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Online Appendix¹

Appendix A: Additional Practical Examples of Different Approaches to IT-Business Alignment

We discuss here a few additional examples of approaches to IT-business alignment. First, *Nestlé*, a Swiss food company, presents an example of IT-change business alignment. *Nestlé* simplified and adapted its dozens of ERP systems by collapsing them into one system and incorporating standardized data management to align with its changing business need for worldwide standardization while allowing for differences in local markets (Shpilberg et al. 2007). The consolidation and simplification of ERP systems were IT changes that aligned with *Nestlé*'s changing business need for standardized operating practices at its businesses, which helped grow *Nestlé*'s revenue from \$50.5 billion to \$80.8 billion (Shpilberg et al. 2007). *Nestlé*'s CEO gave a business executive, not an IT executive, accountability for the IT changes and indicated that it was “really a business initiative”, suggesting that a high degree of IT-business alignment was achieved during these IT changes. The CEO credited the changes in IT systems that “catapulted us [*Nestlé*] to a five-year competitive advantage compared to most fast-moving consumer-goods companies” (Shpilberg et al. 2007).

Second, *Air Canada* is another example of aligning IT changes with business changes. IT is crucial for business innovation in *Air Canada* (Karimi-Alaghehband and Rivard 2014). The Customer Innovation team in *Air Canada* is responsible for tracking technology trends and business changes such as regulatory or business requirement changes. *Air Canada* was the first North American carrier to develop mobile applications and launch a self-service rebooking tool for customers, which allowed passengers to rebook flights in case of cancellation without the help of an agent. For *Air Canada*, constant innovation with IT via flexible IT solutions and changes aligned with business changes is a key differentiator (Karimi-Alaghehband and Rivard 2014).

Finally, as another example, with IT changes, *Marriott* made business changes related to corporate goal setting, capital decisions, organization structure, and talent incentives (Kane 2017). For instance, to keep up with business changes driven by the consumer shift to mobile, *Marriott* made IT changes and moved its experiential elements and online functionalities to its mobile app that is ubiquitous and always on. These IT changes aligned with *Marriott*'s new business tactics around customer experience to focus on customers' trips and stays. *Marriott*'s early mobile platform focused on booking and transaction, but changed to accommodate and align with its “win-the-stay” portion of its business,

¹ Supplementary materials for the article: Saldanha, T., Lee, D., and Mithas, S. 2020. "IT-business Alignment and IT Investment: The Differential Effects of Alignment during IT Investment Planning, IT Delivery, and IT Change," *Information Systems Research* (Forthcoming).

where it offers different levels of guest services via its mobile app. The mobile app improved customer experience and helped differentiate *Marriott* from its competitors (Kane 2017).

Appendix B: Characterizations of IT-Business Alignment in Prior Literature

Prior studies define IT-business alignment in many ways.² For example, IT-business alignment is defined as the degree of strategic fit and functional integration among business strategy, IT strategy, business infrastructure, and IT infrastructure (Henderson and Venkatraman 1999), and “the extent to which business strategies [are] enabled, supported, and stimulated by information strategies” (Broadbent and Weill 1993, p. 164). IT-business alignment is characterized as the “degree to which the mission, objectives, and plans contained in the business strategy are shared and supported by the IT strategy” (Reich and Benbasat 1996, p. 56) and the application of “IT in an appropriate and timely way and in harmony with business strategies, goals, and needs” (Luftman and Brier 1999, p. 109). More generally, IT-business alignment is the fit, balance, linkage, and integration between the business and IT (Chan and Reich 2007; Ray et al. 2007).

Prior work has broadly applied four lenses to categorize IT-business alignment (See Table B1). The first lens characterizes IT-business alignment in two types: intellectual (or strategic) alignment and social alignment. *Intellectual alignment* refers to the link between business strategy and plans, and IT strategy and plans (Reich and Benbasat 2000). *Social alignment* refers to the mutual understanding between IT and business executives of the business and IT mission and objectives (Reich and Benbasat 1996). Studies examine questions pertaining to the intellectual and social alignment dimensions such as the antecedents of social alignment (Preston and Karahanna 2009), and the antecedents and effects of strategic or social alignment on firm agility or performance (e.g., Liang et al. 2017; Tallon and Pinsonneault 2011; Wu et al. 2015).

A second lens characterizes IT-business alignment as strategic, operational, and cross-domain alignments (Henderson and Venkatraman 1999). *Strategic alignment* (like in the intellectual-social lens) refers to the alignment between business and IT unit strategic orientation (Benbya and McKelvey 2006; Chan et al. 1997). *Operational IT-business alignment* is the link between organizational infrastructure and processes and IS infrastructure and processes (Gerow et al. 2015). *Cross-domain IT-business alignment* refers to “the degree of fit and integration among business strategy, IT strategy, business infrastructure, and IT infrastructure” (Gerow et al. 2015, p. 4).

A third lens characterizes IT-business alignment at the project, process, sub-unit, organizational or individual levels (Chan and Reich 2007). At the *organizational level*, alignment refers to the match between IT and business strategies (Sabherwal and Chan 2001; Sabherwal et al. 2019). Alignment at the *project level* refers to the “degree to which an IS's project deliverables are consistent with the project's

² We refer the reader to extensive reviews or meta-analyses of IT-business alignment in the literature (e.g., Benbya et al. 2019; Chan and Reich 2007; Gerow et al. 2014; Leonard and Seddon 2012; Renaud et al. 2016; Tallon 2008).

objectives, which are shaped by the organization's IS strategy” (Jenkin and Chan 2010, p. 35). Alignment at the *process level* is the “fit between intra-process activities and IT use” (Tallon 2008, p. 229).

Individual alignment is the alignment between IS infrastructure and the user’s needs (Benbya and McKelvey 2006), and alignment at the sub-unit level matches organizational and sub-unit objectives (Ravishankar et al. 2011). Research on project level alignment argues for the complementarity of practices (e.g., commitment) to achieve alignment (Iden et al. 2012; Vermerris et al. 2014). Research employing the process view of IT-business alignment considers the consequences of process alignment such as its impacts on operational transformation (Siurdyban 2014), downstream value chain activities (Tallon 2012), or process level business value (Tallon et al. 2016).

A fourth lens characterizes IT-business alignment as internal alignment or external alignment. *Internal IT-business alignment* is the alignment of IT strategy and infrastructure with information systems strategy (i.e., the applications and information) within an organization, whereas *external alignment* refers to the alignment of the firm’s business and IT strategies with industry and technology forces (Chan and Reich 2007). This view of IT-business alignment recognizes the benefit of leveraging IT assets on an enterprise-wide basis to align with supply chains of customers or suppliers to overcome internal challenges and develop relationships with supply chain partners (Galliers 2004; Sledgianowski and Luftman 2005). We note that although the literature has used these four lenses to characterize IT-business alignment, the lenses are not necessarily orthogonal to each other. For instance, cross-domain alignment (between business infrastructure and IT infrastructure) when viewed on a firm-wide basis is an internal alignment at an organizational level.

Appendix Table B1. Key Categorizations of IT-business Alignment in Prior Literature

Categorization	Illustrative Definitions	Other Illustrative Literature
Intellectual (or Strategic) Alignment, Social Alignment	- "Intellectual dimension of alignment is defined as the state in which a high-quality set of interrelated IT and business plans exists" (Reich and Benbasat 2000, p. 82). - Intellectual (or strategic) alignment is "the link between business strategy and I/T strategy" (Gerow et al. 2015, p. 468).	(Preston and Karahanna 2009; Tallon and Pinsonneault 2011; Wu et al. 2015)
	- Social dimension is "the level of mutual understanding of and commitment to the business and IT mission, objectives, and plans" (Reich and Benbasat 1996, p. 58). - Social alignment is "the state in which business and IT executives with an organizational unit understand and are committed to the business and IT mission, objectives, and plans" (Reich and Benbasat 2000, p. 82).	(Gerow et al. 2014; Liang et al. 2017; Tan and Gallupe 2006; Wagner et al. 2014)
Strategic Alignment, Operational Alignment, Cross-domain Alignment	- Strategic alignment is the "alignment between IS strategy and business strategy" (Benbya and McKelvey 2006, p. 286). - IS Strategic alignment is "the alignment between business unit strategic orientation and IS strategic orientation" (Chan et al. 1997, p. 132).	(Chen et al. 2010; Sabherwal and Chan 2001)
	- Operational IT-business alignment is "the link between organizational infrastructure and processes and IS infrastructure and processes" (Gerow et al. 2015, p. 468).	(Benbya and McKelvey 2006; Henderson and Venkatraman 1999)
	- Cross-domain IT-business alignment refers to "the degree of fit and integration among business strategy, IT strategy, business infrastructure, and IT infrastructure" (Chan and Reich 2007, p. 300; Gerow et al. 2015, p. 468).	(Henderson and Venkatraman 1999)
Levels of Alignment: - Project - Process - Individual - Sub-unit - Firm	- Information system project alignment is "the degree to which an IS's project deliverables are consistent with the project's objectives, which are shaped by the organization's IS strategy" (Jenkin and Chan 2010, p. 35).	(Iden et al. 2012; Vermerris et al. 2014)
	- "Alignment in each process is modeled as the fit between intraprocess activities and IT use" (Tallon 2008, p. 229).	(Siurdyban 2014; Tallon 2012; Tallon et al. 2016)
	- Individual alignment is the "alignment between IS infrastructure and user's needs" (Benbya and McKelvey 2006, p. 286).	(Tan and Gallupe 2006)
	- Alignment between IT and business at the sub-unit level (Ravishankar et al. 2011).	
	- Alignment between IT and business at the firm level (Sabherwal and Chan 2001).	(Sabherwal et al. 2019; Yayla and Hu 2012)
Internal Alignment and External Alignment	- Internal IT business alignment is the alignment of IT strategy and infrastructure with information systems strategy (i.e., the applications and information) within an organization (Chan and Reich 2007).	(Galliers 2004; Henderson and Venkatraman 1992; Sledgianowski and Luftman 2005)
	- External alignment refers to the alignment of the firm's "business and IT strategies with industry and technology forces" (Chan and Reich 2007, p. 302).	
Stages of the IT lifecycle	- Stage of the IT lifecycle (IT investment planning, IT delivery, or IT change) where IT-business alignment is focused as the key priority.	This study

Note: This table is not meant to be exhaustive but just shows illustrative studies. The purpose is to capture key ways in which prior literature has categorized IT-business alignment and show how our study is different.

Appendix Table B2. Dynamic Capabilities Literature

Conceptual Papers		
Study	Definition/Explanation of Dynamic Capability	Key Arguments and/or Findings
Teece et al. (1997)	"The firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments" (p. 516). "The term 'dynamic' refers to the capacity to renew competences so as to achieve congruence with the changing business environment" (p. 515).	Dynamic capability refers to the sources and methods of innovation measured by internal technological, organizational, and managerial processes inside the firm.
Eisenhardt and Martin (2000)	"The firm's processes that use resources – specifically the processes to integrate, reconfigure, gain and release resources – to match and even create market change. Dynamic capabilities thus are the organizational and strategic routines by which firms achieve new resource configurations as market emerge, collide, split, evolve, and die" (p. 1107).	Dynamic capabilities are identifiable, specific processes such as product development, strategic decision making, and creating alliances. Dynamic capabilities are important in both high-velocity markets and moderately dynamic markets, where change occurs frequently but along predictable and linear paths. Dynamic capabilities are idiosyncratic in details and have commonalities across firms.
Zollo and Winter (2002)	"A dynamic capability is a learned and stable pattern of collective activity through which the organization systematically generates and modifies its operating routines in pursuit of improved effectiveness" (p. 340).	Dynamic capabilities are shaped by the coevolution of experience accumulation, knowledge articulation, and knowledge codification processes.
Winter (2003)	Dynamic capabilities are "those that operate to extend, modify, or create ordinary capabilities" (p. 991).	Dynamic capabilities contrast with ordinary capabilities by being concerned with change. Developing dynamic capabilities involves patterning of activity and making costly investments. If opportunities to change are sparse, then the cost of dynamic capabilities may not be matched by benefits.
Teece (2007)	"Dynamic capabilities can be disaggregated into (1) the capacity to sense and shape opportunities and threats, (2) to seize opportunities, and to maintain competitiveness through enhancing, combining, protecting, and when necessary reconfiguring the business enterprise's intangible and tangible assets" (p. 1319).	Dynamic capabilities enable business enterprises to create, deploy, and protect the intangible assets that support superior long-run business performance. Continuous alignment and realignment of specific tangible and intangible assets is one of the micro-foundations of dynamic capability.
Barreto (2010)	"A dynamic capability is the firm's potential to systematically solve problems, formed by its propensity to sense opportunities and threats, to make timely and market-oriented decisions, and to change its resource base" (p. 271).	Dynamic capabilities refer to distinct but related facets such as propensity to sense opportunities or threats, to make timely decisions, and to change the firm's resource base. There is a need for research on the boundary conditions under which dynamic capabilities are more relevant and beneficial for firms.
Empirical Papers – Dynamic Capabilities and Firm Performance		
Study	Context and Data	Key Arguments and/or Findings
Shamsie et al. (2009)	Data from seven studios in the Hollywood film industry from 1936 to 1965 to examine the influence of replication and renewal strategies within a project-based industry.	Replication and renewal strategies drive the development of dynamic capabilities and lead to higher return on sales.
Morgan et al. (2009)	108 U.S. firms operating in consumer and business markets offering both services and goods to examine market orientation and marketing capabilities' impact on firm performance.	Market orientation and marketing capabilities are complementary assets that contribute to superior firm performance.
Drnevich and Kriauciunas (2011)	192 business processes at 48 firms in Chile to test impact of IT-based ordinary and dynamic capabilities on relative firm performance.	Dynamic capabilities lead a greater performance when employed in dynamic environments, but are less effective than ordinary capabilities in more stable environments.
Schilke (2014)	302 firms in the chemicals, machinery, and motor vehicle industries, to examine the effects of two dynamic capabilities (alliance management capability and new product development capability) on competitive advantage under varying levels of environmental dynamism.	The relationship between dynamic capabilities and competitive advantage is strongest under intermediate levels of dynamism but comparatively weaker when dynamism is low or high.
Girod and Whittington (2017)	Top 50 U.S. firms between 1985 and 2004 to examine the impact of two forms of dynamic capabilities (organizational restructuring and reconfiguration) on firm performance.	Organizational restructurings are associated with positive firm performance, while reconfigurations are associated with negative firm performance. In dynamic environments, restructurings are less effective while reconfigurations are more positive.

Note: (1) Much text in this table is taken verbatim from the respective studies, to most accurately reflect the research. (2) This table is not meant to be exhaustive but just shows illustrative studies. We refer the reader to elaborate literature reviews and critiques on this topic (e.g., Barreto 2010; Di Stefano et al. 2014; Schilke et al. 2018; Teece 2014; Wang and Ahmed 2007). (3) Studies in each panel are listed in chronological order.

Appendix Table B3. Characterizations of IT-related Dynamic Capabilities in Prior Literature

Study and Type	IT-related Capability Characterized as or Related to Dynamic Capabilities	Key Arguments and Findings about IT and Dynamic Capabilities
Panel A: Broader IT Capabilities Literature using a Dynamic Capabilities Perspective		
Wheeler (2002); C	Net-Enablement is a dynamic capability. As a dynamic capability, net-enablement involves processing multiple concurrent innovations through an organization at any given time.	Four sequenced constructs explain a net-enabled business innovation cycle. These constructs are choosing enabling/emerging technologies, matching with economic opportunities, executing business innovation for growth, and assessing customer value.
Sambamurthy et al. (2003); C	IT competence, including IT investment level and IT capabilities such as IT infrastructure quality (global connectivity and reliability), IT human capital (technical and business skills), and IS/business partnerships	IT investment and capabilities influence firm performance through organizational dynamic capabilities (agility, digital options, and entrepreneurial alertness) and strategic processes (capability building, entrepreneurial action, and co-evolutionary adaptation).
Daniel and Wilson (2003); E	Ability to integrate new and existing IT systems without stifling innovation, tautly coupled e-business and corporate strategy formulation	Eight dynamic capabilities are identified that are necessary for e-business transformation. Two of these relate to IT (see left column); others are not IT related (e.g., rapid cycle of strategy development and implementation; ability to reconfigure sales/service process; ability to integrate new and existing channels; skill to develop and value business cases).
Wade and Hulland (2004); C	Information systems resources, broadly defined as IS assets and IS capabilities	IT resources may take on many attributes of dynamic resources and are particularly useful to firms operating in rapidly changing environments.
Bhatt and Grover (2005); E	IT capabilities (IT infrastructure quality, IT business expertise, and relationship infrastructure)	Superior IT capabilities enable firms to respond quickly to environmental threats and leverage opportunities. Intensity of organizational learning (dynamic capability) positively influences quality of IT infrastructure, IT business expertise, and relationship infrastructure. IT business experience and relationship infrastructure positively influence competitive advantage. Sample: 202 manufacturing firms in electronics, machinery and automobile, forest, home assembly and leather industries.
Pavlou and El Sawy (2006); E	IT leveraging competence in new product development (NPD)	IT leveraging competence in NPD enables NPD dynamic capabilities, which in turn enable NPD functional capabilities and competitive advantage. These relationships are moderated by environmental turbulence.
Banker et al. (2006); E	IT resources (resource planning systems, operations management systems, electronic data interchange systems) used in manufacturing plants	IT assets enable organizational routines and provide building blocks for business processes to form advanced manufacturing capabilities (i.e., dynamic capabilities), which in turn lead to improved plant performance.
Pavlou and El Sawy (2010); E	IT leveraging capability in new product development, comprising three digital IT systems (project and resource management systems, organizational memory systems, and cooperative work systems)	While dynamic capabilities are the primary predictor of competitive advantage in moderately turbulent environments, improvisational capabilities dominate in highly turbulent environments. The more the IT-leveraging capability caters to managing resources and team collaboration, the more it is positively associated with improvisational capabilities in more turbulent environment.
Kim et al. (2011); E	IT capabilities (IT personnel expertise, IT infrastructure flexibility, and IT management capabilities) influence process-oriented dynamic capabilities.	IT capabilities contribute indirectly to the financial performance of a firm by augmenting its process-oriented dynamic capabilities.
Lu and Ramamurthy (2011); E	IT capability comprised of IT infrastructure capability, IT business spanning capability, and IT proactive stance	IT capability is positively related to two types of organizational agility (market capitalizing and operational adjustment agility). There is a significant positive joint effect of IT capability and IT spending on operational adjustment agility, but not on market capitalizing agility.
Singh et al. (2011); CS	Remote patient monitoring and other such IT-enabled innovations in healthcare	Managers of home health agencies and similar health care organizations are able to improve quality of care and reduce costs by adopting remote patient monitoring and other IT-enabled innovations that facilitate dynamic allocation of clinical resources.
Roberts and Grover (2012); E	Web-based customer infrastructure, internal IS integration, external IS integration	IT facilitates the sensing and responding components of customer agility and thereby impacts competitive advantage. Sample: Survey data from 108 high-tech firms.

Study and Type	IT-related Capability Characterized as or Related to Dynamic Capabilities	Key Arguments and Findings about IT and Dynamic Capabilities
Chakravarty et al. (2013); E	IT infrastructure (capturing the quality of IT assets), and IT capabilities (e.g., technical skills, IT-related knowledge, IT human resources)	IT competences lead to firm agility which in turn leads to improved firm performance. These effects are moderated by environmental dynamism. IT competences create dynamic capabilities (e.g., entrepreneurial agility) directly and also activate those capabilities for competitive actions.
Lee et al. (2015); E	IT ambidexterity (i.e., the dual capacity to explore and exploit IT resources and practices)	IT ambidexterity enhances organizational agility by facilitating operational ambidexterity, and the magnitude of facilitation is greater in higher levels of environmental dynamism.
Roberts et al. (2016); E	Managerial use of IS (routine use and innovative use)	Routine IS use is not related to volume or diversity of ideas for organizational innovation, while innovative IS use is positively related to idea volume and diversity. Organizational autonomy and innovativeness positively moderate the innovative use/idea relationships.
Park et al. (2017); E	Business intelligence and communication technologies	Business intelligence and communications technologies and organizational and environmental factors embedded in configurations provide firms with sensing agility, decision-making agility, and acting agility.
Panel B: Prior IT Alignment Literature using a Dynamic Capabilities Perspective		
Chen et al. (2008); CS	Alignment between IT strategy and business strategy	From an executive management view, the alignment process can be regarded as a set of dynamic capabilities that leverage IT to shape and support the firm's business strategies. From an IT perspective, the development process of IT can be seen as a dynamic capability that reconfigures specific IT assets to support other core resources.
Schwarz et al. (2010); E	IT alignment	IT alignment is a firm-specific dynamic capability, fostering resource complementarity between IT and business resources, thereby impacting the strategic and operational success of the firm.
Baker et al. (2011); E	Strategic IT alignment (alignment of IT strategy with business strategy)	Strategic IT alignment is a dynamic organizational competency. The study conceptualizes and develops a measure of dynamic strategic alignment competency encapsulating degree of alignment, firm's history of alignment, and maturity of business processes.
Liang et al. (2017); E	Intellectual alignment, social alignment	Intellectual alignment and social alignment influence agility (a dynamic capability) by impacting inertia and emergent coordination.
Yeow et al. (2018); CS	IT and business alignment	Aligned actions contributed to the organization's sensing, seizing, and transforming capacities. Aligned actions iteratively reconfigured organizational resources and refined strategy in order to respond to both changes in the environment and internal tensions.
Panel C: This Study		
This study; E	IT-business alignment at the IT delivery stage (ITDA), IT-business alignment at the IT change stage (ITCA)	ITDA and ITCA are more effective dynamic capabilities than ITPA because they enable the firm to adapt to changes that occur after the planning stage. Hence, the effect of IT investment on firm revenue is stronger for firms focused on ITDA or ITCA than for firms focused on ITPA.

Notes: (1) Much of the text in this table is taken verbatim from the respective studies, to most accurately reflect the research. (2) This table is not meant to be exhaustive but just shows illustrative studies. (3) Abbreviations: C: Conceptual study; CS: Case study; E: Empirical study. (4) Studies within each panel are listed in chronological order.

Appendix C: Detailed Description of Variables

Concept	Variable name	Definition/Operationalization
Firm Revenue	<i>REVENUE</i>	Firm's total turnover (Rupees)
Firm IT Investment	<i>ITINVEST</i>	Firm's total IT spending (Rupees) across all sites
Firm's focus on IT investment planning alignment as the key priority	<i>ITPA</i>	IT investment is aligned with business strategy
Firm's focus on IT delivery alignment as the key priority	<i>ITDA</i>	IT delivery is aligned with business priorities
Firm's focus on IT change alignment as the key priority	<i>ITCA</i>	IT change is aligned with business change
Hardware Investment	<i>HWINVEST</i>	A firm's IT spending on hardware (Rupees). Hardware includes PC/notebook, servers, enterprise storage, hard copy peripherals (e.g., printers/MFD/scanners), network equipment, and RFID
Software Investment	<i>SWINVEST</i>	A firm's IT spending on software (Rupees). Software includes system infrastructure software, application development and deployment tools, and application solutions.
IT Services Investment	<i>SERVICEINVEST</i>	A firm's IT spending on IT service (Rupees). IT service includes consulting and system integration, information system outsourcing, desktop and network outsourcing, and maintenance and support services.
Software and Services Investment	<i>SWSERVICEINVEST</i>	Summation of SWINVEST and SERVICEINVEST
Firm Size	<i>SIZE</i>	Total number of employees in the firm
Industry	<i>MFG</i>	Whether firm belongs to manufacturing or service sector (Manufacturing = 1, Services = 0).
Legal Status	<i>PRIVATE</i>	Whether legal status of firm is private company/multinational owned foreign subsidiary or government department/public sector (Private = 1, Public = 0).
ROI Calculations Before IT	<i>ROI CalcBefore</i>	Do you do ROI calculation before going for any IT investment? (0 = No; 1 = Yes)
Operational View of IT	<i>ITInvOperational</i>	Are IT investments viewed as strategic investments or operational benefits? (0 = Strategic; 1 = Operational)
Frequency of Update of IT plan	<i>ITPlanUpdateFreq</i>	How frequently is the IT strategy plan updated? 0 = Never; 1 = Once in five years; 2 = Once in three years; 3 = Once in two years; 4 = Once in a year; 5 = Once in half a year; 6 = Once in a quarter;
Industry Benchmarking Before IT	<i>IndBenchBefore</i>	Do you refer to any industry benchmark before going for any major IT investment? (0 = No; 1 = Yes)

Appendix D: Supplementary Analyses and Robustness Tests

Appendix Table D1. First Stage of Heckman Model

	(1) <i>ITDCA</i>
<i>ln(ITINVEST)</i>	0.007 (0.100)
<i>ln(SIZE)</i>	-0.068 (0.126)
<i>MFG</i>	-0.293 (0.269)
<i>PRIVATE</i>	-0.518 (0.369)
<i>ROIcalcBefore</i>	-0.590** (0.257)
<i>ITInvtOperational</i>	1.142*** (0.293)
<i>ITPlanUpdateFreq</i>	0.135 (0.121)
<i>IndBenchBefore</i>	-0.659** (0.264)
<i>Constant</i>	0.548 (1.784)
Observations	122
Chi-square	32.428***

Notes: (1) Heteroskedasticity-consistent robust standard errors in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$.

(3) Dependent variable is defined as $ITDCA = 1$ if either $ITDA = 1$ or $ITCA = 1$; $ITDCA = 0$ otherwise.

(4) Probit model used for estimation.

Appendix Table D2. Accounting for Endogeneity of ITDA and ITCA (Heckman Two-stage Model)

	Dependent Variable is: $\ln(\text{REVENUE})$		
	(1)	(2)	(3)
$\ln(\text{ITINVEST})$	0.325*** (0.107)	0.335*** (0.111)	0.034 (0.100)
<i>ITDA</i>		-1.486** (0.655)	-10.895** (4.347)
<i>ITCA</i>		-1.571** (0.780)	-12.235** (4.677)
$\ln(\text{ITINVEST}) \times \text{ITDA}$			0.556** (0.253)
$\ln(\text{ITINVEST}) \times \text{ITCA}$			0.612** (0.274)
$\ln(\text{SIZE})$	0.063 (0.145)	-0.066 (0.133)	-0.047 (0.116)
<i>MFG</i>	-0.055 (0.322)	-0.044 (0.350)	-0.006 (0.331)
<i>PRIVATE</i>	-1.444** (0.559)	-1.476** (0.627)	-1.311** (0.577)
<i>Inverse Mills Ratio</i>	-0.143 (0.204)	0.758* (0.417)	0.677 (0.415)
<i>Constant</i>	17.963*** (1.604)	19.556*** (1.858)	24.432*** (1.745)
Observations	141	122	122
R-squared	0.197	0.241	0.295

Notes:

(1) Heteroskedasticity-consistent robust standard errors in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$

Appendix Table D3. Accounting for Endogeneity: Propensity Score Matching (PSM)

	Dependent Variable is: $\ln(\text{REVENUE})$			
	(1)	(2)	(3)	(4)
	OLS	OLS-PSM	OLS	OLS-PSM
$\ln(\text{ITINVEST})$	0.129 (0.110)	0.088 (0.095)	0.154 (0.111)	0.109 (0.367)
<i>ITDA</i>	-7.760* (4.005)	-8.444** (3.680)		
<i>ITCA</i>			-9.641** (4.282)	-8.029 (4.736)
$\ln(\text{ITINVEST}) \times \text{ITDA}$	0.416** (0.240)	0.491** (0.224)		
$\ln(\text{ITINVEST}) \times \text{ITCA}$			0.507** (0.246)	0.506** (0.274)
$\ln(\text{SIZE})$	-0.013 (0.126)	0.130 (0.182)	-0.068 (0.108)	-0.276 (0.325)
<i>MFG</i>	0.054 (0.352)	0.431 (0.342)	0.559 (0.445)	1.248 (1.082)
<i>PRIVATE</i>	-0.924 (0.608)	0.103 (1.338)	-2.072*** (0.461)	-3.361*** (1.089)
<i>Constant</i>	21.749*** (1.839)	19.622*** (1.833)	22.395*** (1.766)	23.725*** (5.408)
R-Square	0.210	0.156	0.364	0.563
Observations	114	98	74	23

Notes: (1) Heteroskedasticity-consistent robust standard errors in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$ (One-tailed test for interaction variables, two-tailed test for other variables).

(3) Abbreviations used: OLS: Ordinary Least Squares, PSM: Propensity Score Matching.

Appendix Table D4. Supplementary Analysis (Software and Service Investments)

	Dependent Variable is: $\ln(REVENUE)$			
	(1)	(2)	(3)	(4)
	OLS	OLS	OLS	2SLS
$\ln(SWSERVICEINVEST)$	0.310*** (0.095)	0.325*** (0.107)	0.129 (0.117)	0.088 (0.115)
<i>ITDA</i>		-0.619 (0.380)	-6.921* (3.966)	-8.415** (4.176)
<i>ITCA</i>		-0.646 (0.650)	-8.649** (4.006)	-12.351** (5.636)
$\ln(SWSERVICEINVEST) \times$ <i>ITDA</i>			0.385* (0.248)	0.475** (0.263)
$\ln(SWSERVICEINVEST) \times$ <i>ITCA</i>			0.471** (0.248)	0.687** (0.342)
$\ln(SIZE)$	0.070 (0.143)	-0.014 (0.131)	-0.016 (0.123)	-0.025 (0.124)
<i>MFG</i>	0.031 (0.326)	0.076 (0.361)	0.121 (0.351)	0.156 (0.339)
<i>PRIVATE</i>	-1.552*** (0.539)	-1.542** (0.650)	-1.449** (0.617)	-1.393** (0.577)
<i>Constant</i>	18.421*** (1.415)	19.078*** (1.815)	22.275*** (1.875)	22.969*** (1.742)
R-Square	0.186	0.212	0.241	0.238
Observations	144	124	124	122

Notes: (1) Heteroskedasticity-consistent robust standard errors in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$ (One-tailed test for interaction variables, two-tailed test for other variables).

(3) Abbreviations used: OLS: Ordinary Least Squares, 2SLS: Two-stage Least Squares

(4) Like in our main results, tests suggested that our instrument variables (hardware investments and industry average IT investments per employee) used for 2SLS estimations are valid instruments for endogenizing software and service investment.

Appendix Table D5. Supplementary Analysis (Separating Software Investment and Service Investment)

	Dependent Variable is: $\ln(\text{REVENUE})$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	OLS	OLS	OLS	2SLS	OLS	OLS	OLS	2SLS
$\ln(\text{SWINVEST})$	0.253*** (0.094)	0.247** (0.109)	0.095 (0.129)	0.093 (0.114)				
$\ln(\text{SERVICEINVEST})$					0.319*** (0.090)	0.331*** (0.099)	0.111 (0.103)	0.078 (0.117)
ITDA		-0.619 (0.395)	-5.202 (3.811)	-8.037** (4.139)		-0.693* (0.382)	-7.258** (3.524)	-8.190** (3.972)
ITCA		-0.543 (0.673)	-5.440* (2.893)	-11.290** (5.584)		-0.648 (0.635)	-10.476** (4.659)	-11.197** (4.961)
$\ln(\text{SWINVEST}) \times \text{ITDA}$			0.292 (0.249)	0.476** (0.270)				
$\ln(\text{SWINVEST}) \times \text{ITCA}$			0.302* (0.198)	0.656** (0.352)				
$\ln(\text{SERVICEINVEST}) \times \text{ITDA}$							0.421** (0.232)	0.481** (0.263)
$\ln(\text{SERVICEINVEST}) \times \text{ITCA}$							0.610** (0.296)	0.655** (0.322)
$\ln(\text{SIZE})$	0.107 (0.146)	0.035 (0.138)	0.044 (0.131)	-0.024 (0.128)	0.075 (0.141)	0.005 (0.132)	-0.005 (0.122)	-0.003 (0.125)
MFG	-0.002 (0.338)	0.040 (0.376)	0.086 (0.371)	0.239 (0.355)	-0.033 (0.328)	-0.008 (0.366)	0.013 (0.355)	0.014 (0.340)
PRIVATE	-1.571*** (0.557)	-1.585** (0.671)	-1.532** (0.650)	-1.479** (0.601)	-1.500*** (0.536)	-1.459** (0.647)	-1.288** (0.603)	-1.278** (0.566)
Constant	19.270*** (1.372)	20.201*** (1.789)	22.516*** (1.912)	22.954*** (1.650)	18.506*** (1.383)	19.131*** (1.696)	22.547*** (1.691)	23.040*** (1.704)
R-Square	0.170	0.190	0.205	0.188	0.197	0.228	0.272	0.271
Observations	142	122	122	120	140	120	120	119

Notes: (1) Heteroskedasticity-consistent robust standard errors in parentheses.

(2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$ (One-tailed test for interaction variables, two-tailed test for other variables).

(3) Abbreviations used: OLS: Ordinary Least Squares, 2SLS: Two-stage Least Squares

(4) Like in our main results, tests suggested that our instrument variables (hardware investments and industry average IT investments per employee) used for 2SLS estimations are valid instruments for endogenizing software and service investment.

Appendix Table D6. Supplementary Analysis (Using LATESTAGE as a Moderator)

	Dependent Variable is: $\ln(\text{REVENUE})$				
	(1)	(2)	(3)	(4)	(5)
	OLS	2SLS	LIML	GMM	OLS-PSM
$\ln(\text{ITINVEST})$	0.131 (0.113)	0.084 (0.117)	0.084 (0.117)	0.095 (0.112)	0.160* (0.089)
<i>LATESTAGE</i>	-8.097*** (3.395)	-8.870*** (3.406)	-8.872*** (3.406)	-8.671*** (3.346)	-8.060** (3.092)
<i>LATESTAGE</i> × $\ln(\text{ITINVEST})$	0.435*** (0.201)	0.479*** (0.203)	0.479*** (0.203)	0.468*** (0.199)	0.450*** (0.184)
$\ln(\text{SIZE})$	-0.023 (0.144)	-0.011 (0.140)	-0.011 (0.140)	-0.026 (0.138)	-0.047 (0.192)
<i>MFG</i>	0.156 (0.349)	0.145 (0.340)	0.145 (0.340)	0.155 (0.333)	0.316 (0.333)
<i>PRIVATE</i>	-1.308** (0.580)	-1.303** (0.558)	-1.303** (0.558)	-1.319** (0.536)	-1.022 (0.786)
<i>Constant</i>	22.066*** (1.793)	22.789*** (1.797)	22.790*** (1.798)	22.745*** (1.753)	21.124*** (1.716)
R-squared	0.256	0.255	0.255	0.255	0.208
Observations	125	122	122	122	124

Notes:

- (1) Heteroskedasticity-consistent robust standard errors in parentheses.
- (2) *** $p < 0.01$, ** $p < 0.05$, * $p < 0.10$ (One-tailed test for interaction terms).
- (3) Abbreviations used: OLS: Ordinary Least Squares, 2SLS: Two-stage Least Squares, LIML: Limited Information Maximum Likelihood, PSM: Propensity Score Matching.

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