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HOW DOES STRATEGIC ALIGNMENT AFFECT FIRM PERFORMANCE? THE ROLES OF INFORMATION TECHNOLOGY INVESTMENT AND ENVIRONMENTAL UNCERTAINTY

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Appendix A

States of Low SITA–High Social/Structural Integration and High SITA–Low Social/Structural Integration

High Environmental Uncertainty

In an uncertain environment, unpredictability increases organizational entropy (or disorder) and the likelihood of divergence between IT and business strategies. Social/structural mechanisms that enable internal order in the face of uncertainty are needed to achieve a high level of SITA. Therefore, a state of *low SITA–high social/structural integration* would quickly lead to either (1) the high social/structural integration enabling an increase in SITA (such as when a major environmental shift requires the firm to change its business and IT strategies, and the social/structural integration enables this while achieving SITA); or (2) the low SITA causing a decrease in the social/structural integration (because the business and IT executives may communicate less and have lower shared understanding) (Hirschheim and Sabherwal 2001; Sabherwal et al. 2001).

Also, a firm in an uncertain environment would not be able to sustain a state of *high SITA–low social/structural integration*. Instead, it would need to either develop social/structural integration or encounter a decrease in SITA. This parallels the arguments that organizations overcome entropy arising from the environment by using "proper organization culture, structures, processes, and resources" (Tan and Tan 2005, pp. 144-145) and that SITA "result[s] from skill rather than luck" (Baker et al. 2011, p. 303). Thus, a firm in an uncertain environment can have a state of either low SITA–high social/structural integration or high SITA–low social/structural integration only in a transition period. From either of these states, it would quickly move to a state consistent with the notion of SITA reflecting a capability (i.e., either high SITA–high social/structural integration, or low SITA–low social/structural integration).

Low Environmental Uncertainty

Low environmental uncertainty reduces the likelihood of both aspects that can cause divergence between IT and business strategies, that is, organizational entropy (or disorder) and changes to organizational and IT strategies. If the level of social/structural integration was high, it would enable the firm to enhance SITA, causing a state *of low SITA–high social/structural integration* to be unlikely. However, a state of *high SITA–low social/structural integration* could exist in a less uncertain environment. In such an environment, the firm does not change its business and IT strategies, and managers do not need to be socially/structural integrated to maintain SITA. Instead, SITA would be maintained in such an environment due to organizational inertia as no significant new initiatives are pursued and neither business nor IT strategy is changing (Sabherwal et al. 2001).

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Appendix B

Measurement of Strategic IT Alignment

Prior studies compute strategic IT alignment (SITA) (Oh and Pinsonneault 2007; Sabherwal and Chan 2001) using three broad steps: (1) identification of the firm's business strategy; (2) identification of the relevant aspects of the firm's IS strategy; and (3) calculation of alignment. We next examine how each of these steps is done in this study.

Identification of Business Strategy

We first classify each firm's business strategy in each year into the popular typology of Defender, Analyzer, or Prospector (Doty et al. 1993; McLaren et al. 2011; Miles and Snow 1978; Steelman et al. 2019). This typology is based on the degree of business aggressiveness, viewed as the firm's tendency to innovate, lead, and take risks (Ferrier 2001). Prospectors, who are at one end of the spectrum, strive to innovate and benefit from the "first-mover" advantage while taking major risks (Miles et al. 1978). Defenders, at the other extreme, value gaining efficiency and finding stable and secure advantages. Analyzers, who are in the middle of the aggressiveness spectrum, are not as risk-taking as Prospectors, but are also less committed to stability (Doty et al. 1993). We classify each firm in each year into one of these three types based on six business strategy attributes (scope, liquidity, asset efficiency, fixed-asset intensity, long-range financial liability, and research and development (R&D) intensity). The measure of each attribute and its ideal value for each strategy are same as those Sabherwal and Sabherwal (2007) develop using prior literature. Consistent with the profile-deviation approach, and using prior literature, we set the ideal values for each attribute at low, medium, or high for these three strategies.

We normalize each strategic attribute using the sample mean and standard deviation for that year. The sample firms are classified into Defenders, Analyzers, and Prospectors based on the proximity of each firm's business strategy to the ideal profiles for these strategies. We operationalize high, medium, and low values for ideal business strategy attributes as 0.5, 0.0, and –0.5, respectively (Sabherwal and Chan 2001). We use the root mean square (RMS) distances between each firm's business strategy and the three ideal business strategies to classify each firm's strategy to the closest ideal profile. We compute RMS as $\sum_{i=1}^{n} d_i^2$ where d_i is the distance between the actual and ideal profiles in terms of variable i and n is the number of variables used in the analysis ($n = 6$ in this study). This procedure led to 2,224 firm-year observations in the sample classified into 804 Defenders, 931 Analyzers, and 489 Prospectors.

To **validate the business strategy classification**, we use the Scheffé (1959) test to compare the business strategies in terms of several strategic attributes other than those used to identify business strategies. The results indicate that firms pursuing the three business strategies differ as expected in other aspects as well–specifically, market share, return on assets, return on sales, related diversification (measured as related entropy), cost efficiency (measured as the ratio of cost of goods sold to net sales), and firm size (in terms of the natural log of number of employees)–validating the strategy classification.[1]

Ideal IT Investment Profiles

We next identify each firm's ideal ITI profile using the ratios of investments[2] in six IT areas (R&D on IT, insourcing, outsourcing, hardware, application software, and maintenance), which is consistent with prior alignment research (Swaminathan et al. 2008). We identify the ideal ITI profile for a firm based on its realized business strategy described above. Table B1 describes, with justification,[3] the attributes for the ideal ITI profiles for each business strategy.[4] We obtain each firm's relative investment in each area from the *InformationWeek 500* survey.

Computing Strategic Alignment

Consistent with the prior literature (Delery and Doty 1996; Govindarajan 1988; Sabherwal and Chan 2001), we use the difference between the normalized score (based on the sample mean and standard deviation for the year) of each area of IT investment and the ideal value of that investment for Defenders, Prospectors, and Analyzers to compute the distance between each firm's actual ITI profile and the ideal ITI profile based on its business strategy. As mentioned for business strategy attributes, we operationalize the ideal values as 0.5, 0, and -0.5, respectively. Next, we compute SITA by subtracting the above distance from 1, because smaller distances imply that the actual ITI profile is closer to the ideal profile.

For example, J. B. Hunt, a trucking and transportation company based in Arkansas, is categorized as a Defender in 2006. The ideal profile for Defenders suggests that they should pursue a low level of investment in R&D of IT and insourcing, and a high level of expenditure in outsourcing, purchase of hardware and software, and maintenance. J. B. Hunt's actual IT profile shows low expenditures in R&D and insourcing and high expenditure in hardware and software (consistent with the ideal profile), but moderate expenditures in outsourcing and maintenance (inconsistent with the ideal profile). Thus, SITA is calculated as

$$0.29 = 1 - \sqrt{\left(-0.5-\left(-0.5\right)\right)^2 + \left(-0.5-\left(-0.5\right)\right)^2 + \left(0.5-0\right)^2 + \left(0.5-0.5\right)^2 + \left(0.5-0.5\right)^2 + \left(0.5-0\right)^2}$$

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[1]Detailed results are excluded due to space considerations.

[2]In a few cases, the allocations across various areas do not add up to 100 percent. Therefore, we divide the proportion allocated to each area by the sum of the allocations across areas to compute consistent proportional allocations.

[3]Alternative combinations of the categories to identify IT investment profiles were analyzed and are described in our robustness analyses in Appendix C. The results from these analyses are consistent with the main analysis.

[4]Profile deviation does not involve using archetypes for ITI. But the ITI profiles for Defenders and Prospectors seem similar to IS Conservative and IS Innovator archetypes (Chen et al. 2010), respectively. Specifically, our ideal profile for Prospectors, who follow aggressive IS action (e.g., investing highly on R&D), matches the description of IS Innovators, while the ideal profile for Defenders, who are the least aggressive, matches IS Conservatives. We are grateful to an anonymous reviewer for a suggestion leading to this parallel.

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Table B1. IT Strategy Attributes of Defenders, Analyzers, and Prospectors

IT Investment Area	Theoretical Ideal Values	Justification
Proportion of IT budget spent on R&D on IT	D: Low A: Medium P: High	Prospectors, continually seeking new opportunities, should spend the most on R&D through IT, followed by Analyzers, which seek opportunities to a lesser extent, and then Defenders, which operate in a stable domain. This is consistent with prior arguments and empirical results regarding R&D expenditures (Hambrick 1983; Sabherwal and Sabherwal 2007).
Proportion of IT budget spent on insourcing (salaries)	D: Low A: Medium P: High	Based on prior literature, Hirschheim and Sabherwal (2001) argue that Defenders focus on outsourcing, while Prospectors focus on insourcing, with Analyzers being in between the two (i.e., selective sourcing). Similarly, Hambrick (1983, p. 11) argues "prospectors find that in-house channels can be motivated, educated, and controlled to an extent that outside channels cannot.…prospectors require superior market intelligence, available only through in-house channels." Consistent with such arguments, we view Defenders, Analyzers, and Prospectors as low, medium, and high, respectively in insourcing, and high, medium, and low, respectively, in outsourcing.
Proportion of IT budget spent on outsourcing	D: High A: Medium P: Low	
Proportion of IT budget spent on hardware	D: High A: Medium P: Medium	Defenders emphasize efficiency through routinization (Doty et al. 1993; Miles at al. 1978). They benefit most from routines and reuse of information, which hardware and applications enable. Therefore, Defenders benefit most from investment in hardware and applications. The more dynamic nature of Analyzers and Prospectors limits the value of hardware and applications by reducing the applicability of prior knowledge due to changed circumstances. However, they also purchase hardware and develop applications, although of different kinds (Sabherwal and Chan 2001), and are therefore viewed as "Medium."
Proportion of IT budget spent on applications	D: High A: Medium P: Medium	
Proportion of IT budget spent on other aspects (e.g., maintenance)	D: High A: Medium P: Low	Due to the greater investments in hardware and applications, and greater continuation of hardware and applications over time, Defenders should also spend more on maintenance and related activities. Prospectors should spend the least in this area due to their dynamic nature. Analyzers should be medium in this respect as they deploy hardware and applications from one context in another to a greater extent than Prospectors.

Note: Defenders', Analyzers', and Prospectors' ideal values are shown after "D," "A," and "P," respectively.

Appendix C

Robustness Analyses

In addition to the main analyses, we test several alternative robustness models to explore the generalizability and consistency of our findings, the results for which are reported in Table C1. These models include a different dependent variable (Model R1); different measures of the dimensions of environmental uncertainty (Models R2–R4); and different measures of SITA (Models R5–R9). Each model starts with the primary research model (Model 3, Table 4), and makes one change. While Tobin's *q* is a forward-looking measure of performance, the existing literature (e.g., Oh and Pinsonneault 2007) has also examined the effects of SITA and ITI on accounting measures of performance such as return on assets (ROA). To further examine the generalizability of our findings, Model R1 uses ROA as an alternative and more reactive measure of firm performance (Oh and Pinsonneault 2007). Further, the existing literature (e.g., Xue et al. 2011) has used alternative measures of environmental uncertainty that we did not utilize in our main analysis. Models R2–4 utilize these alternative measures of environmental uncertainty to examine the robustness of our findings when other well-established measures are utilized. Model R2 uses the industry's operational income volatility as the measure of environmental dynamism. Model R3 uses the log value of the reciprocal of the Herfindahl index of the market shares of all firms in the industry as the measure of complexity. Model R4 uses industry's operational income growth as the measure of environmental munificence. The results, presented in Table C1, are consistent with the primary results.

One could argue that the specific investment ratios used in the original measurement of the IS strategy may not clearly differentiate firm strategies. Specifically, a big portion of a firm's investment in hardware, software applications, outsourcing, or maintenance, may be due to legacy costs that move from one year to another without being affected by IT strategy. Therefore, we assess the validity of our findings when each of these aspects of IT investment is dropped from the evaluation of the IT strategy and, hence, the subsequent measurement of SITA. To do so, we calculate SITA in five alternative models (R5–R9). We test these models by excluding specific categories of ITI. Model R5 uses a measure of SITA that excludes both hardware and application development, Model R6 uses a measure of SITA that excludes hardware, Model R7 uses a measure of SITA that excludes application development, Model R8 uses a measure of SITA that excludes outsourcing, and Model R9 uses a measure of SITA that excludes miscellaneous (including maintenance) IT investments. As shown in Table C1, the results of all nine models support all five hypotheses.

Due to the possible biasing effect of unobserved heterogeneity across firms on GLS-estimated coefficients, we use firm fixed-effects and firm random-effects estimations. Fixed- and random-effect estimation models remove time-invariant unobserved heterogeneity that is not captured by the study's control variables (Greene 2011). Models R10 and R11 in Table C2 report the estimated coefficients with fixed- and random-effects estimation, respectively. Both these models also support all five hypotheses.

Model R12 includes two additional control variables: firm age and industry clockspeed. To calculate firm age, we approximate a firm's year of birth as the earliest of the years (1) in which the firm is included in *COMPUSTAT*; (2) in which the firm appears on CRSP; and (3) in which there is a link between *CRSP* and *COMPUSTAT* (based on *COMPUSTAT* data item LINKDT) (Shumway 2001). To calculate industry clockspeed, we follow the approach used by Mendelson and Pillai (1999). Specifically, we first compute for each firm the mean and standard deviation of quarterly sales over the 42 quarters. The coefficient of variation (i.e., the ratio of the standard deviation to the mean) is then used as an indicator of total variation in sales for that firm over this period. This variation has two components: variation due to deterministic temporal effects (cyclic seasonal uctuations and sales growth), and variation due to random effects (uncertainty and turbulence). For each rm, we perform a regression of log (sales) against time to evaluate the growth trend, while including independent dummy variables for quarters (binary) to control for cyclic seasonal variations. The slope of the regression is used as the growth component of sales variability. The residual values from the regression, which indicate the unpredictable variation in sales, are normalized by dividing by the mean value of log(sales). This ratio is used as a measure of the *random component of sales variation*, which is used as a proxy for clockspeed.

Finally, we conduct five robustness tests (Models R13 to R17) for combinations without lagged independent variables and larger sample sizes through imputation. Models R13 to R15 are without any lagged effects, with R13 having no imputed data, R14 using data imputation only for all control variables, and R15 using data imputation for all variables. Models R16 and R17 have one-year lagged effects similar to the main analyses, with R16 using data imputation only for all control variables and R17 using data imputation for all variables. As shown in Table C2, the results of all eight models support all five hypotheses.

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Table C1. Robustness Tests: Alternative Measures

	Model R1	Model R2	Model R3	Model R4	Model R5	Model R6	Model R7	Model R8	Model R9
Dynamism	-0.051	-0.099***	-0.147***	-0.066*	-0.179***	-0.226***	-0.111***	-0.096***	-0.162***
Munificence	0.210***	0.176***	0.224***	0.155***	0.126***	0.151***	0.219***	0.171***	0.096***
Complexity	-0.900**	-0.084***	-0.072**	-0.093**	-0.092**	-0.066*	-0.091***	-0.123***	-0.083***
ITI	0.064*	0.063*	0.085**	0.071*	0.098***	0.083**	0.077*	0.091**	0.109***
SITA (H1a)	0.072*	0.092**	0.074**	0.067*	0.073***	0.069*	0.058*	0.049*	0.072*
ITI*SITA (H1b)	0.093***	0.172***	0.165***	0.081*	0.085**	0.119***	0.170***	0.152***	0.118***
Dynamism*ITI	0.005	0.016	0.041	0.009	0.004	0.051	0.049	0.032	0.027
Dynamism*SITA	0.017	0.009	0.016	0.018	0.028	-0.018	-0.021	-0.005	-0.004
Dynamism*ITI*SITA (H2a)	0.0319***	0.194***	0.378***	0.243***	0.217***	0.314***	0.408***	0.202***	0.214***
Complexity*ITI	0.003	0.023	0.010	0.019	0.005	0.021	0.002	0.003	0.009
Complexity*SITA	0.018*	-0.031	-0.18	-0.015	0.032	-0.005	0.004	0.008	0.011
Complexity*ITI*SITA (H2b)	0.152***	0.121***	0.089**	0.116***	0.114***	0.188***	0.272***	0.245***	0.318***
Munificence*ITI	0.014	0.019	0.005	0.029	0.012	0.018	0.012	0.028	0.008
Munificence*SITA	-0.018	-0.16	0.004	0.031	-0.050	-0.064	-0.018	-0.039	0.012
Munificence*ITI*SITA (H2c)	-0.195***	-0.206***	-0.112***	-0.186***	-0.319***	-0.233***	-0.221***	-0.286***	-0.166***
Constant	0.032	0.057**	0.042*	-0.074*	-0.045**	-0.028**	-0.018*	-0.044*	-0.028**
N	758	758	758	758	758	758	758	758	758
χ^2	18927.4	33752.7	45629.8	28592.6	32541.2	41870.1	39876.3	24593.5	18278.4

Notes: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$. All tests are one-tailed. Slack, Industry *q*, Industry's capital intensity, Regulation, Related diversification, Business strategy of the firm, Size, and Industry and Year dummies are included as controls, but excluded from the table due to space considerations. The cells related to the hypotheses are highlighted for all models. Model R1 uses ROA as the dependent variable. Model R2 uses industry's operating income volatility as a measure for dynamism, whereas Model R3 uses the log value of the reciprocal of the Herfindahl index of the market shares of all firms in the industry as the measure of complexity. Model R4 uses industry's operating income growth as a measure for munificence. Models R5–R9 are based on five alternative measures of alignment, computed by excluding the following categories of IT investment: both hardware and application development (Model R5), only hardware (Model R6), only application development (Model R7), outsourcing (Model R8), and miscellaneous (including maintenance) (Model R9).

Table C2. Further Robustness Tests

	Model R10	Model R11	Model R12	Model R13	Model R14	Model R15	Model R16	Model R17
Dynamism	-0.069*	-0.106**	-0.042*	-0.127**	-0.214***	-0.283***	-0.228***	-0.195***
Munificence	0.210*	0.174*	0.144***	0.237***	0.228***	0.137***	0.067*	0.182**
Complexity	-0.111	-0.014	-0.023*	-0.044**	-0.021*	-0.020*	-0.010	-0.024*
ITI	0.104*	0.114*	0.074*	0.123**	0.139***	0.071*	0.209***	0.185***
SITA (H1a)	0.045*	0.055*	0.033*	0.024*	0.062**	0.064*	0.035**	0.051*
ITI*SITA (H1b)	0.054*	0.068*	0.024*	0.045*	0.090**	0.111***	0.074***	0.046*
Dynamism*ITI	0.023	0.060	-0.018	-0.099**	-0.055*	-0.056*	-0.007	-0.015
Dynamism*SITA	-0.051	-0.025	-0.017	-0.026*	-0.032**	-0.017	-0.034*	-0.043
Dynamism*ITI*SITA (H2a)	0.073*	0.118**	0.021*	0.218***	0.229***	0.337***	0.270***	0.325***
Complexity*ITI	-0.090	0.017	-0.018	-0.021	-0.032*	-0.021	-0.038*	-0.025
Complexity*SITA	0.030	-0.024	-0.002	-0.006	-0.008	-0.011*	-0.002	-0.002
Complexity*ITI*SITA (H2b)	0.066*	0.059*	0.097***	0.055*	0.101***	0.059*	0.117**	0.174***
Munificence*ITI	-0.008	-0.021	0.038*	0.019	0.041*	0.039**	0.061*	0.070*
Munificence*SITA	-0.004	-0.005	0.007	0.020*	0.016	0.011*	0.029*	0.021*
Munificence*ITI*SITA (H2c)	-0.050*	-0.128**	-0.044*	-0.218***	-0.078**	-0.108**	-0.172***	-0.101***
Constant	0.026	0.017	-0.003	-0.028*	-0.016*	-0.021**	-0.013*	-0.010*
N	758	758	758	1,124	1,319	2,224	1,858	2,224
χ^2	1,043.2	2111.9	42,341.2	72716.8	82,608.3	96,058.1	97,407.2	93,175.2

Notes: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$. All tests are one-tailed. Slack, Industry *q*, Industry's capita intensity, Regulation, Related diversification, Business strategy of the firm, Size, and Industry and Year dummies are used as controls in all the models, but are excluded due to space considerations. The cells related to hypotheses are highlighted for all models. Models R10 and R11 report the results with fixed-effects and random-effects estimations of coefficients, respectively. Model R12 reports the results when two additional controls (Firm age and Industry clockspeed) are added. Firm age is nonsignificant ($p > 0.10$) while Industry clockspeed has a significant ($p < 0.05$) negative effect; the coefficients are excluded due to space considerations. Models R13 to R17 report results for combinations without lagged independent variables and larger sample sizes through imputation. Models R13 to R15 are without any lagged effects, with R13 having no imputed data, R14 using data imputation only for all control variables, and R15 using data imputation for all variables. Models R16 and R17 have one-year lagged effects similar to the main analyses, with R16 using data imputation only for all control variables and R17 using data imputation for all variables.

Appendix D

Firm Investment Announcement Analysis

Our main approach to evaluate strategic IT alignment (SITA) rests on assessing business strategy through *COMPUSTAT* data and IT strategy through *InformationWeek* data based on the allocation of IT budget to specific categories of R&D on IT, insourcing, outsourcing, hardware, application software, and maintenance. Both aspects, as with most secondary data analyses, have some limitations. Some aspects of IT expenditures may be due to time-invariant legacy costs that occur irrespective of a firm's existing IT strategy (e.g., maintenance and support costs). Similarly, business strategy assessment based on asset and liquidity measures may be less able to detect managerial aspirations and their year-to-year changes. In an attempt to alleviate these concerns and further assess the robustness of our results, we evaluate business and IT strategies based on public investment announcements made by each firm in each year. Firms utilize public announcements of their strategic investments and actions to provide details on the strategic direction for their stakeholders (McWilliams and Siegel 1997). Thus, by assessing investments publicly announced by a firm, we use an alternative approach to measure business and IT strategies that addresses the potential limitations of high-level budgetary measures in the primary analysis. The next section describes this alternative approach to measuring business and IT strategies, which, to the best of our knowledge has not yet been done in IS research.

Strategy Attributes

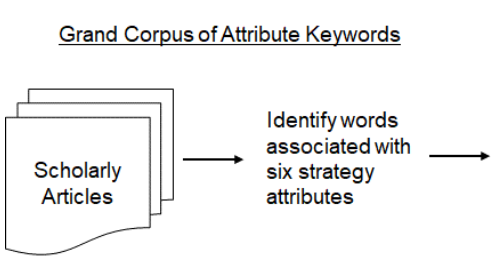
We use prior literature (Sabherwal and Chan 2001; Venkatraman 1989) to identify a different set of business strategy attributes than those used for the main analysis (Appendix B). Specifically, we evaluate the public investment announcements in a given year for a firm based on (1) defensiveness, (2) risk aversion, (3) aggressiveness, (4) proactiveness, (5)analysis, and (6) futurity. ***Defensiveness*** focuses on efficiency through cost-saving. ***Risk aversion*** reflects making conservative decisions. ***Aggressiveness*** reflects a strategic approach that sacrifices short-term profitability for gaining more market share. ***Proactiveness*** reflects the exploration of new ideas and innovations. ***Analysis*** reflects an empirical orientation and tendency to make decisions based on factual information. Finally, ***futurity*** refers to a strategic approach that emphasizes long-term business effectiveness. The ideal profiles for Defenders, Prospectors, and Analyzers in terms of these attributes are based directly on Table 1 from Sabherwal and Chan (2001).

Identifying Keywords for Strategy Attributes

We next develop a database containing words associated with each strategy attribute. To reduce the potential bias of generating associated words from only the authors, we first identify a large set of published scholarly articles discussing alignment and the focal attributes through a systematic literature search via Google Scholar. Scholarly articles are obtained by searching for the keyword "alignment" along with "defensiveness" (6,127 html articles), "risk aversion" (12,318), "aggressiveness" (8,873), "proactiveness" (11,884), "analysis" (13,529), or "futurity" (2,814). For each strategy attribute, we combine the html text of scholarly articles using the attribute to form a grand corpus. Next, each time a sentence within the articles mentions the attribute, we gather the nouns and verbs in the focal sentence, the prior sentence, and subsequent sentence. For example, defensiveness is most frequently associated with efficiency, preservation, and cost reduction. The nouns and verbs most frequently[5] identified in relationship to an attribute are treated as its associated keywords and entered into the associated keyword matrix.[6] Figure D1 summarizes this process.

[5]Verbs and nouns appearing in at least 10% of the relevant articles are considered frequent. The results remain qualitatively unchanged when only verbs and nouns appearing in at least 15% of the relevant articles are considered.

[6]The detailed list of words for each attribute is available from the authors upon request.

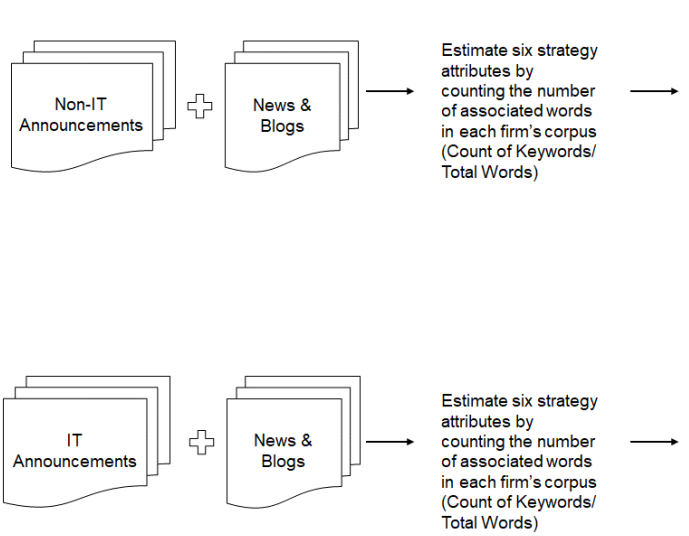


Keyword	Defensiveness	Risk Aversion	Aggressiveness	Proactiveness	Analysis	Futurity
Keyword A	0.05	0.27	.01	.02	.15	.05
Keyword B	0.01	0.00	0.32	0.09	0.01	0.22
…	…	…	…	…	…	…
Keyword Z	0.23	0.02	0.00	0.01	0.05	0.01

Figure D1. The Process for Identifying Associated Keywords for Strategy Attributes

Identifying Business and IT Strategies for Each Firm-Year Observation

Next, we gather the public investment announcements for each firm in each year from the *Lexis/Nexis Academic* database and combine them into a firm-year corpus. We amend the firm-year corpus with the text of relative news and blog posts covering the specific public announcements in each year from *Factiva*. We analyze this final firm-year corpus to identify a count of each of the associated words for the six strategy attributes for each firm in each year. The value of each of the six attributes, for each firm for each year, is calculated as the ratio of words associated with the attribute in the corpus, divided by the total number of words in the corpus. We use the same approach and the same set of keywords for each strategy attribute for business and IT strategies, but use additional search terms related to IT investment and non-IT investments for IT strategy and business strategy, respectively. For both sets of announcements, we exclude news or announcements involving more than one firm. Figure D2 depicts the process of capturing and measuring business and IT strategies from this approach.



Business Strategy Attribute Scores

Year	Firm	Defensiveness	Risk Aversion	Aggressiveness	Proactiveness	Analysis	Futurity
2004	Firm A	0.005	0.004	0.001	0.003	0.003	0.000
2005	Firm A	0.006	0.003	0.004	0.004	0.007	0.001
…	…	…	…	…	…	…	…
2008	Firm A	0.007	0.005	0.001	0.006	0.000	0.007

Information Technology Strategy Attribute Scores

Year	Firm	Defensiveness	Risk Aversion	Aggressiveness	Proactiveness	Analysis	Futurity
2004	Firm A	0.005	0.002	0.004	0.007	0.001	0.001
2005	Firm A	0.003	0.002	0.000	0.001	0.004	0.005
…	…	…	…	…	…	…	…
2008	Firm A	0.006	0.003	0.004	0.005	0.000	0.001

Figure D2. The Process for Identifying Business and IT Strategies

IT Strategy

We estimate each firm's IT strategy from all the public IT-related announcements. For each year, we form a search string, including the name of the firm; **and** any of the keywords: "spend," "invest," "investment," **or** "expenditure"; **and** any of the key words: "information system," "information technology," "computer system," "communication technology," **or** any of the ITs listed in *Information Week's* trending ITs in the given year. This provided a total of 8,617 pieces of text from 1,679 unique announcements about IT investments made by 164 firms from 1999-2008, resulting in 506 firm-year corpuses of ITI announcement text.

Business Strategy

To estimate the business strategy of each firm, we analyze all the public announcements, excluding any IT-related announcements. Specifically, for each year, we form a search string that consists of the name of the firm; ***and*** any of the keywords: "spend," "invest," "investment," ***or*** "expenditure." This produces a total of 34,148 pieces of text from 4,665 unique announcements about non-IT investments made by 183 firms from 1999–2008, resulting in 571 firm-year corpuses of non-IT investment announcement text.

Measuring Strategic IT Alignment

We use the 571 firm-year observations for non-IT investment announcements and the 507 firm-year observations for IT announcements in three alternative approaches for business and IT strategies, as depicted in Figure 4 of the main paper. Two of the three approaches with alternative data (alternative measures 1 and 2) use profile deviation to compute SITA, as in our main analysis. The third measure (alternative measure 3) uses score matching, with SITA for each firm computed using business and IT strategies identified from the public announcements. Due to the need for matched firm-year observations with corpuses of key terms related to both non-IT (571 firm-year observations) and IT investments (507 firm-year observations), the sample for this analysis includes 388 firm-year observations. Having used the same six focal attributes to evaluate business and IT strategies (Sabherwal and Chan 2001), we use a score-matching approach to calculate SITA. For attribute *i*, we subtract the value of each attribute for IT and non-IT announcements and take the absolute value of the difference, $|D_i|$. For example, if a firm's IT defensiveness is rated high (0.5) and its business defensiveness is rated low (-0.5), the absolute difference of defensiveness between the IT and business strategies would be one (1=|0.5–(-0.5)|). We then compute SITA by averaging the value of absolute differences for all the six attributes and subtracting it from one $(1-(\sum_i|D_i|)/6)$.

Results

Table D1 presents the results of GLS estimations, as in the main analyses, for each of the three alternative measures. Results of Model 3 from Table 4 are replicated in the first column of to facilitate comparison. As shown in Table D1, the findings using all three alternative measures are consistent with the main results.

References

McWilliams, A., and D. Siegel. 1997. "Event Studies in Management Research: Theoretical and Empirical Issues," *Academy of Management Journal* (40:3), pp. 626-657.

Sabherwal, R., and Chan, Y. E. 2001. "Alignment between Business and IS Strategies: A Study of Prospectors, Analyzers, and Defenders," *Information Systems Research* (12:1), pp. 11-33.

Venkatraman, N. 1989. "Strategic Orientation of Business Enterprises: The Construct, Dimensionality, and Measurement," *Management Science* (35:8), pp. 942-962.

Table D1. Results for Alternative Measurement Approaches

DV = Tobin's *q*	Main Measure (Same as Model 3 from Table 4)	Alternative Measure 1 (AM1)	Alternative Measure 2 (AM2)	Alternative Measure 3 (AM3)
	Profile Deviation			Score Matching
Slack	0.122***	0.098**	0.058*	0.062**
Industry *q*	-0.070***	-0.124***	-0.097***	-0.081**
Industry Capital Intensity	-0.000	0.012	0.008	-0.004
Regulation	-0.041***	-0.022	0.041#	0.032
Related Diversification	-0.033**	-0.082**	-0.038***	-0.029*
Prospector	0.128***	0.063**	0.119**	
Analyzer	0.081***	0.031#	0.071*	
Size (employees)	0.002	0.054*	0.084**	0.116**
Dynamism	-0.163***	-0.084***	-0.078***	-0.041#
Complexity	-0.032*	-0.051**	-0.062***	-0.032#
Munificence	0.158***	0.117***	0.126***	0.091**
ITI	0.135***	0.094***	0.119***	0.108**
SITA (H1a)	0.044***	0.082***	0.131***	0.013***
ITI*SITA (H1b)	0.065*	0.076***	0.212***	0.064*
Dynamism*ITI	-0.071*	-0.082**	-0.051#	-0.033**
Dynamism*SITA	-0.021	-0.003	0.005	-0.007
Dynamism*ITI*SITA (H2a)	0.172***	0.207***	0.179***	0.195***
Complexity*ITI	-0.034*	-0.017	0.016	-0.024
Complexity*SITA	-0.006	-0.009	0.011*	0.008
Complexity*ITI*SITA (H2b)	0.077***	0.129***	0.122**	0.182***
Munificence*ITI	0.033	0.021	0.004	-0.009
Munificence*SITA	0.016	-0.008	-0.019	0.012
Munificence*ITI*SITA (H2c)	-0.145***	-0.118**	-0.113**	-0.244***
Constant	-0.026**	-0.018*	-0.090***	-0.073**
N	758	506	571	388
χ^2	60287.1	5438.2	6714.3	1229.2

Notes: ***$p < 0.001$; **$p < 0.01$; *$p < 0.05$; # $p < 0.10$; ITI = IT Investment; SITA = Strategic IT Alignment. The cells related to the hypotheses are highlighted.

Appendix E

Analyses of SITA as a Rigidity

In order to further evaluate if SITA reflects a rigidity in less uncertain environments, we conduct three additional analyses. In these analyses, we divide the sample into four quadrants: low uncertainty–high SITA (Q1); low uncertainty–low SITA (Q2); high uncertainty–high SITA (Q3); and high uncertainty–low SITA (Q4).

The first analysis compares the correlation of ITI with firm performance between Q1 and Q2, and between Q1 and Q3. If SITA reflects a rigidity in less uncertain environment, firms in Q1 should be less able to reap benefits from ITI compared to firms in Q2 and Q3.

Further, a rigidity in year *t*-1 should decrease the ability of a firm to change its level of SITA from year *t*-1 to year *t*. Therefore, the second analysis creates the above four quadrants using the values of uncertainty and SITA in year *t*-1 and compares the mean proportional change in the level of SITA, from year *t*-1 to year *t* between Q1 and Q2, and between Q1 and Q3.

Finally, a rigidity in year *t*-1 should decrease the ability of a firm to change its level of investment in different components of IT, from year *t*-1 to year *t*. Therefore, the third analysis creates the above four quadrants using the value of uncertainty and SITA in year *t*-1 and compares the mean proportional change in the levels of the six components of IT investment (i.e., R&D in IT, IT insourcing, IT outsourcing, IT hardware, software, and IT maintenance), from year *t*-1 to year *t* between Q1 and Q2, and between Q1 and Q3.

We conducted these comparisons based on quadrants for each of the three dimensions of uncertainty. Cumulatively, these three analyses involve 48 comparisons (six each for the first two analyses, and 36 for the third analysis). Table E1 provides the results, which consistently indicate that SITA reflects a rigidity in less uncertain environments.

Table E1. Results for Alternative Measurement Approaches

Compared Aspect	Environmental Uncertainty Dimensions[a]	(1) High SITA, Low Uncertainty			(2) Low SITA, Low Uncertainty				(3) High SITA, High Uncertainty			
		Mean	S.D.	n	Mean	S.D.	n	*t* (2 – 1)	Mean	S.D.	n	*t* (3 – 1)
Correlation between ITI and Firm Performance[b]	Dynamism	0.06	0.08	138	0.09	0.07	210	3.59***	0.13	0.08	156	7.94***
	Complexity	0.06	0.08	172	0.10	0.06	233	5.51***	0.11	0.08	142	5.51***
	Munificence	0.05	0.08	160	0.07	0.07	211	2.51**	0.10	0.08	179	5.67***
Proportional change in SITA (year *t* to *t*+1)	Dynamism	0.01	0.08	138	0.04	0.12	210	2.80**	0.07	0.16	156	4.14***
	Complexity	0.01	0.11	172	0.03	0.13	233	1.67*	0.07	0.19	142	3.33***
	Munificence	0.01	0.08	160	0.04	0.01	211	4.71***	0.06	0.09	169	5.33***
Proportional change in IT Investment Components (year *t* to *t*+1)												
R&D on IT	Dynamism	0.00	0.03	138	0.02	0.02	210	6.89***	0.06	0.02	156	19.91***
	Complexity	0.01	0.03	172	0.03	0.02	233	7.59***	0.07	0.03	142	17.64***
	Munificence	0.02	0.02	160	0.04	0.02	211	9.54***	0.08	0.08	179	9.44***
IT insourcing	Dynamism	0.01	0.02	138	0.01	0.03	210	7.46***	0.07	0.04	156	16.54***
	Complexity	0.00	0.03	172	0.04	0.02	233	15.17***	0.07	0.04	142	17.23***
	Munificence	0.00	0.09	160	0.03	0.03	211	4.05***	0.06	0.03	179	8.02***
IT outsourcing	Dynamism	0.01	0.04	138	0.03	0.08	210	3.08**	0.09	0.03	156	19.20***
	Complexity	0.02	0.05	172	0.04	0.04	233	4.32***	0.10	0.09	142	9.46***
	Munificence	0.02	0.02	160	0.03	0.07	211	1.97*	0.11	0.04	179	26.01***
IT hardware	Dynamism	0.03	0.04	138	0.04	0.05	210	2.06*	0.09	0.08	156	8.27***
	Complexity	0.01	0.06	172	0.03	0.04	233	3.79***	0.09	0.09	142	9.06***
	Munificence	0.03	0.06	160	0.04	0.08	211	1.37#	0.09	0.03	179	11.37
Software	Dynamism	0.01	0.05	138	0.03	0.03	210	4.22***	0.08	0.09	156	8.36***
	Complexity	0.01	0.05	172	0.02	0.01	233	2.58*	0.08	0.06	142	11.08***
	Munificence	0.02	0.04	160	0.03	0.07	211	1.73*	0.07	0.05	179	10.04***
IT maintenance	Dynamism	0.00	0.04	138	0.02	0.05	210	4.13***	0.09	0.11	156	9.53***
	Complexity	0.01	0.03	172	0.02	0.06	233	2.19*	0.08	0.04	142	17.23***
	Munificence	0.01	0.04	160	0.02	0.02	211	2.89*	0.08	0.06	179	12.51***

Notes: ***$p < 0.001$; **$p < 0.01$; * $p < 0.05$; # $p < 0.10$ (one-tailed tests); ITI = IT Investment; SITA = Strategic IT Alignment.

[a]Environmental dimensions are measured in year *t*. Low dynamism, low complexity, and high munificence, represent low uncertainty. High dynamism, high complexity, and low munificence, represent high uncertainty.

[b] Correlations are between ITI in year *t* and firm performance in year *t*+1. Firm performance is measured using Tobin's *q*, consistent with the main analysis.