, the two linear growth models (model 1a and model 2a) fit better, which indicated that the incremental constraints of factor loadings over time were valid. The fit ratios of the constraint models (model 1b and model 2b) were not acceptable, which indicated a poor fit for the customer and finance performances.

The results indicated that the business performance of SaaS cloud computing providers actually increased linearly during the survey. In the linear growth model, the means of intercept (initial status) and slope (growth rate) for customer and financial performance were statistically significant with 95 % confidence level. These results showed that the mean value of customer and financial performances started at 3.2, 2.9, respectively, in the first year, and that the growth rate of the two LGCM variables shifted upward in the last year.

Table 5 Descriptive statistics

Construct	N	Min	Max	Mean	Std. Dev.	Skewness	Kurtosis
AD	199	1.000	4.000	2.442	0.742	0.575	−0.115
TM	199	1.000	3.000	1.965	0.563	−0.011	0.192
DS	199	0.333	2.333	1.224	0.652	0.340	-1.060
LS	199	1.000	5.000	2.905	1.185	−0.025	-1.132
FP	199	1.000	5.000	3.080	1.246	0.110	-1.019
CP	199	1.000	5.000	3.281	1.003	0.188	−0.729

(Notes) AD: Application Dimension; TM: Technology Maturity; DS: Differentiation Strategy; LS: Low-cost Strategy; FP: Financial Performance; CP: Customer Performance

5.3 Conditional Model and Hypotheses Testing

After the pair of unconditional LGCMs was established with theoretical structural relationships, we combined two unconditional LGCMs and augmented them with putative predictors (i.e., application dimension, technology maturity, and firm strategies). For the structural estimation of unconditional LGCMs, the paths from the three putative predictors to the initial status and change on the SaaS cloud computing outcome variables were freely estimated. On the other hand, the fixed factor loading values in the two SaaS cloud computing outcome variables were included as they were finalized in the conditional model analysis stage. As shown in Fig. 3, the fit of this conditional model in terms of NFI (0.940), CFI (0.967), and RMSEA (0.075) were accepTable The path coefficient estimates obtained from the conditional model are presented in Table 7.

First, the degree of application dimension (AD) was related strongly and positively to a firm's differentiation strategy and the initial status of customer performance (CP-I); moderately and negatively to the low-cost strategy; and poorly to the slope of customer performance (CP-S). Second, the technology maturity (TM) was strongly and positively related to the

Table 6 Fit indices for latent growth curve models

Model	χ^2 / df	CFI	NFI	RMSEA	Parameter Estimates	
					Mean of intercept	Mean of slope
1a	10.507	0.956	0.951	0.219	3.168***	0.113***
1b	20.963	0.813	0.805	0.318	3.218***	N.A.
2a	14.026	0.932	0.928	0.256	2.935***	0.146***
2b	15.292	0.852	0.842	0.269	3.080***	N.A.

(Notes) Model 1a: LGCM for customer performance; Model 1b: Constraint Model for Model 1a;
Model 2a: LGCM for financial performance; Model 2b: Constraint Model for Model 2a

differentiation strategy, low-cost strategy, and the slope of the customer performance (CP-S); and poorly to the initial status of customer performance (CP-I). Third, the relationship between the differentiation strategy and the low-cost strategy was both strongly positive to the initial status of SaaS cloud computing customer performance (CP-I).

However, each of the two antecedents influenced the slope of SaaS cloud computing customer performance (CP-S) in the exact opposite direction from the expected results from the hypotheses (H7b and H8b), respectively. This means that influence of differentiation strategy and low-cost strategy on SaaS cloud computing providers' customer performance had decreased 18.8 and 33.4 %, respectively, during the three years of the survey period. Finally, the initial status of customer performance (CP-I) was related strongly and positively to that of firm financial performance (FP-I) and the slope of customer performance (CP-S) was strongly and positively associated with that of financial performances (FP-S). As shown in Table 7, the path coefficients revealed that the SaaS cloud computing providers' outcomes were diagonally influenced by three antecedents, application dimension, technology maturity and firm's strategies. Overall, five hypotheses were supported, two were not, and two were refuted.

6 Discussion

6.1 SaaS Cloud Computing Distribution and Software Vendors' Business Performance Growth

The results suggest that two SaaS cloud computing characteristics differentiated from existing IS software played a key role to enhance software providers' business performances. Whereas the paths from application dimension and technology maturity to the customer performance intercept (CP-I) were not significant, they were found to have more effect on the slope of customer performance (CP-S) as time went by. As Choudhary (2007) asserted, delivering SaaS cloud computing with a high application dimension or with web-service technology were

Fig. 3 Results of the structural model

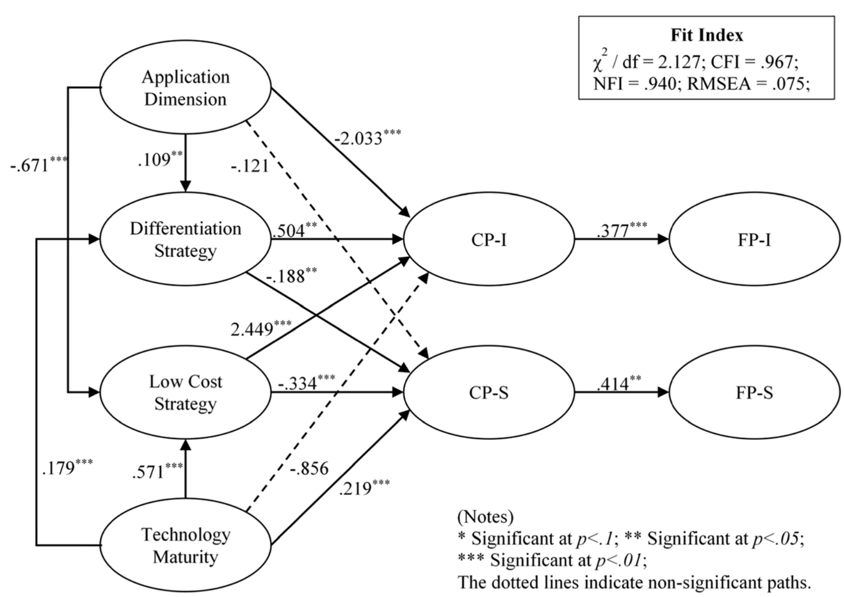


Table 7 Summary of hypotheses testing results

Hypothesis	Path Coefficient	Std. Error	Result
H1: AD → DS	0.109***	0.036	Supported
H2a: AD → CP-I	2.033***	0.568	Supported
H2b: AD → CP-S	-0.121	0.063	Not Supported
H3: AD → LS	-0.671***	0.098	Supported
H4: TM → DS	0.179***	0.053	Supported
H5a: TM → CP-I	-0.856	0.536	Not Supported
H5b: TM → CP-S	0.219***	0.076	Supported
H6: TM → LS	0.571***	0.141	Supported
H7a: DS → CP-I	0.504**	0.243	Supported
H7b: DS → CP-S	-0.188**	0.085	Refuted
H8a: LS → CP-I	2.449***	0.795	Supported
H8b: LS → CP-S	-0.334***	0.072	Refuted
H9a: CP-I → FP-I	0.377***	0.073	Supported
H9b: CP-S → FP-S	0.414***	0.151	Supported

(Notes) * Significant at $p < .1$; ** Significant at $p < .05$; *** Significant at $p < .01$

confirmed to be beneficial to the software providers' business performance growth in the long-term perspective.

First, the direct effect of the application dimension on the slope of customer performance showed similar results with the existing references (Bergeron & Raymond, 1992; Iacovou et al., 1995; Lee & Lim, 2003); SaaS could be used in the corporation's core competence area indicating excellent value for money and could be used in the complicated task units. This confirmed that SaaS cloud computing application competitiveness depended on the degree of integration and utilization of the system. Thus, for software venders to develop SaaS cloud computing, understanding of the integration of the service environment composed of mutually different business characteristics – such as the various rules, processes, modeling, coding, and texts – should be emphasized.

Furthermore, vendors need to find new business models with a broader application dimension. For example, SaaS cloud computing will be able to offer online market platform service in which a number of unspecific corporations participate by expanding the existing closed service centering on specific corporations. They need to integrate a great many documents and functions through redefining the different business process by the number of unspecific participants, which expand their application dimension capacity as far as level of 'the business scope redesign' (Leem & Kim, 2004; Tan, 2001). In this way, SaaS cloud computing will have the genuine capability to innovatively transform the way IT services are provided.

In the meantime, it is found that the SaaS cloud computing providers' customer performances were strongly tempered by the role of technology maturity. Perceptions of difficulty in use due to technological immaturity as well as negative impressions from the initial use of a technology are likely to limit the willingness of users to invest their time and efforts in adopting it while user-perceived merits of the technology often drove the workplace performance increase (Igbaria et al., 1997). Thus, the web-service application users who have experienced the enhancement of firm performance will increase their loyalty by continuously using it and recommending it to other users. In this way, customer loyalty will affect the firm customer performance.

6.2 The Direct Effect of Firm Strategies on the Business Performance

Differentiation strategies composed of application uniqueness, specialized expertise, and channel diversification was found to have direct influence on customer performance (CP-I) in the initial stage of market distribution even though its influence on the change rate of customer performance (CP-S) decreased with the passage of time. First, the results proved that it is effective to concentrate on the specific industry in the initial stage of market adopters rather than support general-purposed applications that are widely used in all the industries. By concentrating on a specific industry, SaaS cloud computing providers can accumulate detailed knowledge of customers' requirements or problems. This would make it easier to offer the additional service required by the specific industry and customers with various portfolios of application service or state-of-the-art technology.

Second, we found that retaining specialized expertise for technological R&D, new-business model development capacity, and new-technology acquisition capacity were strategic advantages in the early stage of SaaS cloud computing distribution. We also confirmed the importance of multiple distribution channels showing that the market situation changed into 'using what product in an instant' from 'using whose product'. This explains that clients are not likely to depend on the SaaS cloud computing vendors' trust, and market power can be regarded as the competitiveness from the conventional product nature, since SaaS cloud computing is usually packaged off the shelf (Chan & Cho, 2009). Instead our results emphasize the SaaS cloud computing providers' technical capability to provide up-to-date software quickly, particularly to support SaaS cloud computing clients without internal IS departments, and the need for vendors' diverse distribution channels to immediately satisfy users diversified and highly changeable requirements.

In addition to the differentiated strategies, SaaS cloud computing providers' low-cost strategy was confirmed to be a decisive factor enhancing their customer performance. The IS adoption in prior studies was indicated to be greatly influenced by 'price'. In particular, customers showed high sensitivity to the software price. In addition to the conventional low-cost strategy, the SaaS cloud computing providers need to develop diverse pay-as-you-go price policies based on a service level agreement (SLA) which is the main characteristic of the SaaS cloud computing business model. To implement this model successfully, SaaS cloud computing vendors need a flexible and deliberate way to meter their services and resources which are being used by clients (CARR, 2009).

6.3 Firm Strategies in the E-business Model

We developed the research model in this study from the assumption that the firm strategies exerted a significant mediation effect on the growth of software vendors' business performance. This research therefore focused on testing longitudinal mediation effects in the multivariate latent growth modeling. A detailed mediation testing procedure for LGCM was followed by (Cheong et al., 2003). As an intermediate step, we combined the two unconditional growth curve models. They were influenced only by the exogenous variables (application dimension and technology maturity) while the relations from the firm strategy variables were not estimated. The model fit of this intermediate model yielded a χ^2 of 318.7 with 82 degrees of freedom ($p < .001$). Then this study compared the χ^2 difference between the full model (the conditional LGCM with all the putative variables) and the intermediate model. The χ^2 difference was statistically significant ($\Delta \chi^2$ (28) = 170.93, $p < .001$) compared with the degrees of freedom difference between two models. This indicated that modeling the relations of the firm strategies improved the model fit significantly and thus justified inclusion of the mediation process in the model.

As the next step, we obtained the point estimate of the mediated effect by taking the product of the two coefficients (from independent and mediation variables to a dependent variable). Second, we calculated the Arithmetic CI index (Cheong et al., 2003). We assessed the significance of the point estimation using Sobel's Z-test, which has been a traditional method of testing the significance of the mediation effect. In addition, we adopted Arojan and Goodman test equations as newer methods which have been shown to have higher explanation power than the Sobel test. The estimates of the results are reported in Table 8. As the mediation test result of a low-cost strategy, we found all the values of the point estimation Z-test statistics to be statistically significant. The asymmetric CI ratios also confirmed that all the mediation paths were statically valid in that the upper and lower limits of the CI result did not include zero. For the mediation test result of the differentiation strategy, the asymmetric CI ratios confirmed that all of the mediation paths were statically valid except for the mediation paths between differentiation and technology maturity. However, the point estimation Z-test statistics confirmed that all of the mediation paths were statically valid. Thus, we found that the firm strategies' mediation effect on the initial stage as well as the change slope of SaaS cloud computing provider's business performance growth were significant.

SaaS cloud computing providers are regarded as Internet corporations in that SaaS cloud computing is the product or service delivered and merchandised through the Internet (Bennett & Timbrell, 2000). As such, this research proved that Internet corporate activities should be conceptualized as the general framework of strategic management. With the growing trend of new economy in the early 2000 s, there were attempts to study SaaS cloud computing with the e-business model perspective focusing on the technology evolution itself (Currie et al., 2007). However, we found that more robust competitive advantages could arise from traditional strengths, and Internet technology can be fortified by the mediation effects of those strategies, especially in the early stage of market introduction.

Table 8 Mediation test for multivariate LGCM

Step	Model Statistics	Full Model			Restricted Model	
I	χ^2	147.77			318.70	
	$\Delta\chi^2$	-			170.93	
	df	54			82	
II	Path	Sobel-Z		Arojan-Z	Goodman-Z	Asymmetric C. I.
	AD→LS→CP-I		1.700**	1.680*	1.710**	(0.125 : 0.660)**
	AD→LS→CP-S		-1.362*	-1.361*	-1.363*	(0.089 : 0.431)**
	TM→LS→CP-I		1.580*	1.564*	1.597*	(0.034 : 0.528)*
	TM→LS→CP-S		-1.558*	-1.535*	-1.583*	(0.006 : 0.382)**
	AD→DS→CP-I		1.319*	1.287*	1.353*	(0.215 : 0.811)**
	AD→DS→CP-S		-2.218***	-2.175***	-2.264***	(0.153 : 0.513)**
	TM→DS→CP-I		1.301*	1.282*	1.344*	(-0.481 : 0.181)
	TM→DS→CP-S		-2.137***	-2.087***	-2.190***	(-0.244 : 0.157)

(Notes) * Significant at $p < .1$; ** Significant at $p < .05$; *** Significant at $p < .01$

Ultimately, software vendors' capabilities that can integrate the Internet-based characteristics and traditional competitive advantages should win in many industries. The examination of the mediation effect in this research aimed at resolving the inconclusive results on the relationship between firm strategies and their environmental factors.

6.4 Practical Implications for Technology Managers

Saif (2015) demonstrated that marketing strategies affected overall corporate performance and emphasized the concepts of standardization and adaptation. He mentioned that the majority of prior studies show several ongoing trends, suggesting that standardization remains an important, positive antecedent to firm performance. The concept of adaptation emphasizes persistent differences between various markets, which means that the firm continues to customize to meet customer requirements (Saif, 2015). With this point of view, our results emphasize using high-level TM for adaptation and implementing differentiation strategies with continuous quality improvements in order to reduce clients' lack-of-fit costs.

These findings suggest that it is important that software vendors make sure to meet a certain threshold of technology maturity if they want to have an increase in business performance. However, vendors need to be mindful of the fact that the threshold could be a moving target according to the business environment in which their clients are situated. They should note that over half of the SaaS cloud computing clients in this survey still use a low technology maturity application (see Table 1). Therefore, detailed customer needs assessment and systematic technology evaluation can help managers make better application portfolios for the client groups.

Floerecke (2018) suggested that a SaaS service should be developed as a system comprising modular microservices in order to meet the desired requirements in terms of cost advantages, performance and scalability (Floerecke, 2018). As a result, the technology supports multi-tenancy to accommodate a variety of user needs and reducing clients' lack-of-fit costs.

We propose a market positioning map as shown in Fig. 4, which is determined by a combination of application dimension and low-cost strategy, the latter depends on the simplicity of implementation. It is applied to the combination of technology maturity and low-cost strategy equally.

7 Conclusions

The recent emergence of ubiquitous Internet technologies has facilitated the delivery of software applications over the network and raised SaaS cloud computing vendors as the new type of outsourcing providers. Given this trend of SaaS cloud computing market activation, this research provides an empirical analysis of the factors to determine the market competitiveness that would enable SaaS cloud computing vendors to survive in a fiercely competitive environment. We longitudinally measured the performances of the SaaS application from the vendor's perspective, which enabled us to infer that the SaaS providers' corporate performances change with time.

This study conducted unconditional LGCM and found that customer and financial performance of SaaS providers were depicted as a linear growth curve with the passage of time. Through the conditional multivariate LGCM analysis, we found that SaaS idiosyncratic factors did not significantly enhance the software providers' business performance in the early stage, but did significantly affect the growth rate of the customer and financial performance over time. In addition, the existing firm strategies were the strong antecedents for the initial stage of SaaS cloud computing distribution, while their influence on the change rate of business performance decreased with the passage of time. More importantly, firm strategies were the key mediators of the SaaS cloud computing idiosyncratic features on the corporate performances and their growth rate simultaneously.

Results of the analysis outlined above suggests that SaaS cloud computing providers, in order to survive in the fierce market competition, need to supplement and reinforce not only the traditional strategy factors that determine the market competitiveness of SaaS cloud computing providers in the initial stages but also SaaS cloud computing idiosyncratic features differentiated from the existing software in the long term without ignoring any of those factors.

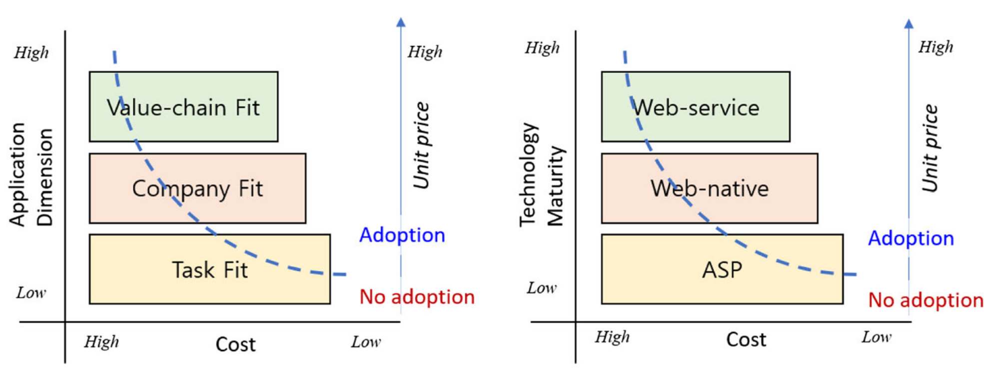


Fig. 4 Positioning map for SaaS by AD (Application Dimension), TM (Technology Maturity)

The contribution of this research is demonstrating the relevance of traditional strategic theory to the SaaS cloud computing business model and, in particular, to show that from the vendor perspective, different priorities and preferences will be placed according to the technological maturity and customers' business environment. Furthermore, by proposing a systematic structure in the SaaS cloud computing providers corporate performances, these findings will help SaaS cloud computing vendors make decisions as to which aspects of SaaS cloud computing need to be focused on to better satisfy their customers – different priorities and preferences will be placed on SaaS-specific indicators and constructs over time. The results also suggest that a 'one size fits all' approach is unlikely to be sustainable for SaaS cloud computing providers. The findings from this study will also help the customer in selection of a SaaS cloud computing vendor. We identified a set of business, strategic, and economic considerations that can help guide interested companies in their evaluation and decision-making process about whether or not to opt for SaaS cloud computing.

However, it is important to recognize the limits of the generalizability of this study. We conducted the study within the domain of a specific organization and industry. We collected data exclusively in Korea to examine and identify influencing factors of SaaS cloud computing providers' business success. The results of this study may not be able to be generalized to the experiences in other countries, though the findings should still have value for such countries. Instead of partial samples, this research surveyed the entire population of business professionals. This extends the generalizability of the current IS success model. Second, the longitudinal data of three years depict only the part of the introductory and growth stages of the entire product life cycle. Within this period of time, the SaaS cloud computing vendors' business performance curve could afford to grow. However, from the Product Life Cycle (PLC) perspective, the performance curve will eventually slow down, flatten, and ultimately decline. Therefore, a longer time frame is needed to assess antecedents' impact on maturity and even declining stages.

Additionally, the impact of firm strategy factors on the relationships between SaaS cloud computing idiosyncratic factors and firm performance are worth further study. In addition, sufficient control variables for corporate performances were not mentioned. Recent studies related to web-based learning specifically mentioned that social influence and intrinsic value (or playfulness) are the variables that may affect our dependent variables. If those variables can be included as control variables in a future, the explanatory power of the study would be enhanced and the effect of SaaS cloud computing vendors' corporate performance as the core construct of this study would be further emphasized.

Appendix A

Table 9 Measurement items for key constructs

Construct	Measurement Items
Application Dimension (AD)	To what degree of application dimension does your SaaS application possess in each of the following attributes: Function integration for individual use Process integration within department level Business integration within corporation level Industry integration between corporations
Technology Maturity (TM)	To what degree of technology maturity does your SaaS application possess in each of the following attributes: Application Service Providing Web-native application Web-service application
Differentiation Strategy (DS)	*Distribution channel diversification*: Does your department joint-sell SaaS application with other vendors? Yes/No. *Application uniqueness*: Is your SaaS application designed to support special industry only? Yes/No. *Specialized expertise*: please write down the exact number of special expertise related with SaaS application development in your department.
Low-cost Strategy (LS)	*Initial set-up fee*: Please write down your SaaS application's initial set-up fee. *Subscription fee*: Please write down your SaaS application's monthly subscription fee.
Customer Performance (CP)	Please write down your solution's expected revenue in the year
Financial Performance (FP)	Please write down your solution' current number of customers.

Appendix B: Point estimation analysis

We obtained mediation coefficients based on the point estimation approach. To verify the statistical significance, we conducted interval estimation based on the Sobel test. There are three principal versions of the Sobel test. The Arojan test adds the third denominator term (Aroian, 1947), and the Goodman test subtracts it (Goodman, 1960). The Sobel test equation omits the third term of the variance estimate in the denominator. We drew formulae for the tests provided here from (MacKinnon & Dwyer, 1993) and from (MacKinnon et al., 1995):

$$\text{Sobel test equation} : z = \frac{a \times b}{\sqrt{b^2 \times {s_a}^2 + a^2 \times {s_b}^2}} \qquad (4)$$

Aroian test equation $: z$

$$= \frac{a \times b}{\sqrt{b^2 \times s_a{}^2 + a^2 \times s_b{}^2 + s_a{}^2 \times s_b{}^2}} \quad (5)$$

Goodman test equation $: z$

$$= \frac{a \times b}{\sqrt{b^2 \times s_a{}^2 + a^2 \times s_b{}^2 - s_a{}^2 \times s_b{}^2}} \quad (6)$$

Where, a = raw (unstandardized) regression coefficient for the association between IV (independent variable) and mediator,

b = raw coefficient for the association between the mediator and the DV (dependent variable) when the IV is also a predictor of the DV,

s_a = standard error of a,

s_b = standard error of b

Baron and Kenny (1986) recommended the Aroian version of the Sobel test because it does not make the unnecessary assumption that the product of s_a and s_b is vanishingly small. Meanwhile, the Goodman version of the test subtracts the third term for an unbiased estimate of the variance of the mediated effect, but this can sometimes have the unfortunate effect of yielding a negative variance estimate.

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