An Empirical Analysis of Software-as-a-Service Development Mode and Its Impacts on Firm Performance

Research-in-Progress

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Abstract

We address the following two research questions: (1) under what circumstances will firms prefer internal SaaS development to external sourcing? and (2) how does the SaaS development mode affect firm performance? We examine the SaaS development actions in the computer industry (SIC code 737) from 2003 to 2012. The preliminary analysis results suggest that firms with large amount of working capital can consider developing SaaS application in-house. However, if firms have high level of R&D capability, they may have better absorptive capability of technology innovation. Firms can grasp SaaS innovation through external sourcing. Our results indicate that the strategic decision of SaaS development mode will have short-term impact on firm performance (i.e., gross margin and market share), but not for the long-run performance (Tobins'q).

Keywords: Cloud computing, Software-as-a-service, IT value, IT technology development

Introduction

Software-as-a-Service (SaaS) is a software distribution model in which software applications are hosted on a remote server (cloud-based), delivered as an on-demand service, and can be accessed by multiple users through the web browser. Different from traditional on-premise software business model, SaaS service providers take charge of the technical infrastructure, operating, hosting and maintenance (Sun et al. 2007). Launching SaaS enables software sellers greater access to customer data and connect to customers direct. It helps to create new markets, attract new customers, and gain more predictable revenue which is important for cash flow management of a company. Although the traditional on-premise license model will be around for years to come, it is slowing losing its dominance to SaaS models. Global SaaS market will reach $14.5 billion in 2015 with an annual growth rate of 18% and 85% of all new software will be SaaS in the next 2-3 years[1]. Most large, traditional software companies are already moving toward SaaS and embracing the changes quickly. According to our statistics, more than 26% of 435 public software sellers in SIC 7372 industry have launched SaaS in or before 2013. Some software companies such as Intuit Inc. and Blackboard announced that SaaS revenue represents more than one third of their total software revenue[2].

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[1] Kanaracus, C. 2012. "Gartner: SaaS market to grow 17.9 percent to $14.5 billion". http://www.infoworld.com/d/cloud-computing/gartner-saas-market-grow-179-percent-145-billion-189583.

[2] "PwC global 100 software leaders: Converging forces are building that could re-shape the entire industry". Available on http://www.pwc.com/en_GX/gx/technology/publications/global-software-100-leaders/assets/pwc-global-100-software-leaders.pdf.

However, enter the SaaS model is not easy and straightforward. Launching SaaS needs software companies to conduct a huge change of the company's business model, such as the marketing and sales tactics, product development and management, and daily operations model (Chapell 2012). All these changes may affect software companies' financial performance. Launching SaaS needs tremendous investment to guarantee service reusability, scalability, and availability, which in the long run may affect SaaS firm's ability to improve its software quality and innovation (Fan et al. 2009). Therefore, for traditional software companies, a key strategic question is: how do firms enter SaaS market to increase firm value and catch up with SaaS trend? Our particular focus in the paper will be on external sourcing of SaaS as a development mode and its effects on firm performance.

The role of external technology sourcing has come to the forefront recently. Recent data suggest that on-premise software sellers are buying SaaS technology companies outright to enter the SaaS market. For example, SAP AG bought SuccessFactors Inc. for $3.4 billion to compete with archival Oracle Corp. in the cloud-computing market. IBM acquired DemandTec Inc. for $440 million, adding Internet-based smarter commerce tools to customers. SaaS acquisition deals dominate the merger & acquisition landscape. The total number and amount of merger and acquisition deals in cloud and SaaS markets grew more than 15% in 2012 and accounted for more than 40% of global M&A deals[3]. However, external sourcing of technology is not risk-free. Failure rates of M&A are typically between 60 to 80 percent (Homburg and Bucerius 2006; Marks and Mirvis 2001). Some companies such as SAP AG reported disappointed performance of the acquired SaaS businesses *ex post* takeovers. Thus, it is important to explore the causes influencing the choice between in-house R&D and external SaaS technology sourcing.

Although many authors in the past decades have noted the rising importance of SaaS in software industry, so far as we know, there is no study examining the SaaS development mode. Previous SaaS researches have covered the areas such as SaaS revenue models (Choudhary, 2007; Ojala 2013), risks and opportunities (Benlian et al. 2010; Hui et al., 2010; Pring and Rold 2009), and the competitions, changes, or impacts evoked by SaaS (Espadas et al., 2008; Fan et al. 2009), the impacts of cloud computing on firm performance (Ge and Huang 2011). But prior literature tells us little about how firms choose between internal R&D and external technology sourcing and the result of this strategic decision. In this paper, we address the following two research questions: (1) Under what circumstances will firms prefer internal SaaS development to external sourcing; and (2) how does the SaaS development mode affect firm performance? We examine the SaaS development actions in the software industry (SIC code 7372) from 2003 to 2012. Currently, we have collected data in the prepackaged software industry (SIC7372) and assembled information for 116 firms in this industry. In the next section, we discuss the related literature and theoretical background of the research. In Section 3, we talk about the data collection, variable measures and econometric analysis. In the conclusion section, we discuss the potential contribution of the research and future plan.

Theoretical Background

The research is closely related to two streams of study: the strategic decision of technology development mode and the impacts of technology development mode on firm performance.

The question of why firms source technology externally vs. engaging in internal R&D has been extensive explored in strategic management literature and organizational structure literature. Prior studies have examined two major sources of external technology: merger and acquisition and technology alliances. Both external technology sourcing need joint and cooperative efforts from two or more separate organizations. Literature suggests that external sourcing is exploration whereas internal development is exploitation of technology. Exploration involves developing new knowledge and exploitation refers to refining knowledge (Levinthal and March 1993). Extensive literature based on transaction cost theory has explained this make-or-buy decision. Transaction cost theory suggests that in-house development will be preferred over external sourcing as market demand uncertainty increases and technology proprietary increases (Robertson and Gatignon 1998). Haffmann and Schaper-Rinkel (2001) found that two categories of factors influence the choice between internal and external development: environmental

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[3] Mckendrick, J. 2013. "Cloud dominated Corporate Mergers and Acquisitions in the Past Year: http://www.forbes.com/sites/joemckendrick/2013/02/13/.

characteristics, and company characteristics. External sourcing is preferred when the use of economies of scale and scope is more important (Haffmann and Schaper-Rinkel 2001). Poppo and Zenger (1998) found that internal development is more efficient when technology development needs firm-specific language and routines. In other words, integration and compatibility of external technology are critical concerns for using external sourcing. Chatterjee (1990) emphasized that concentrated markets favor external sourcing. Firms with internal funds or funds from low-risk debt favor internal development. Based on these prior studies, we can conclude that three major factors are important for technology development mode: company financial resources, company's capability, and market characteristics.

The outcome of technology development mode is relatively under-investigated. Most of the literature focused on the innovation performance of M&A (e.g., Ahuja and Katila 2000; Hitt et al., 1991, 1996; Hoshisson et al., 1994). But their findings are conflict. For example, Ahuja and Katila (2000) found M&A enhances innovation performance (Ahuja and Katila 2000) but Hitt et al., (1996) found a negative impact of technology acquisition. Stettner and Lavie (2012) studied 190 US-based software firms and found that external sourcing improves firm's performance. They suggested that it was more valuable to buy firms with distinct knowledge while relying on setting up knowledge through internal R&D. So far, there are few researches examining the financial performance of SaaS development. As far as we know, no study has examined the impact of SaaS technology on firm performance. Therefore, we develop our research based on the prior strategic literature.

Research Method

Data Sources and Sample

To address the research questions, we assembled a list of firms in computer programming, data processing, and other computer related services (SIC7372) in 2002-2013 from COMPUSTAT. COMPUSTAT reports financial information of 435 public companies in SIC7372. We downloaded the firm's financial statement (i.e., 10-K reports) from lexis.com and news data from Factiva database. Using a batch of keywords which include "announce," "launch," "introduce," and "beta," of "*Software as a Service*," "*SaaS*," "*cloud computing*," "*on demand*," "*pay by use*," and variations with dashes, we first identified all firms that have launched or introduced cloud-based on-demand applications and services from 2003 to 2013. We coded dates of SaaS product launch, mode of SaaS product development, and SaaS product and service descriptions. Following the method used by Li et al. (2010), we also coded data about firm's competitive actions (i.e., marketing, product development, operations, merger and acquisition, and other capacity and scale actions) from news database. We collected firm's accounting and financial data from CRSP and COMPUSTAT. Firm's patent data was collected from US Patent and Trademark Office (USPTO). We consolidated a cross-sectional dataset consisting of information about 435 firms.

In our data sample, 116 out of 435 SIC7372 firms launched cloud-based on-demand software applications and half of them announced that they developed SaaS fully or partly in-house. Salesforce.com was the first public company announced SaaS model in 2003. Fifty-six firms bought SaaS technologies from external sources such as direct buying SaaS companies or joining SaaS strategic alliance. Around 32% of SaaS applications are business applications such as project management, HR, and reporting & registration. Cloud-based CRM and ERP applications are about 27% of the sample. 14% of firms have launched the SaaS version of operating systems and 6% of firms have managed the cloud-based on-demand database. The distribution of our data sample is similar to that used in Suarez et al. (2013).

Table 1 provides explanation of variable measurement and data sources. The descriptive statistics and the correlation matrix are provided in Table 2.

Model Estimation and Preliminary Analysis Results

There are endogeniety issues in the models. It is possible that SaaS launch and firm performance are affected by some omitted variables such as executives' management competence or competitor's peer pressure. Our analysis results will be biased without controlling these endogeneity issues. To correct for potential biases caused by omitted variables, we adopted the two-stage control functions approach (Heckman and Robb 1985). Control functions approach is more robust than propensity score matching because the method of control functions explicitly models omitted relevant conditioning variables rather than assuming there are none (Heckman and Navarro-Lozano 2004). Our econometric model was structured as follows:

First stage: Model 1--SaaS development mode (Probit analysis)

$$\Pr(selfdev = 1 \mid X) = \Phi(X'\beta)\ ;\ \Pr(extdev = 1 \mid X) = 1 - \Phi(X'\beta)$$

where, Pr denotes probability, Φ is the Cumulative Distribution Function (CDF) of the standard normal distribution, and X denotes a vector of regressors including organizational resource slack, capabilities, market characteristics, types of software, other controls and an instrument variable (we use lgsalesIV1 as an instrument).

Second stage: Model 2—Outcome of SaaS development mode choice (OLS regression)

$$Q_{t+1} = \alpha_0 + \beta_1 selfdev + \lambda Controls_t + lamda + \varepsilon$$

where, controls contains a vector of variables including industry growth, industry turbulence, industry competition, firm size, age, and ratio of effort spent on competitive activities and other controls. Lambda is the error correction term generated from the first stage model estimation. We use one year lagged data of variables and controls in the analysis to further account for the concurrency issues of financial and accounting measures.

Table 1 Variable Measurement and Data Sources

Variable	**Measurement**	**Data Source**	**Reference**
Tobins'q	$q = \frac{\text{MVE} + \text{PS} + \text{DEBT}}{\text{TA}}$	CRSP, Compustat	Dotzel et al. (2013)
Gross margin	$\frac{(\text{Sales}_{i,t} \text{ - Cost of sales}_{i,t})}{\text{Sales}_{i,t}}$	Compustat	Morgan and Rego (2005)
Market share	Sales of individual firm i/industry aggregate sales in the same GIC	Compustat	Morgan and Rego (2005)
Selfdev	Self-development SaaS product (Binary coding): =1, if firm *i* developed the cloud-based application in-house; =0 if the cloud-based application was acquired from other firm(s).	SEC filings, Factiva	Self-generated
wcat	= working capital/total asset (indicator of firm's resource slack)	Compustat	Fang et al. (2008)
Effint	= cost of goods sold /sales revenue (indicator of effort intensity)	Compustat	Dotzel et al. (2013)
Marketing capability (mkcap)	Stochastic Frontier Estimation of ($sales = f(\text{SGA}, \text{expenses}, \text{accountsreceivable}, \text{workingcapital}, \text{employees}, \text{controls})$	Compustat	Li et al. (2010)
Lnmean_patent	Log(cumulative average of firm's patent stock in the prior three years)	USPTO website	Li et al. (2010)
mgrowth	Annual growth rate of total sales of SIC 7372 firms (indicator of industry growth rate)	Compustat	Xiong and Bharadwaj (2013)
mturb	Standard deviation of annual market growth of SIC 7372 across prior three years	Compustat	Suarez et al. (2013)
maturity	1/(total number of active firms in the industry per year)*100	Compustat	Suarez et al. (2013)

salesgrowth	Annual growth rate of sales of firm i	Compustat	Suarez et al. (2013)
Competitive actions	number of actions of (product introduction (NPRO) + marketing (NMAR) +pricing (PUPD)/(number of M&A (MA) + number of operation actions (NOPE))	Factiva	Li et al. (2010)
lg(fsize)	Log(total assets)	Compustat	Xiong and Bharadwaj (2013)
lg(age)	Log(firm age)	Compustat	Xiong and Bharadwaj (2013)
gnp	Gross national product	World bank	Fang et al. (2008)
Year2007	Dummy variable (=1, if year>=2007; =0 if year<2007), this is to control the economic downtime in 2007.	SEC filings	Self-generated
lgsalesIV1	Annual Log(total market sales – focal firm's sales)	Compustat	Suarez et al. (2013)

Table 2.Variable Descriptions and Correlations

	Mean	S.D.	Min	Max	1	2	3	4	5	6	7
1. selfdev	0.51	0.5	0	1	1						
2. wcat	0.2	0.4	-5.93	0.91	0.09	1					
3. effint	0.29	0.2	0	2.05	-0.03	-0.09	1				
4. mkcap	1.31	0.47	1.05	7.85	0.19	0.07	0.03	1			
5. mean_patent	0.63	1.25	0	7.59	-0.24	0.11	-0.14	-0.05	1		
6. mgrowth	5.27	10.63	-25.71	15.21	0.19	0.00	0.01	0.04	-0.04	1	
7. mturb	0.24	0.93	-1.25	1.88	-0.39	-0.07	0.01	-0.14	0.04	0.05	1
8. maturity	0.05	0.38	-0.36	0.53	-0.39	-0.07	0.00	-0.15	0.05	-0.47	0.8
salesgrowth	0.26	1.29	-0.9	36.31	0.12	0.01	0.10	0.11	-0.04	0.06	-0.04
Lg(fsize)	5.22	2.13	0.09	11.71	-0.18	0.13	-0.24	-0.18	0.51	-0.06	0.11
Lg(age)	2.86	0.45	1.1	3.81	-0.26	-0.05	-0.01	-0.15	0.26	-0.12	0.21
MA	1.25	2.04	0	17	-0.11	-0.02	-0.11	-0.03	0.44	-0.01	0.04
NMAR	1.99	3.67	0	28	-0.24	-0.01	-0.19	-0.08	0.24	-0.05	0.14
NOPE	1.19	2.07	0	22	-0.05	0.01	-0.07	-0.02	0.11	0.03	-0.02
NPRO	3.6	4.83	0	33	-0.25	0.05	-0.22	-0.05	0.32	0.01	-0.01
PUPD	0.35	0.91	0	9	-0.09	0.05	-0.13	-0.02	0.1	0.03	-0.05
gnp	1.82	2.13	-2.8	3.9	0.3	0.09	-0.07	0.07	0.00	0.12	-0.34
d_busapp	0.32	0.47	0	1	0.06	0.00	-0.11	-0.03	0.01	-0.03	0.00
d_ccc	0.14	0.35	0	1	0.09	-0.04	0.06	-0.05	-0.05	-0.01	0.01
d_database	0.06	0.24	0	1	-0.04	0.02	-0.16	-0.07	-0.03	0.01	-0.01
d_entps	0.27	0.44	0	1	-0.05	-0.06	0.14	-0.06	0	0.03	-0.01
d_inf	0.15	0.36	0	1	-0.01	0.1	-0.06	0.08	0.14	-0.01	0.03
year2007	0.61	0.49	0	1	-0.37	-0.08	0.03	-0.14	0.05	-0.21	0.86

Table 3 presents probit analysis results of Stage 1, SaaS development mode. In the first stage SaaS development mode equation, firms having more organizational slack (working capital) would be more likely to select to develop SaaS in-house. Intuitively, firms with high-level of R&D will be more likely to use their resources and capability to develop technology in-house. Surprisingly, R&D capability is negatively associated with self-development. This counterintuitive finding can be explained that firms with high R&D capability are more likely to successfully integrate externally acquired SaaS technology to their own systems. Hence they would allocate resources to acquire SaaS technologies from other companies. Firms with high R&D capability intent to monopolize technology development in the market. Through merger and acquisition, firms can reduce the number of competitors. The indicator of industry growth is positively associated with self-development mode. Industry turbulence and high-level of industry competition are negatively related to self-development, demonstrating that firms rush to jump on the SaaS bandwagon through buying SaaS technology from other firms when there are intensive competitions and uncertainties in the market. Marketing capability, effort intensity and most of controls are insignificant in the model.

Table 4 reports the results of Stage 2 after controlling for potential endogeneity in SaaS development mode selection. The estimation results demonstrate that the choice of SaaS development mode is significant to the gross margin and market share but not for Tobin's q. Selfdev is negatively associated with gross margin in the following year. It is not surprising the cost of goods sold will be higher when firms sell and market their in-house developed SaaS applications without experience and knowledge in cloud-based on-demand part. Firms may not need to spend much cost of goods sold when they gain knowledge of SaaS operation and marketing from acquired SaaS operations. But in-house development of SaaS technology can help firms to gain market share. Sales and marketing department of firms have better understanding of self-developed service and products than acquired products. In-house developed service and products are consistent and compatible with firm's existing systems. Consistency and compatibility of the SaaS applications are main features favored by SaaS users. Hence, choosing to develop SaaS in-house will help firms to gain market share quickly.

Robustness Test

Our model may also be subject to sample selection bias. Software companies decided to enter SaaS market before they allocated resources to internal R&D or external sourcing. The control function estimation doesn't account this type of endogeneity. We use propensity score matching to match the treatment (i.e., firms launched SaaS) sample with a group of control firms in SIC7372. Based on the kernel-based matching, firms are matched based on firm size, firm age, and types of software. Column (3) in Table 3 reports the results using propensity score matching. The result is consistent with the one from control functions estimation.

Conclusion and Future Research

The study expands the sparse research on strategic development of SaaS. We study the determinants to the choice of SaaS development mode (i.e., in-house self-development vs. external acquisition or sourcing) and its impacts on firm performance. Our research will make a theoretical contribution through a new framework that links service innovation, technology development, and firm performance. The research extends prior research on technology development mode by including service innovation perspective. Second, we identify major factors that influence firm's technology development mode. The preliminary analysis results suggest that firms with large amount of working capital can consider developing SaaS application in-house. However, if firms have high-level of R&D capability, they may have better absorptive capability of technology innovation. Firms can grasp SaaS innovation through external sourcing. Carefully reviewing cases in our sample, we find that large firms with strong R&D capability and market capability are keen on buying SaaS technology. Oracle is one of the top software companies holding a large number of patents. The company has strong R&D capability and is dominant player in the CRM market. However, instead of developing SaaS in-house, Oracle has made a number of SaaS acquisitions in the past three years. The company acquired RightNow Technologies, Inc. for $1.5 billion and Taloo for $1.9 billion in 2012 and bought Eloqua for $956 million in 2013. Concur Technologies, Inc., on the other hand, developed its on-demand travel and expense management services in-house although the company also had large amount of organizational resources. The major difference between these two companies is their R&D capability. Oracle's high R&D capability represents its absorptive capability to integrate and incorporate the acquired SaaS technology smoothly and successfully. In contrast, Concur does not have such strength to ensure that the external innovation can be consolidated into the in-house systems.

Firms shall take into account the market characteristics when making the development choice. Our results indicate the strategic decision of SaaS development mode will have short-term impact on firm performance (i.e., gross margin and market share), but not for the long-run performance (Tobins'q). Firm's gross margin and operating margin immediately dropped after Oracle made a series of SaaS acquisition. The finding suggests that firms be careful at external sourcing if they don't have strong working capital and existing revenue flow to support the upfront investment of SaaS acquisitions.

Currently, we only have data of 116 firms. By assembling SaaS information and accounting data, our sample size drops to less than 100. In the future, we will continue to collect data from other SIC737 industries to increase the sample size. We will also explore other measures of firm performance such as cash flow, sales growth, and abnormal stock market returns.

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Table 3. Probit Analysis Results

VARIABLES	(1) controls	(2) ControlFunctions	(3) PSM
L.wcat		0.215**	0.360*
		(0.106)	(0.204)
L.effint		-2.038	-4.013
		(1.464)	(2.720)
L.mkcap		4.064**	0.705**
		(1.669)	(0.319)
L.lnmean_patent		-0.002	0.125
		(0.196)	(0.296)
L.mgrowth		0.006	0.099
		(0.062)	(0.109)
L.mturb		0.056	-0.197
		(0.075)	(0.149)
L.maturity		0.007	0.061*
		(0.017)	(0.032)
L.salesgrowth	0.728	0.896	1.609
	(0.520)	(0.854)	(1.525)
L.lg(fsize)	0.173**	0.397***	0.406
	(0.079)	(0.134)	(0.254)
L.lg(age)	-0.471	-0.322	-0.474
	(0.384)	(0.499)	(0.920)
Busapp_d	0.315	0.419	1.074
	(0.490)	(0.587)	(0.766)
Ccc_d	-0.402	-0.059	-0.052
	(0.574)	(0.785)	(0.726)
Entps_d	0.194	0.718	0.652
	(0.479)	(0.600)	(0.560)
Inf_d	0.317	-0.774	-0.524
	(0.548)	(0.750)	(0.926)
Year2007	0.673*	-0.277	0.964
	(0.363)	(0.666)	(1.045)
Pscore_ quintiles			-1.965
			(1.286)
Observations	92	76	72
Model chi-square	13.92	29.48	21.22
Log likelihood	-56.02	-36.99	-17.30
Pseudo R2	0.111	0.285	0.380

Table 4. OLS Analysis Results

VARIABLES	(1) Gross margin	(2) Market share	(3) Tobin's q
selfdev	-1.089*	1.244**	-0.006
	(0.610)	(0.555)	(0.687)
l.mgrowth	-0.055	-0.048	0.046
	(0.095)	(0.085)	(0.106)
l.maturity	0.012	-0.009	0.022
	(0.024)	(0.021)	(0.026)
l.mturb	-0.226**	0.010	-0.035
	(0.111)	(0.100)	(0.122)
l.lg(fsize)	0.127	0.383***	-0.072
	(0.159)	(0.134)	(0.164)
l.lg(age)	-0.474	0.255	-0.451
	(0.535)	(0.489)	(0.588)
comp_act_ratio	-0.206***	-0.053	-0.022
	(0.054)	(0.049)	(0.060)
year2007	1.808*	-0.077	-0.980
	(1.053)	(0.958)	(1.154)
lambda2	-0.049	0.543***	0.039
	(0.173)	(0.158)	(0.224)
l.gmargin	1.081***		
	(0.106)		
d_busapp	1.304	0.129	1.021
	(1.915)	(2.136)	(1.513)
d_ccc	0.429	0.999	2.145
	(2.046)	(2.287)	(1.629)
d_entps	0.748	0.914	0.990
	(1.904)	(2.127)	(1.499)
d_inf	0.089	2.994	4.108**
	(2.020)	(2.255)	(1.587)
Constant	1.983	-8.106**	6.675***
	(3.105)	(3.368)	(2.366)
Observations	76	76	72
R-squared	0.510	0.304	0.458

Note: results about the controls of companies' activities (i.e., MA, NMAR NOPE NPROO PUPD) are not reported due to space limitation.
Standard errors in parentheses,*** p<0.01, ** p<0.05, * p<0.1.