

A photograph of two men in business suits sitting at a conference table with laptops and documents, engaged in a discussion. The background shows a whiteboard with a bar chart and some icons.

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A photograph of a woman in a dark blazer and a man in a suit shaking hands over a table, signifying a business agreement or partnership.

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A photograph of two young women wearing light blue t-shirts and gloves, participating in a community cleanup activity by filling a blue plastic bag with trash.

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The Impact of the Software as a Service (SaaS) Model on Business Outcomes: An Empirical Study

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Abstract

We investigate whether variables and company traits impact the SaaS development patterns (in-house vs. mergers and acquisitions) of on-premises software suppliers. Companies that excel in marketing and research and development are more inclined to develop their own SaaS, according to our research. Consequently, the firm's market share grows as a result of internal growth. However, decreased gross profits are more common for companies that created SaaS via mergers and acquisitions. Furthermore, acquirers will not see a return on investment from software as a service (SaaS) mergers and acquisitions for quite some time. For companies making the transition from an on-premises to a SaaS model, our findings have management consequences.

1. Introduction

Both the supply and demand for cloud computing have grown rapidly in recent years. Cloud computing will account for over two-thirds of application software expenditure by 2025¹. Cloud computing has become more popular, and several on-premises software businesses have already released solutions that are compatible with this model (Mell and Grance 2011; Peng and Gala 2014). To illustrate the point, in 2014, Adobe introduced Creative Cloud, marking its first significant upgrade since the demise of the Creative Suite. Many small and medium enterprises were drawn to Salesforce.com because of its subscription-based CRM solution, which allowed them to avoid the high costs of on-premise CRM. As a result of companies' actions in response to the COVID-19 damage to their operations and business, the move to

the cloud has been quickened in recent years. The cloud transition is happening at a breakneck speed, and software and IT service providers must change with it. Software as a service, or SaaS, is a new way of doing business that places software applications on the cloud. As a collection of services provided over the public cloud, SaaS differs from the conventional on-premises software business model that software vendors employ to sell their wares. (Rosenfeld 2012). The transition to software as a service (SaaS) is causing major upheaval in the way on-premises software organizations run their operations and make money (Christenson and Overdorf, 2000). With that in mind, on-premises businesses need to decide how to make the switch to SaaS. In order to make the most of their existing resources and expertise, established on-premises software enterprises may decide to

create SaaS. They may also achieve this objective by consulting other sources of information. They may join the software as a service (SaaS) industry, for instance, by combining with or purchasing an existing SaaS firm. To create SaaS, several businesses use both methods. How businesses decide on SaaS development modes and how those decisions affect performance are the foci of this research. In this paper, we apply the resource-based approach to the question of how the choice of SaaS development mode affects the performance of on-premises software enterprises, as well as what firm and industry variables influence this decision. The effects of the SaaS development paradigm on company performance have not been investigated in the current cloud computing and SaaS research. Our work addresses this knowledge gap by conducting an extensive empirical investigation of the SaaS development style used by on-premises software suppliers.

1.1 Literature Review

Technology development modes have been the subject of substantial prior research (Leiblein et al., 2002; Mudambi and Tallman, 2010; Lahiri and Narayanan, 2013). According to Mudambi and Tallman (2010), researchers have used a resource-based approach to studying what elements impact the method of technology development for enterprises. According to the resource-based approach, the way a company develops its technology is dictated by its resources. All of a company's assets, competencies, and organizational procedures are considered resources. Other items that the company has that might be seen as a strength that can be employed in its plans are also considered resources (Barney 1991). According to the resource-based approach, a company's competitive advantage can only be increased by using resources that are hard for rivals to replicate. Imperfect imitation characterizes rare and precious resources. Specifically, our work is relevant to the literature on technology and innovation

development, mergers and acquisitions, alliances, and the correlation between technological advancement and business success.

To thrive in today's cutthroat business climate, technological businesses must constantly innovate and improve their products and services. To compete with established businesses that have amassed huge customer bases and market shares, new entrants to the market are highly motivated to create groundbreaking innovations. In contrast, established businesses must adapt to new technologies by introducing small but significant improvements to their products and services (Cohen 2010; Henderson 1993; Henderson and Clark 1990). The causes of companies' approaches to technological progress have been the subject of earlier research. The importance of human capitals, such as managers and executives, in the creation of technological innovations has been the subject of several studies. While Burgelman (1983) highlighted the importance of managers taking the lead in innovation development initiatives, Wiseman and Gomez-Mejia (1998) contended that businesses' investments in research and development are determined by the risk-taking behavior of executives. Researchers like Chen and Miller (2007) have looked at the relationship between a company's R&D intensity and its financial resources and cash flows. Various scholars, such as Robertson and Gatigon (1989), have offered explanations for the variation in technological improvements across enterprises by focusing on environmental factors and technological uncertainty. How institutional ownerships impact the modalities of technology development chosen by enterprises has also been explored in previous research. Hoskisson et al. (2002), for instance, talk about how the ownership structure of a company affects whether they choose to source innovative technologies internally or from outside. According to research by Villalonga and Mcgahan (2005), companies' decisions about R&D spending

were influenced by their structure, expertise, resources, and relationships with other businesses. How companies built technologies in-house and also acquired new technologies from outside vendors was the subject of Parmigiani's (2006) research. According to her research, companies are more inclined to purchase technological advancements from other companies if they have a modest amount of uncertainty and asset specificity. The types of technological alliances that formed were dictated by the relationships and network distance between enterprises, according to Vanhaverbeke's (2002) analysis of the phenomenon. We were unable to find any research that looked at how conventional on-premises software companies approach SaaS development. Firm alliance choices and mergers and acquisitions (M&A) are the topics of the second body of literature. Companies in the technology sector often use mergers and acquisitions as a means to expand into new markets (Hayward 2002). Investigating how well acquired companies innovate was the focus of Ahuja and Katila's (2001) research. They differentiated between technical and non-technological purchases, and they said that a larger knowledge base had a beneficial effect on a company's ability to innovate. Performance is adversely impacted by the relative amount of the learned knowledge base, on the other hand. Results after an acquisition are impacted by how well the acquiring and target companies complement each other's resources (King et al., 2008). The acquired enterprises persisted in innovating after the acquisitions, according to research by Barden (2012), which examined their innovation adoption after acquisitions. An alternate strategy to acquiring outside expertise and resources is to form an alliance or a joint venture. Allying with other firms enables the focal firm to access complementary assets and capabilities required for new product development (Lahiri and Narayanan, 2013). Van de Vrande (2013) found that the variance in technological proximity and sourcing mode diversity could affect innovative performance.

Similarly, Lahiri and Narayanan (2013) found that alliance portfolio configuration affects a firm's innovation and financial performance. Innovation could improve firms' performance in many different perspectives (Cohen 2010). Li et al. (2009) studied why some software firms fail in the innovation. They examined the relationship between organizational capabilities and firm's survivor. Specifically, they studied three organizational capabilities: marketing capabilities, R&D capabilities, and operation capabilities. Dotzel et al. (2013) investigated the relationship between service innovation and firm value.

They found that service innovation (Internet-enabled innovation and people-enabled service innovation) affects firms' idiosyncratic risk, systematic risk, as well as firm value. Prior studies have also examined the impacts of team-level and individual-level innovation on firm performance. Tzabbar (2009) found that scientists' or innovators' work changes firms' technological positions. Huckman and Staats (2009) highlighted the importance of team familiarity and manager's role in innovation activities. Teece (1986) argues that firms can benefit from technological innovation by the appropriation of their knowledge stock, which helps firms gain competitive advantages in the market.

Our study adds to this stream of research by examining the on-premises software providers' choices between internal and external development of SaaS software and the impacts of SaaS technology development mode on firm performance.

1.2 Hypothesis Development

Prior researches regard internal development as an exploiting search while external development is an exploratory search (Mowery et al. 1996; Hoskisson et al. 2002; Fleming and Sorenson 2004). Exploration could be captured as a search, discovery, and innovation process, while exploitation is exemplified by refinement, implementation, and execution. Firms need to allocate their resources and capabilities to exploitation and exploration (Heublein 2012), as acquiring knowledge helps in reconfiguring the existing knowledge bases

(Raisch et al. 2009), strengthening the firm's innovative capability (Palomeras and Meler 2010). The acquisition is an effective way for firms to gain new technology, knowledge, resources quickly, and customer base (Cohen and Levinthal 1990), thereby entering the new market efficiently (Hayward 2002). Alliances are an alternative way of access to new knowledge from external sources (Lahiri and Narayanan, 2013)., Whether a firm develops SaaS technology internally or acquires SaaS technologies from external sources (e.g., M&A and alliance) depends on the firm's resources. The choices of SaaS development mode affect the firm's SaaS market entry performance and its on-premises businesses.

SaaS causes disruptions to traditional on-premises software businesses in the way that SaaS uses a "pay-per-use" pricing model. Therefore, SaaS can attract those software users who cannot afford to pay the expensive upfront license of traditional on-premises software (Armbrust et al. 2009). However, SaaS may impact the firm's on-premises business because users may switch from conventional licenses to SaaS. Furthermore, as the "pay-per-use" model takes a long time to make profits than the upfront licenses, the revenue and cash flow may decrease before the SaaS business has a large customer base. Thus, deciding which way to enter the SaaS market so that firms quickly make profits is meaningful to on-premises software providers when they shift to the cloud-based business. They need to balance their cost in investment in SaaS and gain certain profits or advantages in the market. We consider two ways of SaaS development modes: external development, which relies on resources outside the firm's boundary, and internal development, which is based on the firm's R&D activities. We examine the determinants to the SaaS development modes.

1.2.1 Factors that influence firms' SaaS development modes

Resource-based view poses that a firm's competitive strength comes from its unique combination of resources. Firms can identify and combine different resources to gain higher profits, and the imperfect mobility makes its combination hard to copy and follow (Ranft and

Lord 2002). Therefore, a firm's resources determine its technology development strategies (Dotzel et al., 2013; Peteraf, 1993).

Organizational slack is this kind of resource that affect the choice of technological development (Mayer and Salomon 2006). Organizational slack includes the firm's cumulative stock and surplus that can be used in further operation. A larger amount of organizational slack supports a firm in pursuing a growth strategy

(Steensma and Corley 2011). Firms with organizational slack can develop technology through in-house technology teams or acquire technology from other companies.

By acquiring radical innovation, acquirers can enter the new market and gain the first-mover advantage (Wernerfelt 1984). Also, combining acquired unique resources with the firm's existing resources will expand the acquirer's value-creation capability (Amit and Zott, 2001). Therefore, we hypothesize that firms with large organizational slacks are more likely to develop their SaaS through technology acquisitions of other companies.

H1: Firms with greater organizational slacks are more likely to merge and acquire SaaS technology companies to develop their SaaS business.

Knowledge is an overwhelmingly productive resource in the firm (Grant 1997). Firms provide a platform to integrate knowledge stock (Grant 1996). Dosi and Nelson (2010) argue that firms with strong absorptive capacity can assimilate new knowledge acquired externally efficiently and effectively. Absorptive capacity is a firm capability to explore and exploit external knowledge and absorb the new knowledge from outside sources (Cohen and Levinthal 1990). Previous studies showed that it is hard for firms to assimilate new knowledge if it doesn't have knowledge that is related to the new technology and does not have strong absorptive capacity (Talyor 2010; Salvato 2009; Lewin et al. 2011). Therefore, we hypothesize that

H2: Firms with absorptive capacity are more likely to merge and acquire SaaS technology companies to develop their SaaS business.

As SaaS is a service-oriented business model, firms' on-demand service experience is important for their SaaS development strategy. Software companies providing on-demand services have knowledge and resources to adjust their operations and software delivery to service-oriented model. Their on-demand experience can help them shift to SaaS easily and quickly. Furthermore, it might be easier for these firm to assimilate the cloud-related knowledge if they have experience in the on-demand software. Thus, we hypothesize that on-demand experience will make on-premises firms more likely to seek for external knowledge source because they can assimilate the knowledge quickly and then launch cloud-related products.

H3: Firms with on-demand experience are more likely to merge and acquire SaaS technology companies to develop their SaaS business.

Industry factors may affect firms' choice of technology development modes (Leiblein et al. 2002; Dotzel et al. 2013). In the highly competitive industry, firms may imitate their competitors' competitive actions. Therefore, competitors' SaaS development actions influence individual firm's R&D investment on SaaS and the development mode (Cohen 2010). An inverted-U shape relationship between industry competition and firms' innovation has been predicted in previous studies (Cohen 2010), suggesting that, in the high concentrated industry, firms are less likely to invest in innovation because they would rather invest to sustain their advantages within the industry and maintain a resource-dominant position. Thus, we expect that:

H4: When the industry competition is high, firms are less likely to merge and acquire SaaS technology companies to develop their SaaS business.

1.2.2 The impacts of SaaS Development modes on firm performance

Particularly for companies operating in the high-tech sector, investing in research and development of new technologies is crucial. Innovation and new technology boost productivity and financial success, according to previous research (Lahiri and Narayanan 2013).

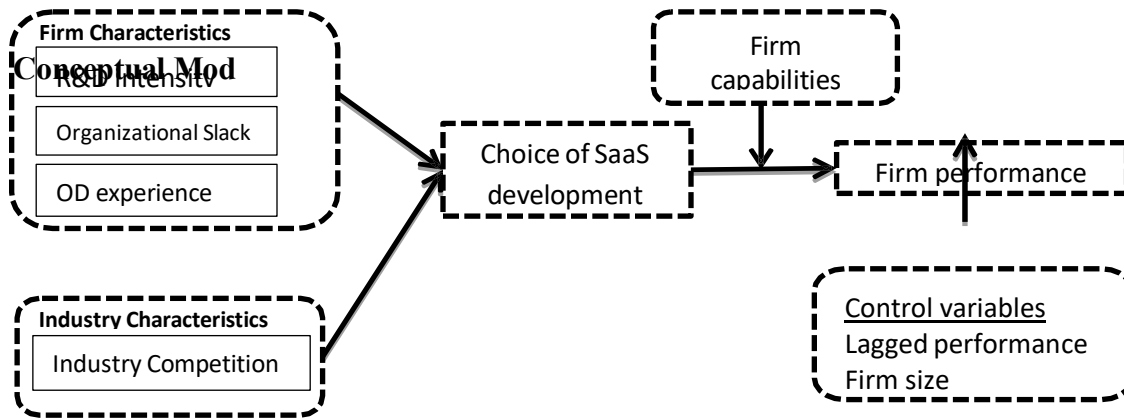
There are two ways in which a company's performance might be affected by the manner of technology development (Zott and Amit 2008). First, companies may swiftly get access to external technology and expand their internal skills and resources via mergers and acquisitions (M&A), according to the knowledge assimilation approach. However, without the necessary expertise and absorption capacity, acquirers could miss out on crucial information and struggle to integrate the acquired technology (Henderson and Clark 1990). In addition, assimilating external information often takes a considerable amount of time, even for acquirers that are able to apply acquired technologies. Acquisition returns may therefore fall short of expectations (Hayward, 2002; Benson and Ziedonis, 2009). From a resource-based view, the acquired technology's installed base is a source of potential income for the acquirer. And by acquiring another SaaS business, on-premises software companies may get into the SaaS market right away. Rapid entry allows acquirers to swiftly gain market share. Hence, mergers and acquisitions involving software as a service businesses may have both beneficial and bad effects on the acquirer's performance.

1.1.1. Marketing capability moderating effects

According to Krasnikov and Jayachandran (2008), a company's capabilities are the sum of its knowledge and skills that allow it to make the most of its resources. The capacity of a company to comprehend and meet the demands of its target market is a measure of its marketing competency (Li et al. 2010). Researchers have shown that in order for businesses to maintain their competitive edge, they need marketing capabilities (Weerawardena 2003). Firms in the high-tech market must prioritize market capabilities because they impact inventive production (Dutta et al. 1999). According to previous research (Xiong and Baharadwaj, 2013), marketing competence acts as a moderator between innovation and company performance. Companies that excel in marketing have a better chance of making money off of new technologies (Dutta et al. 1999). We anticipate that the marketing capacity will enhance the favorable performance consequences of the SaaS development method (H5:). Control factors include company size and scope (Vanhaverbeke et al., 2002; Berrone et

al., 2013; Suraz et al., 2013). You may see the conceptual model in Figure 1.

Figure 1 Conceptual Model



2. Empirical Analysis

2.1 Data Collection

Information was gathered from a variety of sources. We started by compiling a list of companies from COMPUSTAT that provide computer-related services (SIC 737), which includes programming, data processing, and other related industries. The company's 10-K filings from 2003–2013 are retrieved from lexisnexis.com and EDGAR. We also retrieved corporate news from Factiva throughout that time. We employ a combination of cloud-related terms such as "SaaS," "software as a service," "cloud computing," "on-demand," and versions with dashes, together with a batch of keywords that includes "announce," "launch," "introduce," and "beta," to analyze this text data. We started by cataloguing businesses that have launched on-demand apps or cloud-based services. After that, we used coding to organize the information on the release dates, development methods, and descriptions of SaaS products and services. We build software as a service styles such as make, purchase, make, and purchase. As an additional service, we analyzed news articles for information on the company's competitive moves, such as alliances, mergers, and acquisitions, as well as other capacity and scale events. Lastly, we

retrieved the company's financial and accounting records from CRSP and

COMPUSTAT.

The US Patent and Trademark Office provided us with the firm's patent data. We attempt to normalize the company's name before searching for their patent since there is a muddle in the assignee's name of the patents. Compustat and the actual assignee of the patent do not match. Since we are collecting names from Compustat in an effort to identify their patent stock, this might pose issues. We fixed the issue by first standardizing the company's name using data and Stata code from the NBER patent data project, and then we searched in USPTO using the cleaned name. We have collected information from SIC737 firms from 2003 to 2013. There are 1400 businesses classified as SIC737; 342 of them have announced the release of cloud-based software solutions in the last decade. More over half of the total firms, 280 to be exact, choose to build their SaaS product in-house. A hundred and ten businesses choose to either form an alliance to provide SaaS or buy SaaS providers. In addition, 48 of the businesses in our sample have opted to fund both internal and external growth. Application

software for businesses is what most of these firms specialize on. There are a few that provide Internet services or system software.

2.2 Model Specification

In the first stage, we are interested in the firms' choice of make or buy or both make and buy. We code the choices as order numbers. Thus, we use the logit model to predict a firm's choices. The dependent variable is coded as following: =1, No SaaS; =2, Make; =3, buy; =4, make and buy. We consider coding dependent variables proper because as the number becomes larger, investment in SaaS development is also larger.

The model is specified in this way:

$$p_{ij} = \Pr(y_j = i) = \Pr(\kappa_{i-1} < \alpha_i + \beta' X_j \leq \kappa_i) = \phi(\kappa_i - \beta' X_j) - \phi(\kappa_{i-1} - \beta' X_j)$$

where X_j is the vector of the independent variable. In the conceptual model, we predict that firm characteristics and industry characteristics will influence the firm's development choices. Besides, we also add control variables in our model: firm size and business scope, which are represented by the number of segments of the firm.

In stage 2, we model the firm's performance using the following model:

$$Q_{it} = \alpha_i + \beta_1 Make_{it-1} + \beta_2 Buy_{it-1} + \beta_3 Both_{it-1} + \lambda Mode * FirmCapabilities_{it-1} + \delta controls_{it} + u_{it}$$

Mode refers to a firm's development mode: make, buy and both make and buy. Because we think that lagged variables have more predictive power on a firm's development mode choice, we incorporate lagged variables in our model (Ahuja and Katila 2001). Following Xiong and Bharadwaj (2013), we use the system GMM to estimate the model. After Arellano-Bond's (1991) dynamic panel estimator was put forward, it has been increasingly used these years. It has many advantages and is suitable in our context. GMM estimator is designed for 1) "small T, large N" panels, 2) linear function model, 3) independent variables that are not strictly exogenous 4) fixed individual effects. In our context, the system GMM estimator is suitable to use, and it will resolve some endogenous problems that are

concerned. We consider that decisions made by the firm might be affected the firm's performance which means there might be a simultaneous problem here.

And there also might be an omitted variable issued occurred in the model. System GMM is suitable for reducing these two problems. Thus, we choose it as our estimator.

2.3 Variable Measurements

We have two research questions. The first one aims at finding factors that will affect a firm's choice of technology development mode. The second is to examine the association between SaaS development mode and firm performance. Firms simultaneously pursue different objectives depending on their strategy. Thus, we choose other financial performance measurements as dependent variables. For example, technology development will affect a firm's operating margin and sales growth. And we also examine how technology development will affect market share.

In specific, we have the following dependent variables:

Market share: Market share is a good indicator of firm performance (Xiong and Bharadwaj 2013). It could be calculated as sales of firm i divided by total market sales.

Sales growth: Sales growth is calculated as the company's growth rate. It's also a good proxy for overall firm performance. Therefore, we calculate it as the annual growth rate of a firm.

Gross margin: Gross margin is used to determine the value of incremental sales. We use the difference between revenue and cost of goods divided by revenue to represent it (Suarez et al., 2013).

Abnormal return: Despite the above measurements, we also use the abnormal return to measure firm performance. Annual abnormal returns could be regarded as a cumulative abnormal return of 12 months in a year. Thus, we is expected return in the stock market. We obtained the data from CRSP.

Since we have two-stage models, we have two different sets of independent variables. For the first stage, we have measured:

Organizational slack: Following Berrone et al. (2013), organizational slack is measured by selling, general, and administrative (SGA) expenses divided

by sales.

Free cash flow: Cash flow is the amount of cash generated and used by a company in a year. We take the logarithm of free operating cash flow in the model.

On-demand experience: Before launching SaaS, some companies might already have on-demand services. Because it might be easier for these companies to enter the cloud market, thus we code on-demand experience as a dummy variable through the news.

In the second stage of analysis, we use the following variables:

Marketing capability: Several important factors could affect a firm’s performance. As suggested by Li et al.(2010) and Xiong and Bharadwaj (2013), a firm’s capabilities are an essential element that is expected to influence firm performance. This ability will help firms maintain a good relationship with their customers and improve their selling and promotion of their products. Following Li et al. (2010) and Xiong and Bharadwaj (2013), we calculate marketing capability using stochastic frontier estimation of the equation: $revenue = f(\text{patents; sales, general, and administrative stock; receivables})$.

Operating capability: Unlike marketing capability, the operating capability is a firm’s ability to distribute and use its resources effectively. From the previous study, we also calculate operating capability using stochastic frontier by the equation: $operating\ income = f(\text{cost of goods sold, capital expenditures, employees})$.

Absorptive capacity: Despite those capabilities affecting firm performance, we also consider a firm’s absorptive capacity. Absorptive capacity is important for firms because it indicates the ability to learn external knowledge and apply new knowledge (Lichtenthaler and

Lichtenthaler, 2009). We use R&D intensity as a proxy of absorptive capacity (Mowery et al. 1996). R&D intensity is measured by research and development expense divided by total assets. *Advertising intensity:* As we discussed before, a firm’s marketing resource will affect its performance; we also account for it by considering advertising intensity (Villalonga and McGahan, 2005). Similarly, advertising intensity is measured by advertising expense divided by total assets.

Interaction terms: we include firms’ development modes and capabilities interaction terms in the model since we are interested in whether firms’ abilities will moderate the relationship between development modes and firm performance.

Industry factors are also influential on firm performance. Therefore, our industry concentration, growth, and competition measures are consistent with previous research (Fang et al., 2008; Suarez et al., 2013; Xiong and

Bharadwaj, 2013). Therefore, we use HHI to represent industry characteristics affecting a firm’s performance. Herfindahl index is used to measure the concentration of industry. It’s calculated as $H = \sum_{i=1}^N$

Control Variables

We also control the firm’s size, age, and year dummy, indicating whether the firm’s SaaS development was before or after 2009. And we also control the annual gross national product (GNP) to control macroeconomic influence. Firm size is used as the control variable. We use the logarithm of total employee number as a proxy of firm size.

Table 1 explains the variable measurements and Table 2 shows the summary statistics of variables. We report the correlation matrix of variables used in Stage 1 and Stage 2 analyses in Table 3 and Table 4, respectively.

Table 1 Measurements of Variables

Variable	Measurement	Data Source	Reference
Sales growth	Annual growth rate of firm i	COMPUSTAT	Suarez et al. (2013)

Market share	Sales of firm i /total market sales	COMPUSTAT	Xiong and Bharadwaj (2013)
ROA	$\frac{\text{net income}}{TA}$	COMPUSTAT	Moatti et al. (2013)
Gross margin	$\frac{\text{revenue} - \text{cost of goods sold}}{\text{revenue}}$	COMPUSTAT	Suarez et al. (2013)
CAR12	$\sum_{k=1}^{12} Rit - Rrf, t$	CRSP	Xiong and Bharadwaj (2013)
Independent variable			
Makeonly	Binary variable =1, if firm develops SaaS in-house; otherwise =0	Factiva, SEC filings	Arora et al., (2014)
Buyonly	Binary variable =1, if firm acquires SaaS; otherwise =0	Factiva, SEC filings	Arora et al., (2014)
Both (make&buy)	Binary variable =1, if firm develop SaaS in-house and acquire SaaS; otherwise =0	Factiva, SEC filings	Arora et al., (2014)
Organizational slack	SGA/sales	COMPUSTAT	Berrone et al. (2013)
Free cash flow	Log(free operating cash flow)	COMPUSTAT	Xiong and Bharadwaj (2013)
Marketing Capability	Stochastic Frontier Estimation	COMPUSTAT USPTO	Xiong and Bharadwaj (2013)
R&D intensity	$\frac{R\&D\ expense}{Sales}$	COMPUSTAT	Villalonga and McGahan (2005)
Ad intensity	$\frac{Advetising\ expense}{Sales}$	COMPUSTAT	Villalonga and McGahan (2005)
Mode*Marketing Capability	The interaction of marketing capability and each of three SaaS development modes		Self-generated

Mode*Operating Capability	The interaction of operating capability and each of three SaaS development modes		Self-generated
Mode*R&D intensity	The interaction of R&D intensity and each of three SaaS development modes		Self-generated
Mode*Ad intensity	The interaction of AD intensity and each of three SaaS development modes		Self-generated
Ondemand experience	Dummy variable: =1, has on-demand experience	Factiva News	Self-generated
HHI	$H = \sum_{i=1}^N S_i^2$	COMPUSTAT	Vrande (2013)
Noseg	Number of segments	COPMUSTAT	Wiles et al. (2012)
Firm size	Ln(emp)	COMPUSTAT	Ahuja and Katila (2001)

Table 2 Statistics Description

Variable	Obs	Mean	Std. Dev.	Min	Max
Develop_mode	8363	1.27	0.66	1.00	4.00
ODexp	8350	0.17	0.38	0.00	1.00
HHI	8350	0.18	0.09	0.00	0.99
slack	6917	3.47	52.53	0.00	3348.00
lgfreeCF	5183	2.61	2.25	-4.51	10.16
ADintensity	3598	0.26	8.07	0.00	457.00
RDintensity	5673	0.89	19.99	0.00	1325.50
grossmargin	7463	-4.45	165.80	-180.00	1.00
CAR12	2816	0.05	0.53	-2.32	5.13
salesgrow	6119	1.24	43.42	-1.00	3218.67
mktshare	7753	0.01	0.05	0.00	1.00
makeonly	8363	0.13	0.34	0.00	1.00
buyonly	8363	0.07	0.25	0.00	1.00
both	8363	0.03	0.16	0.00	1.00
MKcap	6823	0.17	0.08	0.00	0.78
cumRDintensity	5223	0.49	3.81	0.00	201.40
cumADintensity	2878	0.33	8.91	0.00	457.33
lnemp	6761	0.69	0.95	0.00	6.08
noseg	6593	2.48	0.77	1.00	6.00

Table 3 Stage1 Variable Correlations

	choice	ODexp	HHI	slack	lgfreeCF
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Develop_mode	1.000				
ODexp	0.278	1.000			
HHI	-0.116	-0.020	1.000		
slack	-0.018	-0.019	0.016	1.000	
IgfreeCF	0.088	0.013	-0.007	-0.093	1.000
ADintensity	-0.068	-0.060	0.088	0.216	0.002
RDintensity	-0.014	-0.024	0.016	0.898	-0.100
lnemp	0.067	0.035	0.000	-0.050	0.825

Table 4 Stage2 Variable Correlations

	1	2	3	4	5	6	7	8	9	10	11
cumRD	1.00										
cumAD	0.18	1.00									
grossMargin	-0.13	-0.62	1.00								
CAR12	-0.06	-0.09	0.11	1.00							
salesgrowth	0.00	0.03	0.07	0.19	1.00						
mktshare	-0.09	-0.01	0.02	-0.01	-0.03	1.00					
makeonly	-0.03	0.00	0.05	0.06	0.04	-0.07	1.00				
buyonly	-0.04	-0.04	0.05	0.05	-0.01	-0.04	0.21	1.00			
both	-0.05	-0.01	0.03	0.05	0.00	-0.03	0.48	0.68	1.00		
MKcap	-0.03	0.03	-0.03	0.01	-0.01	-0.08	-0.05	-0.01	0.04	1.00	
lnemp	-0.29	-0.02	0.04	0.01	-0.02	0.62	0.03	0.04	0.03	-0.08	1.00
noseg	-0.05	-0.08	0.05	0.04	0.00	0.07	-0.06	-0.02	0.02	0.00	0.02

As shown in Table 3 and Table 4, all correlations are lower than 0.70. The mean variance inflation factor (VIF) is 3.56, indicating that our data has no multicollinearity problems.

3. Analysis Results

4.1. Stage 1 Analysis Results

Table 5 displays the results of the first stage of regression analysis. Our model's predictions about the importance of firm characteristics in determining development mode were correct. Companies with greater capital on hand are more inclined to put it into software as a service investments. Companies with more financial resources are more inclined to invest in cutting-edge technology, so this makes perfect sense. But in the model, resource slack does not seem to be a major component influencing the firm's choice. Cloud computing is a game-changer as it alters the way businesses operate. Because bigger companies get fewer benefits from revolutionary changes, they are less inclined to implement them, according to earlier research (Cohen 2010). However, they will also alter this in order to avoid the possibility of losing their monopoly status or increasing their market share. Because not all businesses see SaaS as a game-changer, resource slack may not be a big issue. Their laxity or size has no bearing on this assessment. In the grand scheme of things, it's not that crucial when making decisions. Our research also shows that the investment in SaaS by a company is inversely correlated with their cumulative R&D intensity. One measure of a company's capacity for innovation is the level of investment it makes in research and development (Hughes 1988). Companies with a stronger capacity for innovation are more likely to create software as a service (SaaS) offerings, as anticipated. Acquisitions are more likely

to be their strategy than either make or buy. Prior research has used R&D intensity as a surrogate for absorption capacity (Mowery et al. 1996). The capacity to absorb new information from outside sources is what a company's absorptive capacity measures, as opposed to its innovative capacity, which is the ability to create new knowledge inside (Lichtenaler & Lichtenthaler 2009). Some companies may find that purchasing similar businesses or developing strategic partnerships is all it takes to get access to external information. They may therefore be less motivated to manufacture their own goods. We also discover that on-demand experience has a major impact on the decisions made by businesses regarding the creation of SaaS solutions. Software as a service development is more common among companies with this kind of background. Their investment in software as a service development is also higher. Companies may find it simpler to capitalize on their on-demand expertise by creating cloud-related goods. According to Villalonga and McGahan (2005), the level of advertising intensity might be seen as a resource for the market. Less investment in SaaS is the result, according to our hypothesis, of more intense advertising. We speculate that this could be due to the fact that companies with a stronger emphasis on marketing propaganda are less inclined to engage in risky investments in emerging technologies. Companies that rely heavily on advertising may have more valuable brands that are difficult to transfer. This suggests that these companies may gain more if they developed items under the same brand.

Table 5 Stage1 Regression Result

VARIABLES	D.V.= choice
L.slack	0.016 (0.021)
L.lgfreeCF	0.155*** (0.054)
L.cumRDintensity	-0.011*** (0.318)
L.ADintensity	-0.070*** (0.018)
L.ODexp	0.164*** (0.014)
L.HHI	-2.071 (2.826)
L.lnemp	-0.329*** (0.114)
L.noseg	0.084 (0.146)
# ofObservations	1,538

Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Here---

Stage 2: Impacts on Financial Performance

Following Ahuja and Katila (2001), we incorporated the lagged effects in our models. We also try to see if the company's capability will moderate the relationship between firms' technology development mode and firm performance. We first run regression on the essential factors, then add moderator effects to the model. Finally, we add the model of the interaction term of marketing capability and technology mode. Table 6 reports the results.

Table 6 shows that the development mode decision has a different impact on different perspectives of a firm's performance. For market share, it seems that internal sourcing will help increase their market share by 0.4%, taking into marketing capability's moderator effects. There could be two reasons to explain this. First, from the demand side, SaaS products have their markets instead of the original software market. As Cohen (2010) pointed out: innovation could bring new demand. Like small and medium enterprises, at first, they might not be able to afford a CRM system, but the situation changed when salesforce.com emerged and brought them the idea of "pay-per-use." Second, the company

Insert
Table 6

could be able to gain more market share by attracting people who are willing to switch. Some customers might switch from traditional software to SaaS products because it is more beneficial for them. Thus the company could also enhance its market share in the original market.

For sales growth, we can see from Table 6 that developing SaaS will decrease the growth rate. This could be the result of resource cannibalization (Roberts and Mcevily 2005). New products are likely to attract more attention, and they need the effort to be well understood and promoted. As a firm's resource is limited, then if the firm spends their resource on new products, existing products might suffer. Thus, the overall sales growth rate could be decreased by introducing SaaS products. However, both make and could help the company in sales growth. Acquiring a cloud-based firm or alliance with existing firms could help the focal firm enter the market quickly compared to internal development. When a focal firm acquires a target firm, not only does it acquire its technology and knowledge of it, but it could also acquire the customer base of the target firm. Allying with another might also help the focal firm to get benefits from its partner's customer base. Doing only one mode: make or buy, might have an uncertain outcome, but doing both make and buy signaling that the company has a more significant investment in SaaS and aims to get specific power in this market. This could make customers more confident in this company's new products. Besides, considering from the other perspective, usually, larger firms are capable of taking a risk doing this. They might be more attractive to customers because of their existing monopoly position.

Besides, we found that internal sourcing hurt gross margin. We know that gross margin depends on both revenue and cost. Sales increase might be accompanied by cost increase. New product development requires the company to invest in R&D and product marketing. Thus, the overall cost will be higher. Therefore, the gross margin decline might indicate the firm's declining competitiveness in its products. Internal development might cause this problem because it takes longer before the firm can launch the product. Especially when the firms' competitors already have SaaS-related products, internal

development might harm the firm's competitiveness. However, we can see that if the firm has higher marketing capability, it will moderate the relationship between self-development and the company's gross margin. Sales could significantly enhance a company with higher marketing capability compared to cost. Thus, firms that are effective in marketing could benefit from internal development.

4.3. Additional Analysis

Despite all the firm performance measurements we discussed, we were also interested in how the make or buy decision would impact stock return. Because the acquisition could take quite a long time to finally complete, and internal software development might also take some time to promote, we consider using an annually cumulative abnormal return properly in our context. Our results show that the make or buy decision didn't affect the firm's abnormal return. Then we consider the effects of the decision in the year when the decision is made. Stock return is more sensitive to the company's decision. Thus, the make-or-buy decision could affect this year's abnormal return rather than next year's. Table 7 shows the result of further analysis. Here, we can observe that if the firm makes both and buys this year, it would negatively impact abnormal returns. Suppose the firm announces the launch of a new product and the acquisition of a SaaS-related firm. In that case, the investment in SaaS development will be high, and the risk will also increase as the investment increase. Thus, the investors might feel the high risk of the firm's decision, which eventually leads to less confidence in the firm.

---Insert Table 7 Here---

4.4. Robustness Check

In the previous section, we used system-GMM instead of OLS to release the simultaneous issue. System GMM is used in literature because it could remove some endogenous issues, i.e., simultaneous problems. And we now do further analysis to make our study robust. Second, we only consider the financial benefits of entering a new market. However, financial performance is just a single perspective. Based on the knowledge-based theory, internal knowledge development and external knowledge acquisition might differ. Thus, we also use patent stock as our dependent variable:

$$PatentStock_{(t)}=(1-\delta)PatentStock_{(t-1)}+patentNo_{(t)}$$

Here we set $\delta=0.15$ to calculate patent stock. We are considering that patents might need longer to be granted.

Thus, we incorporate two-year lag variables in our model to test the effects of the development mode. The results are shown in Table 8.

---Insert Table 8 Here---

In model 1, we only include a variable that is variable lagged one year. This is because the development has no significant effects, while the lagged two-year variable shows that only both make and buy could harm the firm's innovation performance.

Previous research has shown that the absolute size of the acquired company relative to the two companies influences post-acquisition performance (Kapoor and Lim 2007). Thus, we include the size of the acquired company in our analysis based on the employee number. The result remains consistent with our primary analysis.

4. Discussion

We catalog the variables that could impact a company's approach to technological development, and we discover that R&D spending affects the mode of development that a company chooses, with more R&D spending suggesting that companies would build their cloud services in-house. Even though they've been there for more than a decade, cloud computing development is still unsure about them. When companies have the resources to accomplish it internally, they often choose to do so since the final result is more likely to mesh well with how they conduct business (Christenson and Overdorf 2000). Furthermore, companies with strong marketing capabilities often favor internal growth, since this demonstrates their capacity to meet client demands. We examine the connection between a company's capacity and its manner of technological growth here. From both a financial and an innovation standpoint, we further attest to the connection between various technological initiatives and the

success of businesses. Contrary to expectations, however, many viewpoints on financial success are unaffected by the growth style. While internal development may not provide significant benefits to organizations, it might assist in increasing their market share. However, we did find that acquisitions may hurt rather than help a company's performance, which is in line with other studies (Hayward 2002). However, while concurrent sourcing might reduce technological uncertainty because firms have to invest more in the technology development process than single mode, the return might require time. Consequently, there are a number of real-world consequences for how a company chooses to operate: first, the company would be better off sticking with a single mode. They may not aid the company in quickly expanding their business, whether they create or purchase, in the long or short term. Nonetheless, software as a service should continue to have a secondary focus from businesses. But when companies with better marketing skills are pushed to buy up cloud-related businesses and get into the cloud market first, the purchase may not be beneficial to the company directly. However, the majority of businesses should avoid concurrent sourcing. Disagreement amongst various information providers could further impede the company's product development process, leading to stagnant financial performance. The literature on IT strategy and IT value has benefited from our work in several ways. Cloud computing, often known as SaaS, is all the rage right now, but academics have paid little attention to how cloud services are really developed. There is a cost to entering the cloud business, but we are proving that doing it well is crucial. Cloud computing has introduced a new "pay-per-use" concept to the software business, and we are interested in studying this technological phenomena for its technical aspects. Technology shock is something that businesses worried about their innovation efforts confront, and this technology has the potential to be disruptive (Christenson and

Overdorf 2000). The method of technology development and the firm's success were both illuminated by our analysis. Also, we proved that marketing skills matter for tech development; these aspects of the business could influence one another and produce varying outcomes. Nevertheless, there are certain limitations to our research. To begin, our research on the evolution of SaaS is limited to software businesses. Infrastructure as a Service and Platform as a Service are the other two varieties of cloud computing. These two weren't on our radar. Second, we failed to take into account the technical aspects of the acquired businesses or coalitions, such as the degree to which their technologies overlapped or their technical capacities (Sears and Hoetker 2014). Startups with a focus on cloud service development could be the intended targets; prior to acquisition, these companies might serve a variety of clients. We may have missed a crucial detail on the purchased company's future performance due to these factors. Nonetheless, we think that we

may aid businesses planning to enter this industry by providing a synopsis of the ways cloud computing services are being developed.

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