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The business value of cloud computing: the partnering agility perspective

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Abstract
Purpose – The purpose of this paper is to focus on the value creation potential of cloud computing in inter-firm partnerships. It examines how cloud-based IT infrastructure capabilities in flexibility and integration contribute to partnering agility and, consequently, firm performance. This study also introduces business lifecycle and market turbulence as internal and external context variables, respectively, to investigate the different roles of cloud computing in value creation.
Design/methodology/approach – A questionnaire was used to collect data from 184 client firms of the largest cloud computing services provider in China (Alibaba Cloud). The theoretical model was tested using PLS analysis.
Findings – Cloud infrastructure (CI) flexibility has a positive effect on partnering agility, while the effect of CI integration on partnering agility is moderated by business lifecycle and market turbulence.
Research limitations/implications – The surveyed firms are all Alibaba Cloud clients, which may limit the generalization of the findings.
Practical implications – The study suggests that besides the cost benefits, the value creation aspect of cloud computing should also be emphasized in research and practice. The study provides a new perspective to understand the business value of cloud computing in inter-firm partnerships.
Originality/value – The study suggests that the flexibility-related and integration-related features of cloud computing can create value for firms by facilitating inter-firm collaboration in exploiting business opportunities.

Keywords Cloud computing, Lifecycle, Cloud infrastructure flexibility,
Cloud infrastructure integration, Market turbulence, Partnering agility
Paper type Research paper

1. Introduction
Cloud computing refers to an "IT service model where computing services are delivered on demand to customers over a network in a self-service mode, independent of device and location" (Marston *et al.*, 2011). Compared with traditional IT, cloud computing has some special features such as ubiquity, elasticity, resource sharing, data concentration, low cost, and pay-per-use (Armbrust *et al.*, 2010). By changing the way IT software and hardware are designed and purchased, cloud computing has begun to change the IT industry and business in other industries (Son *et al.*, 2014).

The use of cloud computing has become increasingly popular in both private and public sectors (Son *et al.*, 2014). The huge potential of cloud computing has raised the

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attention of some researchers. Some studies have noticed how cloud computing creates value for firms. For instance, Iyer and Henderson (2010) mentioned that, by implementing cloud computing, an enterprise can gain the agility to respond to changes in the environment. Sultan (2011) used a case study to illustrate that cloud computing can promote collaboration with customers and information sharing among work staff. Chen and Wu (2013) used a mathematical method to study the impact of cloud computing on market structure and related issues. Although the above studies have provided important insights, they usually either provide only qualitative description or focus on the technical aspects of cloud computing. There are many questions remaining. For instance, besides the cost advantage, what are the most important features of cloud computing for value creation? How can cloud computing create value for firms? Research to date has not provided sufficient answers to such questions.

Some studies have indicated that a key benefit of cloud computing is to enhance the collaboration between enterprises. For example, Truong (2010) suggested that businesses can enhance their competitive advantage through the effective collaboration with partners by implementing cloud computing. Demirkan and Delen (2013) suggested that cloud computing can facilitate inter-organizational collaboration in workflows and business processes. Grant and Tan (2013) also pointed out that cloud computing is the future IT for effectively promoting inter-organizational relationships.

Nowadays in many industries, more and more supply chains or firm networks are replacing individual firms as the competitive unit. Increasingly, firms have started to manage resources across their production and distribution networks and collaborate with network partners, rather than manage their internal resources alone (Liu *et al.*, 2013). Research has shown that the access to complementary resources from external sources, such as business partners, contributes to firm performance strategically (Faria *et al.*, 2010).

This paper proposes that the unique characteristics (e.g. ubiquity, elasticity, resource sharing, data concentration, low cost, and pay-per-use) of cloud computing are the keys for firms in creating value in inter-firm partnerships. Therefore, in this study, we investigate how cloud computing creates value for firms through the angle of partnering agility. We identify two very important characteristics of cloud computing (i.e. flexibility and integration) that can facilitate the partnering agility of firms. More specifically, we suggest that cloud-based IT infrastructure can effectively promote organizational agility through the interaction with partners (i.e. partnering agility) in pursuing market opportunities, thus enhancing firm performance.

We also introduce business lifecycle and market turbulence as internal and external contextual variables, respectively, to investigate the different roles of cloud computing in different environments. Internal context variables usually reflect a firm's own features, such as firm scale and organizational structure; and external context variables usually reflect the environment for a firm's survival and development, such as market environment (Franz and Robey, 2007). Business lifecycle theory claims that businesses also have a lifecycle with stages of birth, growth, maturity, and death (Wang and Singh, 2014). The organization lifecycle model sustains that all organizations go through predictable developmental stages and their strategies, structures, and activities match their developmental stages (Kori and Misangyi, 2008). Business lifecycle theory indicates that firm performance will be influenced by the different organization and management characteristics in different developmental stages. Researchers have investigated various management problems by using this theory (Kori and Misangyi, 2008; Wang and Singh, 2014). In this study, we treat business lifecycle as an internal context variable. On the other hand, market turbulence usually reflects firm's external environmental changes in market demands, consumer needs, and competitor strategies (Pavlou and Sawy, 2006). Hence, we treat market turbulence as an external context variable in this study.

Specifically, we investigate three research questions:

RQ1. What are the most important features of cloud computing for value creation?

RQ2. How can cloud computing create value for firms in inter-firm partnerships?

RQ3. Will the value creation of cloud computing be different in different market environments and in different firm lifecycle stages?

The paper proceeds as follows: the next section reviews the research background related to cloud computing, IT infrastructure capability, and partnering agility. The research model and hypotheses are then developed and tested based on survey data from the client firms of Alibaba Cloud. We conclude the paper by discussing the practical and research implications of this study.

2. Research background

2.1 Cloud computing

Cloud computing refers to a service model of IT resources based on the internet (Low *et al.*, 2011). The services offered by cloud computing can be listed in the following three main areas (Marston *et al.*, 2011):

(1) Infrastructure as a service (IaaS) – services offered via this mode include internet-enabled remote delivery of a full computer infrastructure (e.g. computing, storage devices, etc.). IaaS targets IT organizations and software developers to allow them to increase or decrease the number of virtual machines running depending on their workload to promote efficiency in the use of IT resources (e.g. Amazon's Elastic Compute Cloud) (Lin and Chen, 2012). The benefits of this model include pay-per-use and resource elasticity to match the computing demands (Oliveira *et al.*, 2014).

(2) Platform as a service (PaaS) – this mode provides all services through the internet needed by programmers for developing software. PaaS provides a full or partial application development environment that enables developers to access resources for application development and to collaborate with others online (e.g. Amazon's Simple Storage Solution and Google's App Engine) (Low *et al.*, 2011). An advantage of this model is the ability to provide all aspects of software development (design, testing, maintenance, and hosting over the internet (Oliveira *et al.*, 2014).

(3) Software as a service (SaaS) – this mode provides applications as a service through the internet. The cloud vendor is solely responsible for any update or change in the application allowing the user to focus on core business activities (e.g. SalesForce CRM) (Sultan, 2011). The benefits of this model include centralized configuration and hosting, software release updates without requiring reinstallation, and accelerated feature delivery (Oliveira *et al.*, 2014).

Although the above three types of services serve different purposes and target different customers, they all rent computing resources to customers through the internet (Lin and Chen, 2012). IT resources are no longer regarded as products, rather they are understood as services which can be rented and subscribed from the providers and accessed via the internet, presenting a computing paradigm shift (Chen and Wu, 2013; Marston *et al.*, 2011).

Well-known cloud providers include big names such as Google, Microsoft, and Amazon. Google's App Engine offers client organizations access to Google's cloud-based platform that provides tools to build and host web applications. Microsoft provides "cloud operating system" named Windows Azure, which gives client organizations access to several online Microsoft services like Live, .Net, SQL, and SharePoint. Amazon offers its Amazon Web Services, a suite of several services which include the Elastic Compute Cloud (EC2) for computing capacity, and the Simple Storage Service (S3) for on demand storage capacity. Other companies also have been actively investing in cloud computing. For example, SalesForce.com has introduced SaaS service named Force.com, an integrated set of tools and application services that independent software vendors and corporate IT departments can use to build any business application and run it on the same infrastructure that delivers the Salesforce CRM applications.

In addition, cloud computing has different cloud deployment models, it is usually divided into four categories: public cloud, private cloud, community cloud, and hybrid cloud (Marston *et al.*, 2011). Because public cloud (e.g. cloud services by Amazon and Google) is the most widely applied model and has the highest research and application values (Armbrust *et al.*, 2010; Chen and Wu, 2013), we focus on the public cloud computing service, e.g. Amazon, and Alibaba in China.

2.2 From traditional IT infrastructure to cloud infrastructure (CI)

IT infrastructure capability can be an effective source of business value. It refers to a firm's ability to deploy shareable platforms such as data services, network services, and application services (Lu and Ramamurthy, 2011). Cloud computing is considered the next-generation IT infrastructure (Lin and Chen, 2012; Armbrust *et al.*, 2010; Chen and Wu, 2013). Although the advanced features of cloud computing such as elasticity, resource sharing, and pay-as-you-go have been widely noted in research, the existing research tends to focus on the technical aspects, and it is still not clear how firms can exploit such features to contribute to business. We believe that firms can develop a new ability in deploying cloud-based resources to support their business. As an IT infrastructure capability, we call this ability a firm's CI capability. CI capability can be viewed as an upgraded version of traditional IT infrastructure capability because cloud computing has unique advantages such as resource sharing, elasticity, pay-per-use, etc. The special features of cloud computing can be categorized into two types: flexibility-related (e.g. elasticity, scalability, ubiquitous access, and pay-per-use) and integration-related (e.g. data concentration and resource sharing environment) (Marston *et al.*, 2011; Chen and Wu, 2013). Therefore, this study focusses on a firm's two types of cloud-enabled infrastructure capabilities: CI flexibility and CI integration.

More specifically, we define CI flexibility as the degree to which a firm delivers cloud-based IT solutions quickly and effectively to support business (Ravichandran and Lertwongsatien, 2005). The special features of cloud computing may change a firm's IT infrastructure and IT deployment model, making the firm more flexible in scheduling and deploying IT resources (Marston *et al.*, 2011; Sultan, 2011). For instance, Marston *et al.* (2011) highlighted that cloud computing can provide firms with immediate access to IT resources, which can result in a faster time to market and a smoother way of scaling services. Sultan (2011) claimed that cloud computing makes it easier for firms to scale their services according to client demand and realize rapid software deployment.

CI integration is defined as the degree to which a firm has integrated internal and external IT resources, including IT applications and data, based on cloud computing technology (Saraf *et al.*, 2007). Data concentration, resource pool, and shared environment strengthen firms in the integration of data and applications, making firm collaboration easier. Marston *et al.* (2011) pointed out that cloud-based applications allow information sharing and collaborative work. For instance, several people can work on different parts of the same document simultaneously in Google Docs. McAfee (2011) claimed that one key benefit of cloud computing is to facilitate collaboration. He suggested that some of the greatest successes of cloud computing to date have come from allowing groups and communities to work together in ways that were not previously possible.

2.3 Partnering agility

Partnering agility is one part of organizational agility and reflects the organizational agility in the context of inter-firm partnerships. Organizational agility is a kind of firm capability that can handle changes that turn up beyond expectation in business environments by means of rapid and innovative actions that exploit changes as opportunities to grow and expand (Lu and Ramamurthy, 2011; Sambamurthy *et al.*, 2003). Sambamurthy *et al.* (2003) suggested that organizational agility consists of three related capabilities: operational agility, customer agility, and partnering agility.

Specifically, partnering agility is defined as the ability of an organization to leverage the assets, knowledge and competencies of suppliers, distributors, contract manufacturers, and logistic providers through alliances, partnerships, and joint ventures. Partnering agility enables an organization to modify or adapt its extended enterprise network when it needs access to assets, competencies, or knowledge not currently available in its networks (Sambamurthy *et al.*, 2003; Lee *et al.*, 2015). Partnering agility also facilitates a firm to quickly identify appropriate partners or modify existing partnerships (Agarwal and Selen, 2009), and to explore innovation and competitive opportunities via building a network of extended strategic or virtual partnerships (Sambamurthy *et al.*, 2003).

3. Research model and hypotheses

We propose the following research model (see Figure 1). That is, a firm's CI flexibility and CI integration affect its partnering agility, which in turn affects firm performance.

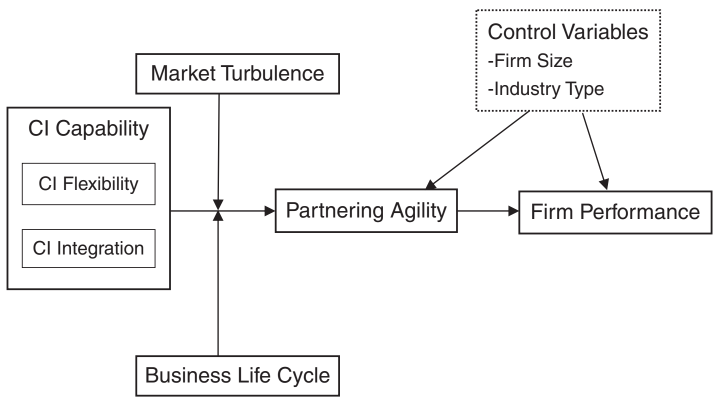


Figure 1.
Research model

In addition, the relationship between CI flexibility (CI integration) and partnering agility is moderated by contextual factors such as market turbulence and business lifecycle.

3.1 CI capability and partnering agility

Cloud computing enables firms to flexibly deploy IT resources and frees firms from the constraints of time, place, and capacity. Such cloud-enabled flexibility helps firms to quickly deploy IT applications with low cost, which may improve organizational agility through the interaction with partners, namely, partnering agility.

Inter-firm collaboration should not only include knowledge sharing, but also include process coupling (Saraf *et al.*, 2007). CI flexibility enables firms to fast deploy IT applications when they face process change and new business because it helps firms to easily scale their IT services and makes possible new classes of IT applications (Marston *et al.*, 2011). In addition, cloud computing renders the deployment of IT applications free from the constraint of hardware capacity as well as related upgrade, backup, and maintenance. Firms also do not need to invest in their own IT resources, but only pay for the services on demand (Chen and Wu, 2013). For instance, by deploying the Salesforce partner portal, Dell can get 1,000+ partner registrations done per month. This new global dealer registration program enables Dell to manage channel conflicts and to create custom-branded portals for its 44,000 partners (source: Salesforce.com). Hence, we hypothesize:

H1a. CI flexibility is positively associated with partnering agility.

Cloud computing may also facilitate the IT integration between firms and their partners, thus enhancing partnering agility. First, due to the dramatic decrease in IT implementation cost and implementation time through cloud services, nowadays it is much easier for firms to integrate data and IT applications with their partners. Second, the availability of PaaS and IaaS dramatically facilitates software vendors to develop various new SaaS applications to support different functions. For instance, Sultan (2011) provided a case in which a company used Microsoft's Azure to develop a cloud-based application to connect with their partners, sharing project-related information and conducting collaboration. Because cloud-based IT integration can often lead to integration in business processes and collaboration between business partners, it should promote a firm's ability in exploring and exploiting opportunities by leveraging partners' resources and knowledge.

For example, by using IBM cloud services, a UK third party logistics company named "Gist" creates a scalable B2B integration platform with trading partners. The key benefits of this integration include faster on-boarding of trading partners, scalability and flexibility in handling new partner message requirements (source: IBM.com). Therefore, we hypothesize:

H1b. CI integration is positively associated with partnering agility.

3.2 Partnering agility and firm performance

Firms with superior partnering agility are able to catch more business opportunities by leveraging the resources of partners. Collaboration with partners will enhance the value of their products/services and make them different from their competitors' products/services, thus enhancing their firm performance (Truong, 2010). The information sharing between partners in a partnership would facilitate decision making and execution of tasks with greater speed and flexibility and increased awareness and alertness (Agarwal and Selen, 2009). Partnering agility also helps firms exploit opportunities through efficient sourcing and staging of assets and resources (Sambamurthy *et al.*, 2003). Hence, we hypothesize:

H2. Partnering agility is positively associated with firm performance.

3.3 The moderating role of business lifecycle and market turbulence

We further suggest that the effect of CI capability on partnering agility may be moderated by contextual factors such as business lifecycle and market turbulence. CI flexibility may significantly enhance a firm's partnering agility in the early stage through the reduction of fixed costs, the improvement of process flexibility, and the establishment of inter-firm collaboration. In the early stage, firms usually lack money for hardware and software, have non-standard business processes, and face changing markets. The use of cloud computing makes IT resources purchasable with operational funds rather than as a capital expenditure (Chen and Wu, 2013). The decrease in IT costs facilitates IT deployment in firms, thus promoting the partnering agility. In addition, CI flexibility enables firms in the early stage to rapidly initiate new business and deploy new IT applications, which help firms deal with non-standard business processes and unstable markets through new electronic partnerships with other firms.

In contrast, firms in the late stage may have stable business partners, abundant cash flow (i.e. a high level of cash ability to pay), standard business processes, and stable markets (i.e. stable market demands, consumer needs, and competitor strategies). In addition, these firms often have established collaboration and stable coupling processes with business partners. Therefore, for firms in the late stage, the need for establishing new business partner relationships is lower than for firms in the early stage. Accordingly, the influence of CI flexibility on partnering agility will decrease as firms move from the early stage to the late stage. Hence, we hypothesize:

H3a. The effect of CI flexibility on partnering agility becomes weaker as firms move from the early stage to the late stage.

As suggested above, CI integration facilitates information sharing and system integration between partner firms. Early stage firms often have limited resources and cannot cope with market changes well due to their small scale, insufficient money, and lack of market experience. Therefore, early stage firms need to communicate more with their business partners in order to gain external resources complementary to their own resources. The use of cloud computing facilitates the information sharing and process coupling between early stage firms and their partners. Such activities improve firms' ability in obtaining resources from an external source, thus helping them to explore and exploit market opportunities.

In contrast, firms at the late stage usually have abundant cash flow, rich market experiences, and established collaborative relationships. These firms often have obtained certain resources and achieved a position in the market. Therefore, firms in the late stage need less external resources than early stage firms. Thus, the impact of CI integration on partnering agility will weaken as firms move from the early stage to the late stage. Hence, we hypothesize:

H3b. The effect of CI integration on partnering agility becomes weaker as firms move from the early stage to the late stage.

Market turbulence often reflects unpredictability in market demands, consumer needs, and competitor strategies (Pavlou and Sawy, 2006). The use of cloud computing enables the flexibility in IT deployment and makes it easier for firms to establish collaboration with new business partners, thus enhancing firms' partnering agility. Firms in high-turbulence markets face frequent changes in market demands and customer preferences. In such environment, firms may need to leverage more resources and knowledge from existing business partners and new ones. As suggested above, the use of cloud computing can facilitate the resource and knowledge exchange with business partners (Marston *et al.*, 2011; Son *et al.*, 2014; Grant and Tan, 2013). In other words, the use of cloud computing helps firms to establish new partnerships for exploring and exploiting business opportunities in high-turbulence markets.

In contrast, firms in stable markets face more stable demand and customer preferences; and competition in such markets is also not so fierce. As a result, firms in stable markets may not need to access lots of external resources and knowledge. Therefore, firms in such markets have lower needs in IT flexibility than firms in turbulent markets. So we hypothesize:

H3c. The effect of CI flexibility on partnering agility becomes stronger when market turbulence becomes higher.

CI integration may especially promote firms' partnering agility in turbulent markets, too. Firms in high-turbulence markets face frequently changing market conditions. They need to collaborate with partners to obtain the external resources to cope well with the changes in markets. CI integration can promote information sharing between partners, which should help firms cope with market uncertainty. In a market with high turbulence, firms need to leverage IT to support knowledge flows and business processes (Pavlou and Sawy, 2006). As suggested above, cloud computing-enabled integration can support smooth communication between business partners. Therefore, the role of cloud may become more important in turbulent markets. In addition, CI integration also promotes IS coupling, thus helping the collaboration between firms and their partners, which is especially important in turbulent markets.

In contrast, firms in stable markets do not need to change frequently due to the relative stability in market demand and customer preferences. As a result, the demand of such firms in inter-firm collaboration and integration is lower than those in turbulent markets. Hence, we hypothesize:

H3d. The effect of CI integration on partnering agility becomes stronger when market turbulence becomes higher.

4. Method

4.1 Sample and data collection

In China, Alibaba Cloud is the largest public cloud services provider. The services offered by Alibaba Cloud include SaaS such as electronic commerce and ERP; PaaS such as development environments; and IaaS such as storage and servers. We chose the client firms of Alibaba Cloud as our sample. An e-mail about the online survey was sent to a random sample of 500 Alibaba client firms. A reminder of the survey was sent a month later. In total, 199 of questionnaires were returned, 15 of which were invalid. In the end, we had 184 valid questionnaires, with a valid return rate of 36.8 percent. Table I presents the sample profile and the characteristics of the respondents.

Characteristic	Frequency	%
Size		
< 10 employees	38	20.7
10-100 employees	53	28.8
100-300 employees	62	33.7
> 300 employees	31	16.8
Industry group[a]		
Information transmission industry (telecom- and internet- related)	47	25.5
Software and information service	53	28.8
Electronics and computing machinery	54	29.3
Wholesale and retail	21	11.4
Others	9	4.9
Characteristics of respondents		
Chief executive officer (CEO)	48	26.1
Chief information officer (CIO)	62	33.7
IT department manager	53	28.8
Business manager	21	11.4

Notes: $n = 184$. [a]The classification standard according to China's Ministry of Industry and Information Technology and National Bureau of Statistics

Table I. Sample characteristics

This study used the late return technique to test non-response bias. Late responses, i.e. those received toward the end of the survey period are considered similar to non-responses. Late responses are typically used as a measure of non-response bias and numerous recent studies have employed the technique (Isik *et al.*, 2013; Shi and Chow, 2015). The sample of 184 responding organizations was divided into a group of 153 early respondents (reply before the reminder) and a group of 31 late respondents. There was no statistically significant difference between early and late respondents in terms of firm age, number of employees, and annual sales. Hence, we believe that non-response bias is unlikely to be an issue.

We also conducted Harman's single factor test to examine the potential for common method bias (Ainin *et al.*, 2015). We extracted five factors from our results, with the first factor accounting for 38 percent of the variance, and less than 50 percent of the variance, indicating that common method bias is not an issue in this dataset (Hew *et al.*, 2015).

In addition, it should be noted that the sample selection of the study may involve potential bias. First, there are many well-known cloud providers in the world, such as Amazon, Google, and Microsoft. In China, Alibaba, Huawei, and Tencent are the leading cloud providers. Although Alibaba Cloud is the largest public cloud services provider, many China's firms may adopt other cloud services. In addition, this study only focusses on the public cloud, but many client firms may choose private cloud services (e.g. provided by IBM, Microsoft, and Tencent). Therefore, the study may have potential bias in findings as we only use the client firms of Alibaba Cloud as our sample.

4.2 Measures

To ensure the reliability and validity of constructs, this study used established measures when possible. To ensure consistency in meaning between Chinese survey questions and prior English survey questions, three researchers translated the English version into Chinese and then had a group discussion to confirm that the Chinese version was a correct translation. In addition, we pre-tested our questionnaire with three managers from the cloud provider and three managers from cloud user firms. Based on the feedback from the pre-test, we adapted a few survey questions. The questionnaire used a seven-point Likert scale with anchors ranging from 1 (extremely disagree) to 7 (extremely agree). The detailed survey questions are provided in the Table AI.

The measure of CI flexibility is adapted from Saraf *et al.* (2007), Bhatt *et al.* (2010) and Bhatt and Grover (2005), with six measurement items regarding the scalability and elasticity of cloud-based IT infrastructure and its support for new business and changing demand. The measure of CI integration follows Bharadwaj *et al.* (2007), Saraf *et al.* (2007), and Roberts and Grover's (2012) work, operationalized with four items regarding cloud-based data and software integration. The measure of partnering agility follows Agarwal and Selen's (2009) work with six items related to employee skills, new structure implementation, new business processes and so on. The measure of firm performance follows Bhatt *et al.* (2010) and consists of five competitive advantage-related items on financial performance, sales growth, profitability and so on.

For contextual variables, we use Kazanjian's (1988) framework and measures for business lifecycle. Kazanjian (1988) divided business lifecycle into four stages: start-up, growth, maturity, and decline. We follow Gomez-Mejia (1992) and combine the start-up and growth stage together as the early stage, and the maturity and decline stage together as the late stage. The measure of market turbulence follows Pavlou and Sawy's (2006) study, focussing on dimensions such as customers' changing product preferences, changes in marketing practices, frequent new product introductions, and competition.

We also included firm size and industry type as control variables in our analysis. Firm size was measured by following the ordered category regarding employee number in Table I. We used four dummy variables for the five industries shown in Table I to control for the effect of industry.

5. Data analysis and results

The proposed research model was tested by using PLS modeling with SmartPLS2.0. PLS has become popular in research, particularly because it has specific advantages, such as minimal requirements on measurement scales and sample distribution (Chin *et al.*, 2003).

5.1 Validity and reliability

To test convergent validity and reliability, two metrics were used: average variance extracted (AVE) and composite reliability (CR). As illustrated in Table II, all the values of AVE and CR for all constructs were satisfactory, with CR larger than 0.865 and AVE larger than 0.765 (Gefen and Straub, 2005). Thus, the measurement items we used converged on the same latent construct.

Constructs	AVE	Composite reliability
Market turbulence	0.823	0.891
CI flexibility	0.812	0.872
CI integration	0.778	0.865
Partnering agility	0.765	0.874
Firm performance	0.849	0.903

Table II. Item convergent validity and reliability

To assess the discriminant validity, following Gefen and Straub (2005), we developed a matrix of correlations between constructs with reflective measures. We replaced the diagonal with the square root of the AVE (see Table III) and found that the square root of AVE for each construct was higher than the elements off the diagonal. We also assessed discriminant validity by conducting a comparison between the loadings of an item on its associated construct with its cross-loading on other constructs. For our model, all items were loaded on their corresponding constructs more strongly than their cross-loadings on other constructs (see Table IV). Therefore, taken together, there was strong empirical support for the reliability and validity of the constructs in our research model.

Table III. Correlations between constructs

Constructs	Mean (SD)	MT	F	I	PA	FP
Market turbulence (MT)	3.908 (1.024)	*0.907*				
CI flexibility (F)	4.485 (1.101)	0.573	*0.901*			
CI integration (I)	4.252 (1.053)	0.469	0.489	*0.882*		
Partner agility (PA)	3.890 (0.982)	0.415	0.577	0.424	*0.875*	
Firm performance (FP)	4.296 (0.789)	0.515	0.421	0.566	0.582	*0.921*

Note: Square root of AVE on diagonal

Table IV. Cross-loading

Item	FP	MT	F	I	PA
FP1	*0.815*	0.514	0.573	0.499	0.557
FP2	*0.844*	0.397	0.512	0.529	0.522
FP3	*0.849*	0.515	0.525	0.478	0.564
FP4	*0.869*	0.357	0.473	0.469	0.515
FP5	*0.822*	0.353	0.506	0.465	0.560
MT1	0.429	*0.837*	0.563	0.502	0.556
MT2	0.424	*0.865*	0.594	0.526	0.532
MT3	0.363	*0.807*	0.545	0.510	0.564
MT4	0.472	*0.772*	0.504	0.518	0.592
F1	0.483	0.456	*0.744*	0.482	0.573
F2	0.513	0.488	*0.812*	0.521	0.458
F3	0.454	0.538	*0.802*	0.525	0.581
F4	0.517	0.652	*0.814*	0.655	0.415
F5	0.433	0.454	*0.823*	0.501	0.483
F6	0.477	0.467	*0.815*	0.459	0.502
I1	0.395	0.549	0.510	*0.749*	0.535
I2	0.510	0.511	0.507	*0.760*	0.571
I3	0.444	0.568	0.568	*0.798*	0.584
I4	0.453	0.526	0.602	*0.781*	0.536
PA1	0.472	0.523	0.570	0.522	*0.732*
PA2	0.541	0.480	0.558	0.549	*0.788*
PA3	0.512	0.484	0.572	0.536	*0.743*
PA4	0.486	0.503	0.564	0.455	*0.715*
PA5	0.464	0.574	0.574	0.569	*0.756*
PA6	0.497	0.579	0.527	0.545	*0.772*

5.2 Results

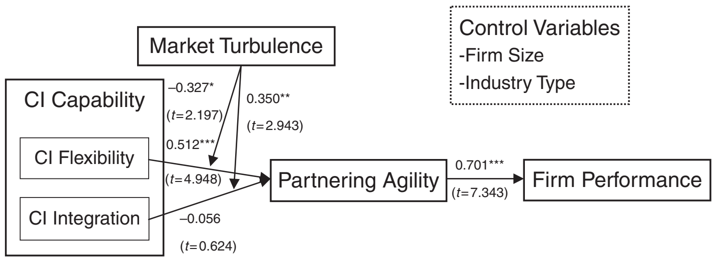
We computed *t*-statistics and path significance levels for each of the hypothesized relationships using the bootstrapping method. Path coefficients and R^2 values were obtained by running the PLS algorithm to assess the predictive performance of the structural model. The construct of partnering agility had an R^2 value of 0.604 and firm performance had R^2 value of 0.511. Chin *et al.* (2003) described the R^2 value of 0.67, 0.33, 0.19 in PLS path model as substantial in content, medium and weak. The R^2 value of partnering agility and firm performance are close to 0.6, which indicates the model has strong explanatory ability.

For the moderating effect of market turbulence, the analysis was conducted by adding the interaction terms to the main effects model (Lu and Ramamurthy, 2011). The results are shown in Figure 2. For control variables, the results also show that firm size and industry type have no significant effect on a firm's partnering agility and performance outcomes.

Because business lifecycle is a categorical variable, we use the multi-group PLS analysis method to test the moderating effect of business lifecycle (Qureshi and Compeau, 2009). The sample size of firms in the early stage is 101, and the size in the late stage is 83. We analyze the two groups separately by PLS, with results shown in Table V.

We find that the difference of path coefficients from CI flexibility to partnering agility between early stage group and late stage group is not significant (Table V). Therefore, *H3a* is not supported. The difference of path coefficients from CI integration to partnering agility between early stage group and late stage group is significantly negative (Table V), which supports *H3b*.

Regarding the moderating effect of market turbulence, it is found that the path from the product of CI flexibility and market turbulence to partnering agility is negative (Figure 2), which does not support *H3c*. The path from the product of CI integration and



Notes: $*p<0.05$; $**p<0.01$; $***p<0.001$ (two-tail test)

Figure 2.
Analysis results

Path	Path coefficient Early stage	Late stage	Difference	*t*- statistics	Significant or not	Results
H3a: flexibility → partnering agility	0.264	0.344	0.08	0.965	No	Not supported
H3b: integration → partnering agility	0.636	0.365	−0.271	−2.919	Yes	Supported

Table V.
The path coefficient difference of multi-group PLS analysis

market turbulence to partnering agility is positive and significant ($\beta = 0.350$; $p < 0.001$), which supports *H3d*.

The overall analysis results are shown in Table VI.

6. Discussion

6.1 Findings

Most of our hypotheses are supported by the results of PLS analysis. First, there is a positive association between CI flexibility and partnering agility, which indicates that CI flexibility can promote partnering agility. The analysis results support our view as CI flexibility is positively related to partnering agility.

Second, we find that the path between CI integration and partnering agility is not significant, which does not support our view. On the other hand, the analysis results also show that the effect of CI integration on partnering agility becomes stronger when market turbulence is high or when a firm is in its early stage. Together, our study indicates that CI integration may not have a universal effect on partnering agility. Only in certain situations, such as in turbulent markets or in the early stage, can CI integration enhance partnering agility.

Third, the results show that the effect of CI flexibility on partnering agility is positive and is not influenced by business lifecycle. The insignificant effect of business lifecycle does not go in line with our hypotheses. One explanation for this inconsistency is that as today's business becomes increasingly complex, not only early stage firms, but firms in the late stage also need to rely on external resources to exploit business opportunities. As a result, business lifecycle may not set a boundary for the effect of CI flexibility on partnering agility.

In addition, we also proposed that market turbulence may play a positive moderating role in the relationship between CI flexibility and partnering agility. The analysis results, however, do not support our argument as the path coefficient is not positive but negative. One explanation for this unexpected finding is that the business opportunities in turbulent markets change so rapidly that firms need to respond to such opportunities quickly. However, the coordination between partner firms, especially between new partners, is not easy and takes time. As a result, firms may often rely on the help from established partners to catch such opportunities. In this case, the flexibility characteristic of cloud computing should become less important, rather than more important, for firms.

Finally, we hypothesized that partnering agility contributes to firm performance. The results support this hypothesis.

Table VI. Hypotheses and results

	Relations	Coefficients	*t*-statistics	Results
H1a	Direct effect: flexibility → partnering agility	0.512***	4.948	Supported
H1b	Direct effect: integration → partnering agility	−0.056	0.624	Not supported
H2	Direct effect: partnering agility → firm performance	0.701***	7.343	Supported
H3a	Flexibility × business lifecycle → partnering agility	–	–	Not supported
H3b	Integration × business lifecycle → partnering agility	–	–	Supported
H3c	Flexibility × market turbulence → partnering agility	−0.327*	2.197	Not supported[a]
H3d	Integration × market turbulence → partnering agility	0.350**	2.943	Supported

Notes: [a]Contrary to the hypothesis. Significance levels: *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$ (two-tail test)

6.2 Implications and limitations

Our study contributes to research in three ways. First, we classify the features of cloud computing into two categories (flexibility-related and integration-related) and identify two firm capabilities related to each category, respectively. Second, this study investigates the mechanism through which cloud computing creates value for firms in inter-firm partnerships. That is, CI flexibility and CI integration promote partnering agility, which in turn contributes to business value. Finally, we also illustrate that contextual factors, such as business lifecycle and market turbulence, may set boundary conditions for the effect of CI capability on partnering agility.

Our study provides important managerial implications as well. First, we suggest that when firms effectively use cloud computing technology in their IT infrastructure, they can facilitate the flexibility and integration of their IT infrastructure and thus support the firms' internal and external business processes. Our study tries to remind managers that the advanced features of cloud computing and the capabilities in leveraging such advanced features in internal and external business processes are two different things.

Second, our study suggests that the use of cloud computing enables firms to connect with their business partners, and that the use facilitates the transfer of knowledge and the integration of processes between partners. Therefore, firms may need to think about adopting cloud computing in order to explore and exploit the advanced features of its technology to support their business.

Finally, our results show that contextual factors, such as business lifecycle and market turbulence, may set a boundary for the effect of CI integration on partnering agility. Therefore, firms in different environments should take their specific situations into account when adopting cloud computing because the importance of some of its features may vary in different environments.

Despite the research findings and implications, our study has several limitations. First, this study only examines the effect of CI capability on partnering agility. There are other types of organizational agilities such as customer agility, operational agility, and supply chain agility. Future research may also investigate the influence of CI on the agilities in the context of customer, operation, supply chain and so on. Second, because the study mostly focusses on the technology advantages to investigate the role of cloud computing, future research may embrace other theoretical perspectives in understanding the value of cloud computing in different contexts. Finally, the current research only employed data from the client firms of Alibaba Cloud in China, which may limit the generalizability of the research findings. Future research may retest our model by using data from other cloud providers.

7. Conclusions

Due to its advanced features, cloud computing technology has become increasingly popular and has gained a lot of attention from researchers. Unlike prior studies that often focus on the cost-saving aspect of cloud computing, this study investigates how firms leverage the flexibility and integration characteristics of cloud computing to enhance partnering agility. Through collaboration with business partners, firms can catch more market opportunities and improve their performance. Our study suggests that besides the cost-saving aspect of benefits, the value creation aspect of cloud computing should also be emphasized in research and practice. In particular, we suggest that the flexibility-related and integration-related features of cloud computing can create value for firms by facilitating inter-firm collaboration in exploiting business opportunities. Our study provides a new perspective on understanding the business value of cloud computing.

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Appendix

Constructs	Items
CI flexibility	1. Cloud computing makes our IT architecture to be able to cope with the greater instantaneous volatility of service quantity 2. Cloud computing makes our IT infrastructure to be able to cope with large fluctuations of service requirements 3. Cloud computing makes our IT architecture capable of coping with fast change 4. Cloud computing makes our IT architecture highly scalable 5. Cloud computing enables our IT architecture to support new business relationships easily 6. Cloud computing enables our IT architecture to accommodate changes in business quickly
CI integration	1. Cloud computing makes our data retrievable by our partners 2. Cloud computing helps us to easily share our data with partners 3. Cloud computing supports us in integrating applications with the systems of our partners 4. Cloud computing supports our software applications in working seamlessly with our partners
Partnering agility	1. When we partner, employees accomplish greater soft skills required to manage customer encounters 2. When we partner, we are able to quickly implement new governance structures 3. When we partner, we are able to combine, recombine, and create new business processes at short notice 4. Through online, rapid, and up-to-date communication across the partnership, we are able to reduce information discrepancies 5. Working with partners gives us an ability to innovate our service offerings technologically 6. Working with partners brings about new ways of managing organizational structures and partnerships
Firm performance	1. Over the past three years, our firm's financial performance has been outstanding 2. Over the past three years, our firm's financial performance has exceeded the competitor's performance 3. Over the past three years, our firm's sales growth has been outstanding 4. Over the past three years, our firm's profitability has been higher than our competitor's profitability 5. Over the past three years, our firm's sales growth has exceeded the competitor's sales growth
Market turbulence	1. In our kind of business, customers' product preferences change a lot over time 2. Marketing practices in our product area are constantly changing 3. New product introductions are very frequent in this market 4. There are many competitors in this market

Table AI. Constructs and measurement items

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