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Abstract

Purpose – Based on the literature of IT strategic alignment and e-collaboration, the purpose of this paper is to specify how e-business strategic alignment (e-alignment) influences e-collaboration capabilities and improves firm performance, and whether the time-lag effect existed in this relationship.

Design/methodology/approach – The authors tested the research hypotheses using a field survey of 145 Chinese corporations. The research model was validated using SmartPLS 2.0 with both subjective and objective data collected from the survey and Oriana database.

Findings – The results support the notion of a positive and significant link between e-alignment and e-collaboration capabilities and between e-collaboration capabilities and firm performance. The authors also show that the effect of e-alignment on performance is fully mediated by e-collaboration capabilities and that e-collaboration with suppliers has a one-year time-lag effect on firm performance.

Research limitations/implications – This research extends and integrates the literature on IT strategic alignment and e-collaboration, and explains why and how e-alignment generates firm performance.

Practical implications – This paper includes two implications for managers. First, when formulating e-business strategies, managers should focus on establishing e-collaboration capabilities with partners. Second, the downstream process is the direct sources of business value. Managers should take the establishment of e-selling process as a critical business strategy.

Originality/value – By focussed on intermediate factors and time-lag effects, this study provides significant implications for IT strategic alignment and e-collaboration literature.

Keywords e-Alignment, e-Collaboration capabilities, Mediators, Time-lag

Paper type Research paper

1. Introduction

For decades, chief information officers have treated business-IT alignment as the top issue in their business activities (Luftman and Zadeh, 2011; Siurdyban, 2014). Because of this industry concern, much research has been conducted on whether and how IT strategic alignment can generate value for firms (Chan *et al.*, 2006; Tallon and Pinsonneault, 2011; Wu *et al.*, 2015). These studies mainly focus on firm performance such as financial performance, market growth, cost reductions, and improved operational efficiency(Tallon and Pinsonneault, 2011; Gerow *et al.*, 2014).

However, studies examining the IT strategic alignment-performance relationship have been far from conclusive (Tallon and Pinsonneault, 2011; Wu *et al.*, 2015). Some research found "an alignment paradox" (Tallon, 2003), which means aligned firms report no improvement or even a decline in performance. There are two reasons

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underlying this paradox. First, there is difficulty in isolating the benefits of alignment from other factors that may also contribute to organizational performance (Tallon and Pinsonneault, 2011). In order to quickly respond to changing market conditions, IT should integrate resources into bundles of digital capabilities (Barua *et al.*, 2004). Consequently, these digitally attributable capabilities (Drnevich and Croson, 2013), which can operationalize information system strategy and generate value, have become critical mediators between IT strategic alignment and firm performance. Second, because the alignment process is too time-consuming, benefits from IT strategic alignment may not be realized immediately but rather may emerge over an extended period of time. Alignment might provide full benefits only after integration with organizational processes and completion of organizational changes over time (Das *et al.*, 2011).

In order to solve the alignment paradox, this study combines e-collaboration capabilities and time-lag effects in the study of e-business strategic alignment[1] (a fusion between e-business technologies and business strategy) and firm performance (Bharadwaj *et al.*, 2013; Burn and Ash, 2005). First, we do so by placing both e-alignment and e-collaboration capabilities[2] in a nomological network predicting firm performance. Many manufacturing firms now view e-alignment and e-collaboration capabilities as concurrent goals, but researchers have not yet integrated the e-alignment and e-collaboration capabilities literature as a way to assess how these two objectives might be achieved. Our knowledge and understanding of how, or if, e-alignment and e-collaboration capabilities are related is limited. Each area of literature evolved separately and remains so today (Tallon and Pinsonneault, 2011; Cheng *et al.*, 2006). Second, we also consider the time lagged effect of e-alignment and e-collaboration. Benefits from IT strategic alignment may be realized over an extended period of time. Alignment might provide full benefits only after integration with organizational process and completion of organizational changes over time (Das *et al.*, 2011). Specifically, we examine financial data collected from 145 firms over a three-year time period, assessing the relationship between e-alignment and firm performance, and the mediated effect of e-collaboration capabilities, which are defined as the ability to facilitate coordination of various decisions and activities between a firm and its partners over the internet.

Therefore, this study explores the adding-value evolution process from e-business strategic alignment to building distinctive e-collaboration capabilities and consequently creating financial performance through a study accounting for time-lag effects regarding firm performance. We try to answer the following two questions:

(1) How does e-alignment affect firm performance through e-collaboration capabilities?

(2) Is there a time-lag where e-alignment and e-collaboration improve firm performance?

2. Theory development

IT strategic alignment is a hot issue among practitioners and researchers. Prior research features two streams regarding IT strategic alignment (Chan and Reich, 2007). The first stream treats IT strategic alignment as an ongoing process, which requires specific IT management capabilities, encompasses specific actions and reactions and has discernable patterns over time (Kearns and Sabherwal, 2006; Wanger *et al.*, 2014). These papers help us understand how business-IT alignment works. The second stream treats IT strategic alignment as an end state, which focusses on the antecedents, measures, and outcomes of IT alignment (Chan *et al.*, 2006; Raymond

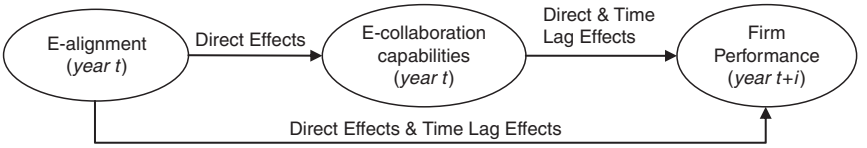
and Bergeron, 2008; Karahanna and Preston, 2013). For instance, Karahanna and Preston (2013) indicate that cognitive and relational social capital influence information systems strategic alignment but that structural social capital exerts its influence through its effects on cognitive social capital. In this paper, we treat e-alignment as an end state, so we can focus on its operational and financial outcomes.

Although prior research studied the relationship between IT strategic alignment and performance, there are still some flaws. First, those studies did not consider the characteristics of e-business technology which can enhance information sharing and collaboration between the focal firm and its partners. Collaboration with partners through the internet also is a critical factor to enable competitive advantage (Rosenzweig, 2009; Zhao *et al.*, 2008). Second, few studies explored the intermediate factors between IT strategic alignment and performance. Actually, IT strategy first affected the operational level factors and then enhanced firm performance (Tallon, 2011; Kim *et al.*, 2013). Last but not least, many researchers did not consider the time lagged effect of IT strategic alignment. However, the effect of IT applications is considered to have a lagged effect. For example, the performance of implementing an electronic healthcare system has a four to 12 month time-lag (Venkatesh *et al.*, 2011).Therefore, e-alignment and e-collaboration capabilities also need time to reveal their outcomes.

Our conceptual model (Figure 1) takes into account the shortcomings of previous research. This model is in the context of e-business applications, and focusses on how e-alignment affects the formalization of e-collaboration capabilities and improves firm performance. As the critical source of firm performance, we emphasize the e-collaboration capability with suppliers and distributors. This allows us to test the direction of the relationship between e-alignment and e-collaboration capabilities, but it also allows us to evaluate if two e-collaboration capabilities mediate, fully or partially, the relationship between e-alignment and firm performance. Furthermore, this model also incorporates the lagged effects of e-alignment and e-collaboration capabilities. The lag effect of IT applications is widely recognized by both practitioners and researchers (Menon and Kohli, 2013; Campbell, 2012). Brynjolfsson and Hitt (1998) suggest that "if there is some lag or adjustment time required to match organizational factors and IT investment, we would expect to see more benefit over longer time periods." Specifically, Wu and Chen (2006) found the implementing effects of firm-level e-business strategies have a three-year time-lag effect. Other research found that it took an average of approximately three years after the year of investment for the firms to realize the greatest performance benefits (Campbell, 2012).

2.1 e-Alignment and firm performance

From reviewing prior studies (Tallon and Pinsonneault, 2011; Karahanna and Preston, 2013), we found that IT alignment improved firm performance in general. For companies



Notes: Year *t* represents the year of 2007; year *t*+*i*(*i*=0,1,2) represents the year of 2007,2008, and 2009 separately. in order to test time-lag effect, we measure three years(year=2007,2008,and 2009) of firm financial performance, respectively

Figure 1.
Conceptual model

to succeed in an increasingly competitive, information-intense, dynamic environment, e-alignment is a necessity. e-Alignment is an important factor in sensing environmental threats and opportunities before deciding how firms should respond (Tallon and Pinsonneault, 2011). Therefore, firms can generate high firm performance through this e-alignment (Wanger *et al.*, 2014). Therefore, this suggests the following hypothesis:

H1a. The extent of e-alignment is positively associated with firm performance.

Although much research has indicated a strong positive association between IT strategic alignment and firm performance (Gerow *et al.*, 2014), not all evidence concludes that alignment has direct or positive implications for performance. Palmer and Markus (2000) did not find a relationship between alignment and retail-specific measures of firm performance. Similarly, Tallon (2003) found that while 70 percent of companies reduced costs or improved sales and customer service after increasing strategic alignment, 30 percent saw no improvement, and some even saw a decline.

These mixed results may be caused by the time-lag effects of IT applications. As Brynjolfsson and Hitt (1998) have said, increased benefits over time would be indicative of a time-lag for matching organizational factors and IT investment. Recently, Wu and Chen (2006) developed the IT performance measure hierarchy and suggested that performance measures for higher levels may take a long time to show their effects. Hence, we expect:

H1b. e-Alignment has a time-lag effect on firm performance.

2.2 e-Collaboration capabilities and firm performance

Consistent with prior literature, our conceptualization of e-collaboration capabilities is the extent of facilitating coordination of various decisions and activities beyond transactions among the suppliers and distributors over the internet (Rosenzweig, 2009). Our framing of e-collaboration capabilities consist of e-collaboration with suppliers and e-collaboration distributors.

The relational view provides a good theoretical lens for examining the mechanisms of how e-collaboration capabilities influence firm performance. The relational view suggests that "a firm's critical resources may span firm boundaries and may be embedded in interfirm resources and routines" (Dyer and Singh, 1998). The relational view identified four primary sources of supernormal profit returns that can generate relational rent or competitive advantage (Dyer and Singh, 1998). In this paper, we suggest that e-collaboration capabilities can enhance firm performance through two sources: relation-specific assets and knowledge-sharing routines (Rosenzweig, 2009).

First, e-collaboration capabilities are a kind of relation-specific asset. Relation-specific assets are those which are specialized in conjunction with the assets of suppliers and distributors. When firms make relation/transaction-specific investments and generate e-collaboration capabilities, firm performance or competitive advantage can be achieved. By constructing e-collaboration capabilities, firms can enhance firm performance through generating lower total value chain costs, greater product differentiation, fewer defects, and faster product development cycles. For example, e-collaboration, such as information exchanges, that supports joint planning and forecasting at multiple levels, can yield operational performance gains (Beatriz *et al.*, 2014; Saeed *et al.*, 2005).

Second, e-collaboration capabilities can facilitate relational rents through organizational processes that enable knowledge to be transferred across firm boundaries. From improved management of assets, reduced costs of operations, and enhanced productivity, buyer and supplier strategic information flows positively impact the relationship-specific performance

of both sharing and receiving parties (Klein and Rai, 2009). For instance, P&G and Wal-Mart found a way to leverage IT by sharing data and knowledge across their mutual supply chains. The resulting channel has become more efficient because channel activities are better coordinated (Grean and Shaw, 2003).

Therefore, e-collaboration capabilities can enhance firm performance through relation-specific assets and knowledge-sharing routines, which can enhance relational rents and competitive advantage. Thus, we offer the following hypotheses:

H2a. e-Collaboration with suppliers will be positively related with firm performance.

H3a. e-Collaboration with distributors will be positively related with firm performance.

Compared to firm strategies, e-collaboration capabilities are operational level capabilities, which also may have a time-lag effect on firm performance. There is a three-level structure of organizational hierarchy (i.e. corporate strategies, manufacturing decisions, and operational activities) with a time-lag effect (Wu and Chen, 2006). Performance of lower levels may take a short time to show their effect. For example, compared to a three-year lag effect of firm strategies, researchers found there is a positive relationship between operational activities and firm performance over a regular one-year time period (Wu and Chen, 2006). Hence:

H2b. e-Collaboration with suppliers has a time-lag effect on financial performance.

H3b. e-Collaboration with distributors has a time-lag effect on financial performance.

2.3 e-Alignment and e-collaboration capabilities

e-Alignment is a kind of business- or firm-level strategy (Bharadwaj *et al.*, 2013). At the same time, e-collaboration capabilities with partners are functional/operational level capabilities (Mishra *et al.*, 2013). Specifically, e-alignment can be treated as a higher-level capability, and e-collaboration is a lower-level functional/operational capability (Wanger *et al.*, 2014). e-Collaboration capabilities allow firms to perform functions, such as distribution and logistics, while e-alignment enables firms to systematically and reliably adapt lower-level capabilities to dynamic and collaborative environments (Fortune and Mitchell, 2012). Therefore, as a higher-level capability, e-alignment is the starting point to formulate and execute this e-collaboration capability through e-business technologies (Wanger *et al.*, 2014). Therefore:

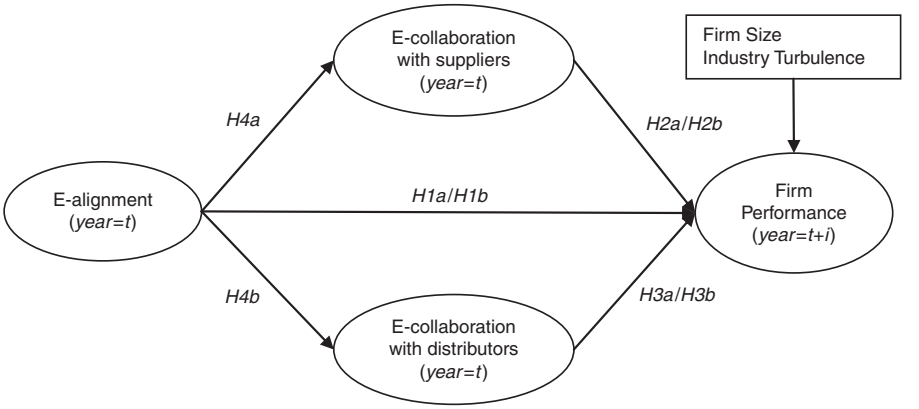
H4a. e-Alignment will positively enhance e-collaboration with suppliers.

H4b. e-Alignment will positively enhance e-collaboration with distributors.

2.4 Control variables

We also controlled for firm size and industry turbulence in explaining firm performance. Firm size is the natural log of annual revenue (Wang *et al.*, 2013). Larger firms have more slack resources for IT investment, are more likely to achieve economies of scale (Mithas *et al.*, 2013), and are more capable of bearing the risk associated with IT investment. Further, prior research shows that the strategic effect of IT leveraging competence is more pronounced in higher levels of environmental turbulence (Pavlou and Fygenson, 2006; Xue *et al.*, 2012). We used an industry turbulence index (from 2007 to 2009) to measure industry turbulence, and it is adopted from the Chinese National Bureau of Statistics (www.ce.cn).

All of the hypotheses are shown in the research model in Figure 2.



Notes: *H1b*, *H2b*, and *H3b* are the time-lag effects. Year *t* represents the year of 2007; *year t+i*(i=0, 1, 2) represents the year of 2007, 2008, and 2009 separately. In order to test time-lag effect, we measure three years(year=2007, 2008, and 2009) of firm financial performance, respectively

Figure 2.
Research model

3. Research methodology

3.1 Context and procedure

We tested the research hypotheses using a field survey of Chinese corporations. We chose Chinese enterprises in our research for the following two reasons. First, as a developing country, China is a flourishing area with traditional business that can reflect characteristics of e-business development in traditional enterprises. Second, most of the businesses in China recognize economic potential of e-business and are supportive of or plan to develop e-business. The questionnaire was based on a comprehensive literature review and interviews with business and IT managers and was refined via several runs of pretests, revisions, and pilots tests. The initial questionnaire was refined in four steps (translation accuracy, two-stage Q-Sorting, peer review, and pilot's tests).

We considered using multiple respondents from each organization but decided to use a single informant for two reasons. One major reason was the adverse effect multiple informants per organization would have on sample size. Second, collecting data using multiple informants from each organization has been argued to create potential bias (Kearns and Sabherwal, 2006).

In over 43 percent of the cases, the informant was the CIO but, in other cases, it was vice presidents, chief accounting officers, or other functional managers. Perceptions of a single respondent can lead to common source bias. To reduce any motivation for exaggeration and self-promotion, respondents were advised that results would be completely anonymous. In addition, we used several questionnaire design strategies that have been recommended (Nunnally and Bernstein, 1994) to minimize the problems inherent in self-report data, such as reverse-coding of some items so that one end of a Likert scale was not always associated with positive outcomes. Further, we split the sample into two groups: IS manager vs business managers. We used one-way ANOVA to compare the means of factor scores of all constructs between the two groups ($p > 0.1$). Hence, we conclude that the role of the respondents did not cause any survey biases.

Demographic information collected supported the respondents as reliable sources. On average, respondents had 4.4 years of college education and 5.0 years of experience in their company. The average status was 2.4, indicating that they were less than two reporting levels from the CEO. Thus, their experience and exposure to the views of top management provided them with keen insights into the behavior of top and middle (or business) managers and with an understanding of organizational planning.

The Chinese Electronic Commerce Association (CECA), Committee of Economics and Commerce in the major cities of China (i.e. Beijing, Wuhan, etc.) supported this survey and provided us with a list of manufacturing firms. A convenience random sample of 600 firms was selected from the list. In 2007, we sent 600 questionnaires to the enterprises in China by e-mails or letters. In total, 224 responses were received in 2007, resulting in a 37.3 percent response rate. We checked the sample for consistency and dropped invalid responses, resulting in a final dataset of 145 valid cases. Table I shows the frequency of survey response by major industry group. Table II provides characteristics of the responding companies. Because the firms contained almost sizes (small, medium, and large companies) and the major industries in China, the samples was considered appropriately representative for this study.

Industry	No.	Rate (%)
Computers/communications	31	21.4
Oil/petroleum	26	18.0
Electronics machinery	15	10.3
Utilities	23	16.0
Transportation	11	7.6
Metals/plastics	10	6.8
Pharmaceuticals/healthcare	6	4.1
Others	18	12.4
Missing	5	3.4

Note: $n = 145$

Table I. Survey response by industry

	No.	Rate (%)		No.	Rate (%)
Location			*Revenue*		
North and West China	14	9.7	< ¥10Million	16	11.0
East China	19	13.1	¥10-¥50Million	16	11.0
South China	25	17.2	¥50-¥100 million	18	12.4
Central China	82	56.6	¥100–¥1,000 million	36	24.8
Missing	5	3.4	> ¥1 billion	53	36.6
No. of employees			Missing	6	4.1
⩽100	16	11.0	*Ownership type*		
101-500	32	22.1	State owned	56	38.6
501-1,000	25	17.2	Joint venture	32	22.1
1,001-5,000	28	19.3	Privately owned	38	26.2
5,001-10,000	18	12.4	Foreign invest	13	9.0
> 10,000	22	15.2	Missing	6	4.1
Missing	4	2.8			

Note: $n = 145$

Table II. Characteristics of respondent companies

3.2 Non-response bias

We tested for non-response bias with early and late respondents (using Pearson-correlation) and also the mean responses of respondents and non-respondents (using *F*-test) on respondent position ($r = 0.64$, $p < 0.05$; $F = 0.34$, ns), sales revenue ($r = 0.65$, $p < 0.05$; $F = 0.54$, ns), and number of employees ($r = 0.73$, $p < 0.05$; $F = 0.85$, ns).The result revealed no evidence of response bias in the collected data.

3.3 Common method bias (CMB)

Besides the procedural remedy of CMB mentioned above, our analysis sought to safeguard against CMB by employing different types of measures for some key constructs and different scale types for certain measures (Podsakoff *et al.*, 2003). Specifically, we utilized formative and objective measures for firm performance and employed reflective and subjective measures for other constructs. In addition, we evaluated common method variance by applying the Harmon one-factor test (Lowry and Gaskin, 2014). Three factors were extracted from the data. No single factor accounted for the bulk of the covariance (greater than 50 percent), suggesting that CMB was not a significant issue for our data.

3.4 Measures

All the research constructs (expect firm performance) were measured using closed-end five-point Likert-scale items, with scales ranging from 1 = "strongly disagree" to 5 = "strongly agree." In total, 13 items were used to measure the three constructs. These items are given in the Appendix. The measures of each research construct are discussed below.

e-Business strategic alignment was measured using five items adapted from Preston and Karahanna's work. Following the Bharadwaj *et al.* (2013) definition, e-alignment reflects a fusion between the business strategy and IT strategy. The term e-alignment in the paper, as in many other studies (Chen, 2010; Tallon and Pinsonneault, 2011; Valorinta, 2010), refers to the intellectual dimension of IS strategic alignment, and shared understanding represents important aspects of the social dimension. It contains the congruence of business and IT objectives, the tight linkage of business and IT groups and their decisions, and the alignment of business and IT planning.

e-Collaboration capability is comprised of two capabilities: e-collaboration with suppliers and e-collaboration with distributors (Rosenzweig, 2009). Based on a measure of e-collaboration, we developed eight items to measure two capabilities. Specifically, e-collaboration with suppliers was measured using four items that reflected e-collaboration level (such as online procuring and collaborative forecasting/production planning) with suppliers. e-Collaboration with distributors was measured using four items that reflected e-collaboration level (such as online ordering and collaborative forecasting/production planning) with distributors.

Consistent with studies on IT and firm performance by (Chae *et al.*, 2014; Tallon and Pinsonneault, 2011), we assessed firm performance using two standard financial metrics: return on assets and the ratio of operating income to assets. These metrics have been used elsewhere in studies of the performance impacts of IT (Dehning and Richardson, 2002; Kohli and Devaraj, 2003). Given the time-lag between business and IT planning processes (Das *et al.*, 2011), the benefits of e-alignment and e-collaboration are likely to arise after some amount of time has passed. Thus, for the firms in our sample, we use firm performance data from Oriana (https://oriana.bvdep.com)

for 2007 (the year of the survey was administered) and the next two years: 2008 and 2009. We adopted three-year financial performance to analyze lag-time effects because the literature that has suggested that time lags over three years may provide meaningful results for organizational performance measures (Hendricks *et al.*, 2007). Therefore, we obtained financial performance from 2007 to 2009 for the 145 cases.

4. Model estimation and results

To establish the nomological validity of constructs, we used partial least squares (PLS), because of the relatively small sample size, and because it allows use of both formative and reflective constructs (Lowry and Gaskin, 2014; Peng and Lai, 2012). The psychometric properties of all scales were assessed within the context of the structural model through assessment of discriminant validity and reliability.

4.1 Measurement model

Firm performance is modeled as formative constructs (Jarvis *et al.*, 2003). All other constructs were reflectively modeled. The psychometric properties of the scales were assessed in terms of item loadings, internal consistency, and discriminant validity (Tables III and IV). Item loadings and internal consistencies greater than 0.70 are generally considered acceptable (Lowry and Gaskin, 2014).

As can be observed from the factor analysis results in Table III and composite reliability scores in Table IV, the scales used in the study largely meet these guidelines. To assess discriminant validity (Chin, 1998), indicators should load more strongly on their

Indicators	ESA	ECD	ECS
ESA1	*0.856*	0.155	0.215
ESA2	*0.874*	0.199	0.120
ESA3	*0.829*	0.219	0.225
ESA4	*0.793*	0.302	0.327
ESA5	*0.806*	0.316	0.259
ECD1	0.248	*0.877*	0.263
ECD2	0.264	*0.853*	0.289
ECD3	0.295	*0.868*	0.241
ECD4	0.205	*0.823*	0.251
ECS1	0.143	0.229	*0.807*
ECS2	0.259	0.207	*0.873*
ECS3	0.225	0.352	*0.786*
ECS4	0.345	0.253	*0.804*

Notes: ESA, e-Business strategic alignment; ECS, e-collaboration with suppliers; ECD, e-collaboration with distributors

Table III. Results of factor analysis

	Composite reliability	ESA	ECS	ECD
ESA	0.95	*0.89*		
ECS	0.93	0.58	*0.89*	
ECD	0.96	0.58	0.60	*0.93*

Notes: ESA, e-Business strategic alignment; ECS, e-collaboration with suppliers; ECD, e-collaboration with distributors. The italic numbers on the leading diagonal are the square root of AVE

Table IV. Interconstruct correlations

corresponding construct than on other constructs in the model, and the square root of the average variance extracted (AVE) should be larger than the interconstruct correlations. As shown by the factor analysis results and comparison of interconstruct correlations and AVE (bold numbers on the leading diagonal) in Table IV, the constructs met these guidelines, pointing to the discriminant validity of the constructs in the model.

In assessing a formative construct, such as firm performance, we computed item weights that reflected the influence of individual formative construct items. Each item weight was greater than 0.10 (Peng and Lai, 2012), and the sign of the item weight was consistent with the underlying theory. All items were significant at the 0.01 level. In addition, all the variance inflation factor values were less than 3.3 (Diamantopoulos and Siguaw, 2006), indicating that multicollinearity was not severe. To examine the discriminant validity of the formative construct of firm performance, we computed the average of intra-construct item correlations for this construct and the average of intra-construct item correlations between this construct and other constructs (Peng and Lai, 2012). We found that the average of intra-construct item correlations was greater than the average of inter-construct item correlations. High correlations with a global item and low correlations with other constructs provided evidence of discriminant validity (Diamantopoulos and Winklhofer, 2001). These results suggested that the instrument has acceptable measurement properties.

4.2 Structural model

We estimated three models in SmartPLS 2.0 (Table V). In models 1-3, we used financial performance data in 2007-2009, respectively. The results of these three models regarding three years are shown in Table V. Significance levels were computed in SmartPLS using 500 bootstrap samples[3]. As a reminder, the expected sign of each hypothesis is identified in parentheses. In terms of models 1-3, we noticed first that e-alignment had not had an effect on firm performance during three years. Furthermore, our analysis revealed that e-alignment had a positive and significant effect on e-collaboration capabilities with suppliers ($\beta = 0.58$, $p < 0.001$; *H4a* is supported) and distributors ($\beta = 0.58$, $p < 0.001$; *H4b* is supported).

The results show that e-collaboration capability with distributors fully mediates the effect of e-alignment on firm performance for years 2007, 2008, and 2009 (*H2a* is supported). Perhaps most interesting of all, our analysis reveals that e-collaboration capabilities with suppliers had a one-year lag effect on firm performance. After 2007, e-collaboration capabilities with suppliers began to have a positive effect on firm performance (*H3b* is supported). As for control variables, we found industry turbulence and firm size did not have a significant effect on firm performance from 2007 to 2009.

Finally, post hoc mediation analyses were conducted to examine whether e-collaboration fully mediated the influence of e-alignment on firm performance. In our first analysis, we assessed whether e-collaboration capabilities mediated the influence of e-alignment on firm performance. In model 1 (2007), results of the mediation analysis showed that e-collaboration capability with distributors fully mediated the effect of e-alignment on firm performance. In model 2 (2008), results of the mediation analysis showed that e-collaboration capabilities fully mediated the effect of e-alignment on firm performance. In model 3 (2009), results of the mediation analysis showed that e-collaboration capabilities fully mediated the effect of e-alignment on firm performance.

Furthermore, we tested the percent of explained variance in firm performance when e-collaboration capabilities were removed from the model. First, from 2007 to 2009, the direct effect existed when the mediators were omitted. Second, we tested the R^2 changes

	Model 1 year = 2007	Model 2 year = 2008	Model 3 year = 2009
Control			
Firm size	−0.05^{ns}	−0.05^{ns}	0.06^{ns}
Industry turbulence	−0.07^{ns}	−0.02^{ns}	0.09^{ns}
e-Alignment→firm performance	−0.02^{ns}	0.09^{ns}	0.12^{ns}
(*H1a*/*H1b*)	*0.05*	*0.06*	*0.07*
e-Alignment→e-collaboration with suppliers	0.58***	0.58***	0.58***
(*H4a*)	*0.04*	*0.04*	*0.04*
e-Alignment→e-collaboration with distributors	0.58***	0.58***	0.58***
(*H4b*)	*0.04*	*0.05*	*0.05*
e-Collaboration with suppliers→firm performance	0.09 ^{ns}	0.21**	0.19**
(*H2a*/*H2b*)	*0.07*	*0.10*	*0.08*
e-Collaboration with distributors→firm performance	0.34***	0.21**	0.20*
(*H3a*/*H3b*)	*0.07*	*0.08*	*0.08*
Explained variance: R^2			
Firm performance (%)	14.8	19.5	19.2
e-Collaboration with suppliers (%)	33.1	33.1	33.1
e-Collaboration with distributors (%)	33.1	33.1	33.1
Test of mediation effects			
Sobel test of e-collaboration with suppliers as Mediator	1.28^{ns}	2.07*	2.34*
Sobel test of e-collaboration with distributors as Mediator	4.60***	2.56**	2.44*
e-Alignment→firm performance	0.25	0.35	0.25
(direct path only, omitting the mediator)	$R^2 = 6\%$	$R^2 = 11.9\%$	$R^2 = 12.7\%$
f^2 Statistic(Pseudo F)			
Firm performance	0.10 (14)***	0.09 (12.6)***	0.08 (11.3)***

Notes: Standardized path estimates; $n = 145$. ECS, e-Collaboration with suppliers; ECD, e-Collaboration with distributors. Standard error terms are shown in italics. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

Table V.
PLS Smart model results

during these three years if the mediators were omitted. Using three-year financial data respectively, we further examined the contribution of e-collaboration capabilities on firm performance. We ran a model with e-alignment in the model (after removing e-collaboration capabilities) as direct determinants to firm performance. e-Alignment explained 6 percent (2007)/11.9 percent (2008)/12.7 percent (2009) of the variance in firm performance (8.8 percent (2007)/7.6 percent (2008)/6.5 percent (2009)), lower than when e-collaboration capabilities are the sole determinant of firm performance. An *F*-test comparison of these two models showed that the difference in explained variance of firm performance was statistically significant ($p < 0.001$). Therefore, the post hoc analyses suggest that e-collaboration capabilities are important proximal antecedents of firm performance beyond e-alignment.

To understand the additional contribution of mediation paths, we examined the incremental changes in R^2. A procedure for measuring the effect size and significance of the change in R^2 between models is an f^2 statistic calculated by dividing (R^2 full mediation-R^2 direct effect) by (1-R^2 full mediation). Subsequently, a pseudo *F*-test for the change in R^2 with 1 and (*n*–k) degrees of freedom was calculated by multiplying the f^2 statistic by (*n*–*k*–1). These results are summarized in Table V. Accordingly, the additional variance explained by the mediators significantly adds to the exploratory power of the overall model.

Stone-Geisser'Q^2 (Geisser, 1975) is often used to assess predictive relevance. We used the blindfolding procedure (Omission distance is set to 7) in SmartPLS to calculate Q^2. We found the Q^2 of e-collaboration capabilities and firm performance were bigger than 0.19. Therefore the model is viewed as having predictive relevance.

5. Discussion

The objective of this research was to extend our understanding of IT strategic alignment and its implications, principally in resolving the issue of whether there exist any mediators and time-lag effects between e-alignment and firm performance. We examined this by embedding e-alignment and e-collaboration capabilities in a nomological network leading to firm performance. Further, we investigated the time-lag effect of e-alignment and e-collaboration capabilities by using three-year firm performance[4].

While previous studies represented IT strategic alignment as having a direct effect on firm performance, our results show that e-collaboration capabilities are important mediators between e-alignment and firm performance. This better explains how e-alignment affects firm performance. Further, mediation analyses indicate that e-collaboration capabilities mediated the link between e-alignment and firm performance. Specifically, during three years, e-collaboration capabilities fully mediated the relationship. This indicates that e-collaboration capabilities are critical to improve firm performance. This finding goes beyond prescriptive advice in the literature for firms to tighten IT strategic alignment in order to increase firm performance (Chan *et al.*, 1997, 2006). Our results do not contradict this advice; instead, we believe that e-alignment can lead to value for firms, namely by improving efficiency and effectiveness of e-collaboration with their partners. However, previous research has not considered e-collaboration capabilities in their IT strategic alignment studies.

In addition, by examining the time-lag effects of e-alignment, we found e-alignment did not have a direct and time-lag effect on firm performance. Instead, we found that the lagged effect exists where e-collaboration capability with suppliers improves firm performance; however, e-collaboration capability with distributors did not have this lagged effect. The potential reason for it may be the costs (including time and capital) of constructing e-procurement processes are much higher than those of e-selling processes. Similarly, Barua *et al.* (2004) found that most firms lag in their supplier-side initiatives relative to the customer-side (Barua *et al.*, 2004). Specifically, this paper found that the effectiveness of e-collaboration capability with suppliers has a one-year time-lag. Yao and Zhu (2012) also found the use of e-linkage tends to behave differently depending on whether it is used upstream or downstream in the supply chain. This finding also was supported by Wu and Chen (2006), who found that the effectiveness of IT operational activities have a one-year time-lag. However, they did not distinguish among different business processes, such as e-selling and e-procurement processes. Therefore, this study confirms and furthers prior conclusions.

There are two contributions that expand previous studies. First, that the effects of e-alignment on firm performance are fully mediated by e-collaboration capabilities shows that the value of e-alignment lies in how e-alignment prepares firms for collaborating with suppliers and distributors. Second, the time-lag effect of e-collaboration with distributors showed that there is indeed a time-lag effect existing in the IT operational activities. This finding also explained why some prior research did not find a direct relationship between IT investment and firm performance (Brynjolfsson and Hitt, 1998).

6. Implications and future research

6.1 Implications for research and practice

This research extends the literature on IT strategic alignment and explains the "alignment paradox" in three specific ways. First, we found that e-collaboration capabilities are important mediators between e-alignment and firm performance. This helps uncover new roles of information technology and new sources of IT value (Chan and Reich, 2007; Tallon and Pinsonneault, 2011). Former IT alignment research lacked the full exploration of mediators between IT strategic alignment and firm performance. Second, previous studies of e-collaboration capabilities focussed on the operations level (Kock and Nosek, 2005; Rosenzweig, 2009). They did not explore the antecedents of e-collaboration capabilities from a strategic level. This paper explained the sources of e-collaboration capabilities from a firm's strategic perspective. Third, former studies of IT strategic alignment did not investigate the time-lag effect of IT applications (Tallon, 2011; Tallon and Pinsonneault, 2011). In this paper, we found e-collaboration capability with suppliers has a time lagged effect. Past studies have not isolated this difference between two e-collaboration capabilities. This also provides the reasons why the "alignment paradox" exists.

These results have two important implications for management. First, our results show that e-alignment can be a source of competitive advantage if e-collaboration capabilities are themselves sources of differentiation. A high level of e-alignment can enhance the differentiated e-collaboration capabilities which would improve firm performance. Therefore, when formulating e-business strategies, both CIOs and CEOs should focus on establishing e-collaboration capabilities with partners. Second, the lag effect of e-collaboration with suppliers suggests that IT outcomes also relate to different business processes. The downstream process is the direct sources of business value. Therefore, managers should take the establishment of e-selling processes as a critical business strategy. This also can explain why there are many companies that care more about the user experience, such as Google maps.

6.2 Future research

Our findings suggest several avenues for future IS research. First, the sample used was from China. In future research, a sampling frame that combines companies from different countries could be used in order to generalize our research results. Second, this research takes a static, cross-sectional picture of e-alignment and e-collaboration capabilities, which make it difficult to address the issue of how e-alignment and e-collaboration are created over time. A longitudinal study could enrich our findings. Third, we plan to collect current data from the industry and justify and extend our findings in the future.

7. Conclusion

At a time when firms need to collaborate, collaboration capability is seen as a key competitive imperative. Much research focussing on the operational level found that collaboration capability enhanced operational and financial performance in firms. Arguments abound that IT plays a role in providing collaboration capability. In this paper, we found that e-alignment can integrate and fit a firm's business processes, thus enhancing e-collaboration capability with partners and promoting firm performance.

Our research reveals that e-alignment is a potent source of value and worthy of the priority status consistently afforded it by top executives (Luftman and Zadeh, 2011). More importantly, our results show that e-alignment affects e-collaboration

capabilities first instead of directly affecting firm performance. Finally, we found the value-adding mechanism of two e-collaboration capabilities is different. The effectiveness of e-collaboration capability with suppliers has a one year time-lag. Therefore, strategizing for e-collaboration is a useful exercise for firms facing an interfirm collaborative environment.

Notes

1. For ease of expression, we refer to e-Business strategic alignment as e-alignment.
2. e-Collaboration facilitates coordination of various decisions and activities beyond transactions among the supply chain partners over the internet.
3. In order to check robustness, we used bootstrap samples of 1,000 and 5,000 to re-run our model. We found the results are consistent with 500 bootstrap's.
4. Using financial data in 2010, we also found a similar result to 2009's.

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(The Appendix follows overleaf.)

Appendix

	Questions	Very disagree				Very agree
ESA[a]						
ESA 1	The objective of e-business technology strategy is congruent with the business strategy's in your organization.	1	2	3	4	5
ESA 2	The groups of e-business technology and business are tightly linked to make decisions.	1	2	3	4	5
ESA 3	Our planning of business strategy and e-business technology strategy are closely aligned.	1	2	3	4	5
ESA 4	Both IT and Business managers cooperate with each other.	1	2	3	4	5
ESA 5	Top management team supports IT investment and IT group construction.	1	2	3	4	5
ECS[b]						
ECS1	We have utilized e-business technology to facilitate online procuring with our primary suppliers.	1	2	3	4	5
ECS2	We have utilized e-business technology to facilitate collaborative forecasting planning with our primary suppliers.	1	2	3	4	5
ECS 3	We have utilized e-business technology to facilitate collaborative production planning with our primary suppliers.	1	2	3	4	5
ESC 4	We have utilized e-business technology to integrate with that of primary suppliers for placing orders.	1	2	3	4	5
ECD[c]						
ECD1	We have utilized e-business technology to facilitate online ordering with our primary distributors.	1	2	3	4	5
ECD2	We have utilized e-business technology to facilitate collaborative forecasting planning with our primary distributors.	1	2	3	4	5
ECD 3	We have utilized e-business technology to facilitate collaborative production planning with our primary distributors.	1	2	3	4	5
ECD 4	We have utilized e-business technology to facilitate collaborative logistics planning with our primary distributors.	1	2	3	4	5

Notes: ESA, e-Business strategic alignment; ECS, e-collaboration with suppliers; ECD, e-collaboration with distributors

Table AI. Survey instrument

Sources: [a]Chan *et al.* (1997, 2006), Preston and Karahanna (2009); [b]Rosenzweig (2009), Mishra *et al.* (2013); [c]Rosenzweig (2009)

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