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Resilience through Technology Intensity and International Related Management Experience: An Explorative Examination of European Firms during the COVID-19 Crisis

Naser Shekarian
University of Colorado Denver, naser.shekarian@ucdenver.edu

Ronald Ramirez
University of Colorado Denver, ronald.ramirez@ucdenver.edu

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Research-in-Progress

Naser Shekarian
Information Systems, Business School,
University of Colorado Denver
1475 Lawrence St.,
Denver, CO, 80202, USA
naser.shekarian@ucdenver.edu

Ronald Ramirez
Information Systems, Business School,
University of Colorado Denver
1475 Lawrence St.,
Denver, CO, 80202, USA
ronald.ramirez@ucdenver.edu

Abstract

Recovering from disruption and responding to a crisis is becoming a major concern for firms, especially during the COVID-19 pandemic. Prior research suggests that in the presence of uncertainty and disruption, resilience is influential in retaining performance. Less is known, however, about how organizational and technological factors come together to build a resilient firm. Using organizational information processing theory (OIPT), our study helps to fill this gap by examining the interplay between technology intensity and international related management experience to build a resilient mechanism. The empirical findings show this resilience mechanism can strengthen business performance during times of crisis. Moreover, further analysis provides new insights based on the scope of a firm's market, supply dependency, and its business sector. Specifically, the interaction of technology intensity with international related management experience makes a greater impact on the performance for firms that are operating and selling their products or services internationally, have more dependency on an international supply, and service firms. Our findings support the complementary role of international related management experience to build a resilient firm and provide managerial insights for crisis response strategies.

Keywords: International related management experience, resilient firm, technology intensity

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Introduction

A firm's environment can create unique challenges of different forms, from within and outside of its boundary. A natural disaster, political conflict, economic recession, equipment failure, and human error are just a few of the countless factors that can undermine the stability and viability of a firm and its environment (Sawalha 2015). Moreover, firms today operate in a world that is increasingly interconnected both socially and technologically. Consequently, it is even more difficult for a firm to resist shock, impact, and disaster while maintaining a competitive position (Annarelli and Nonino 2016). The COVID-19 crisis in both its instancy and geographic scope uniquely disrupted global business. Almost overnight, firms were grappling to serve customers, maintain regular operations, and deal with financial uncertainty. Similarly, the global supply chain was impacted significantly due to new national health conditions, border lockdowns, and changing modes of work (Gu, Yang, and Huo 2021; Ivanov 2020). Many firms experienced material delays as well as a shortage of production and service workers. Through stockouts and price pressure, these upstream disruptions had and continue to have negative implications across many industries. While interconnected and outsourced global supply chains provided price efficiency prior to the COVID-19, the crisis forced firms to look inwardly to organizational resources or to available alternative sources when developing a response (Kumar et al. 2020). Resiliency can enable a firm to cope effectively with a crisis and respond through building organizational capabilities (Sawalha 2015). Resiliency is the ability of a firm to anticipate, prepare, respond, and recover from a shock once it occurs (Annarelli Nonino 2016). Prior research shows that in times of crisis, a firm with resilient business models can perform better as compared to a non-resilient firm (Gu, Yang, and Huo 2021; Wong et al. 2020). A resilient firm is able to respond effectively and retain performance by relying on resources and structures that promote competencies and capabilities. These capabilities and competencies, in turn, help a firm to enlarge information processing and facilitate change management (Vogus and Sutcliffe 2007), two factors critical during times of disruption.

Technological capabilities play a critical role in building resiliency. IT provides capabilities to store, share, and disseminate information across a firm. Moreover, IT brings new possibilities for the way information is applied within a firm. IT facilitates organizational change through its ability to enable various dimensions of change including agility, flexibility, collaboration, and information integration (Swafford, Ghosh, and Murthy 2008; Tuanmat and Smith 2011). Moreover, in the era of pervasive digitization, where digital technologies are embedded into a wide range of products and services, the role of technology in organizational change is increasing. Adopting digital based organizational change represents a technology based solution for building a resilient firm during times of crisis. This is crucial as resilient firms need to sense market changes and process information effectively to maintain performance in uncertain times. Technology based resiliency enables a firm to acquire information processing capabilities and allows it to informate key processes like those in a product supply chain (Gu, Yang, and Huo 2021). Dubey et al. (2017), for example, show that technological capabilities are an important organizational asset that can lead to higher visibility in the supply chain, and in turn, impact supply chain performance like a reduction in inventory lead time.

Literature also highlights the role of top management and their international related experience on firm performance. According to Bouquet, Morrison, and Birkinshaw (2009), top executives with prior experience in international and prominent firms can sense new changes in the business environment and make informed strategic responses. Carpenter, Sanders, and Gregersen (2000) show that management with international experience benefits a firm in two ways; (1) substantive, as a manager with international experience has more knowledge of a firm's operations and competitive position and can help other

executives to think globally, and (2) symbolic, serving as a role model and inspiring employees. Nielsen (2010) also highlights that top management with international experience, through a broader vision and knowledge of institutional and strategical factors, can facilitate the internationalization process and improve firm financial performance.

While these studies are informative, there is a need to reexamine the role of technology and international related management experience in the resilience of firms during times of crisis, especially given the uniqueness of the global business environment created by the COVID-19 pandemic. In addition, while technology offers an opportunity to maintain information flows and transparency across global supply chains, decisions in times of crisis like COVID-19 become non-routine. As such, the importance of management decision makers may increase as their experience can provide essential knowledge for analyzing and interpreting information for critical business decisions (Hsu, Chen, and Cheng 2013). Especially during times of uncertainty, top executives are dealing with far more information than they are able to process and handle. As such, top executives need to be selective and efficient in information processing and interpretation. In times of significant global uncertainty and disruption, we argue that international related management experience can allow a firm to harness the interconnectedness of technology and turn information into actionable insights. Together, the combination of international related management experience and technology builds a mechanism of resilience for firms. In this study, we thus examine: How does technology and international related management experience affect the performance of a firm during a crisis? To examine this question, we turn to the theory of organizational information processing (OIPT) to develop a framework of the synergistic benefits of international related management experience and technology (Smith et al. 1991). OIPT informs how technology affects organizational processes through the lens of information and its role and effect on organizational behavior and decision making (Smith et al. 1991). A firm needs to acquire information processing capability to deal with unforeseen uncertainties in an institutional environment. OIPT helps to frame how a firm can reduce uncertainty in decision making through acquiring a capability to integrate, process, and analyze different sources of information in a timely manner. OIPT has a long history of application in IT and organization research (Chou et al. 2007; Joseph and Gaba 2020; Smith et al. 1991).

We examine our theoretical framework through an empirical analysis of a cross-sectional dataset of 1,287 European firms across three countries that are important trading partners (Belgium, Netherlands, and Luxembourg). The advanced logistics infrastructure and multinational business environment of Belgium makes it a suitable context for our study. Belgium is also among the top ten counties for imports from the U.S. and operates the 13th largest port in the world (2nd biggest in Europe). The U.S. Department of Commerce also considers Belgium among the top five most important international trading partners (International Trade Administration 2020). Netherlands is Belgium's third largest import and export trading partner. Also, Netherlands and Belgium are among Luxembourg's top four trading partners (WITS 2020[1]). Ordinary least squares results provide support for our hypotheses, indicating that technology intensity and international related management experience positively impact firm performance during times of crisis. Moreover, these critical inputs combine to positively impact firm performance during times of crisis. Also, this complementarity is stronger for firms with an international scope and for service firms, as compared to manufacturing and retail firms. Our study shows human capital is a critical complement to technology and extends research on the role of technology (Dong, Xu, and Zhu 2009; Gu, Yang, and Huo 2021; Piaskowska et al. 2021; Rai, Patnayakuni, and Seth 2006) and management experience (Hsu, Chen, Cheng 2013; Nielsen 2010; Rodenbach and Brettel 2012) in times of crisis. In addition, how both factors can combine to create a resilient mechanism (Wong et al. 2020), providing a new perspective for developing resilience strategies for crisis preparedness and response.

Hypothesis Development

Technology Intensity

Technology intensity refers to the depth of technology that exists in a firm and supply chain processes from within both upstream and downstream channels (Gu, Yang, and Huo 2021). Prior studies suggest that information technology (IT) positively impacts a firm and its supply chain performance through several

[1] https://wits.worldbank.org/

mechanisms; (1) coordination, (2) information sharing, and (3) transparency. Firstly, through embedded technology, IT facilitates the coordination of processes and activities in a firm; a capability that is difficult to imitate. In turn, coordination enables a firm to leverage its resources, create synergy in the supply chain, build efficient internal and external communications capabilities, and ultimately achieve its business goals (Huo, Zhang, and Zhao 2015; Prajogo and Olhager 2012). Secondly, IT can improve information sharing capability within a firm and its supply chain; a capability that reduces uncertainty and provides informed and fast decision making in times of crisis. In other words, IT enables a firm to process a vast amount of information in real-time, extract and disseminate actionable insights across the supply chain, and track supply chain activities efficiently. As a result, supply chain partners will have access to more information with higher accuracy in a shorter time (Dubey et al. 2017). Thirdly, IT improves information transparency in a firm and its supply chain. Transparency provides shared understanding and access to information for supply chain partners. Transparency is an essential capability in times of crisis, as transparency helps a firm to reduce the impact of unprecedented disruptions. Also, within a transparent supply chain, a firm can proactively plan for potential disruption, respond effectively, and ultimately reduce associated risks (Brandon-Jones et al. 2014). During times of crisis, a firm needs to make swift decisions, act quickly, and share information efficiently. As IT can improve the performance of a firm and its supply chain through coordination, information sharing, and transparency, we hypothesize:

H1: During a crisis, a higher level of technology intensity is associated with an increase in firm performance.

International Related Management Experience

Management international related experience enables a firm to swiftly exploit, acquire, and organize resources so that regional boundaries are not barriers to product and service development, business opportunities, or manufacturing locations. Moreover, management international related experience, through providing more knowledge on multinationals' foreign employees, market, competitors, and customers, helps a firm to develop the capabilities necessary to consistently profit from global uncertainties created as a result of a crisis, exchange rates, governmental policies, or competition changes (Carpenter, Sanders, and Gregersen 2000). In times of significant uncertainty, a firm's current business model and level of performance is challenged. To adapt appropriately, firms need to develop a mechanism to sense changes in the competitive landscape, identify customer needs, and understand the new product and service marketplace to develop new strategies (Azam, Boari, and Bertoltti 2018; Rodenbach and Brettel 2012). Management must also be able to process information to design and adjust their operational and interorganizational processes to meet the demands of any new supply chain requirements (Carpenter, Sanders, and Gregersen 2001; Hsu, Chen, and Cheng 2013). Such as is the case currently with COVID-19 and the global supply chain. During the early stages of the pandemic, the global shutdown started a chain of events that led to global inventory shortages from toilet paper to computer chips.[2] Consistent with literature (Azam, Boari, and Bertolotti 2018; Dencker and Gruber 2015; Hsu et al. 2013; Piaskowska et al. 2021), global supply chain managers with international experience have been able to evaluate and respond to the crisis by finding new sources for parts and supplies, create partnerships with multiple suppliers, and generally adopted a more risk adverse supply chain strategy.[3] Therefore, we hypothesize:

H2: During a crisis, management with international related experience is associated with a higher firm performance.

Resilience through International Related Management Experience and Technology Intensity

We expect that the interplay between management with international related experience and technology intensity can build a resilient mechanism. Literature identifies human capital, through its tacit knowledge, and technology enabled capabilities are complements that can contribute to higher levels of performance (Carpenter, Sanders, and Gregersen 2001; Siqueira and Fleury 2011). Moreover, specialized human capital

[2] https://www.washingtonpost.com/national/coronavirus-toilet-paper-shortage-panic/2020/04/07/1fd30e92-75b5-11ea-87da-77a8136c1a6d_story.html, https://www.bloomberg.com/news/articles/2021-08-23/chip-shortage-set-to-worsen-as-covid-rampages-through-malaysia

[3] https://harbert.auburn.edu/news/supply-chain-post-covid.html

is a necessity today given the evolution of globally integrated business models arising out of the internet and digitization technology eras. As such, the international experience of a firm's management is critical for processing and analyzing information from multiple cultures and for effectively overseeing business operations across the globe (Dyke, Fischer, and Reuber 1992; Hsu, Chen, and Cheng 2013). However, technology is just as important; without an appropriate technological infrastructure and applications, management may not be able to capture and access appropriate information, analyze that information to inform actionable insights, and implement change within a firm and its global supply chain, especially in limited time frames (Brandon-Jones et al. 2014; Prajogo and Olhager 2012). This, we argue, is especially the case during times of crisis. In sum, we hypothesize:

H3: *Technology intensity and international related management experience complement each other for higher performance during a crisis*.

Hypotheses 1-3 are illustrated in the research model found in Appendix A, Figure A1.

Methodology

Data and Variables

The primary data for this study comes from a survey conducted during the COVID-19 crisis by a reputable international financial institution with a worldwide presence, on European firms across three countries (Belgium, Netherlands, and Luxembourg). Examining these contiguous neighbors (Netherlands and Luxembourg) can lead to new insight on the role of technology and management experience in organizational performance for an appropriate response during acute stages of a crisis. Belgium has one of the most globalized and advanced logistics infrastructures as is among the top six countries based on the logistics performance index (Van Steenkiste 2020). Netherlands and Luxembourg match well with Belgium and contribute to the study as Netherlands is Belgium's third largest import and export trading partner. Also, Netherlands and Belgium are among Luxembourg's top four trading partners (WITS 2020).

Table 1 lists our study variables. The dependent variable in our study is firm sales during the COVID-19 crisis in 2020 (*LTotSales*). Technology intensity (*TechIntst*) reflects the level of technologies used in product and service planning, procurement, and supplier chain management. International related management experience represents the experience of a high-level manager within a multinational or prominent firm (*MgmtIntExp*). We control for firm size by using number of employees (*NoOfEmpl*) and firm enterprise size (*MultiEstSz*). We use *manufacturing* and *retail* dummies to control for firm industry sectors. We control for the international supply chain through the percentage of domestic supply (*DomSupPerc*) and international market (*IntMkt*) as global supply chains were critically impacted during the COVID-19 pandemic. Research and development investment (*LR&DInvt*) and competition intensity (*CompIntst*) variables control for competition and R&D investment. Table 2 provides the descriptive statistics and correlation amongst variables. All correlations above the absolute value of 0.1 are significant at the 0.01 level. The correlation between total sales (*LTotSales*) as the dependent variable and technology intensity (*TechIntst*) as the independent variable is 0.39. However, since the value of VIF test is 1.35 at the highest, multicollinearity should not be a concern (Wooldridge 2016). A detailed description of variables is available in Appendix B, Table B1.

Table 1. Description of Variables

Variable	Description
Logarithm of Total Sales (LTotSales)	The logarithm of firm total sales in dollars during 2020.
Technology Intensity (TechIntst)	It demonstrates the level of technology that exists within a firm supply chain, planning product/service provision, and procurement management.
Management International Related Experience (MgmtIntExp)	If top management has prior experience in a multinational firm or in a prominent firm: 1=Yes; 0=No.
Multi-Established Size (MultiEstSz)	The size of the multi-establishment firm.
Logarithm of R&D Investment (LR&DInvt)	The logarithm of total monetary amount spent on research and development in 2019.

Competition Intensity (CompIntst)	The square number of firm competitors in million.
Domestic Supply Percentage (DomSupPerc)	The percentage of firm supply of raw materials, inputs, and finished goods purchased from domestic sources in 2020.
Number of Employees (NoOfEmpl)	The total number of firm full-time employees in thousands.
International Market (IntMkt)	If firm is operating and selling its products or services in an international market: 1=Yes; 0=No.
Service Sector (Svc)	If firm sector type is service: 1=Yes; 0=No.
Retail Sector (Retail)	If firm sector type is retail: 1=Yes; 0=No.

Table 2. Descriptive Statistics and Correlation Matrix (n= 1,287)

	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10
LTotSales	15.07	1.70	9	21	1.00									
TechIntst	4.32	1.80	2	8	0.39	1.00								
MgmtIntExp	0.35	0.48	0	1	0.17	0.16	1.00							
MultiEstSz	8.14	53.35	1	996	0.14	0.05	0.02	1.00						
LR&DInvt	3.99	5.44	0	17	0.28	0.25	0.13	0.01	1.00					
CompIntst	0.91	2.14	0	28	-0.11	-0.09	-0.04	0.00	-0.09	1.00				
DomSup	53.88	38.71	0	100	-0.20	-0.19	-0.10	0.00	-0.13	0.06	1.00			
NoOfEmpl	0.06	0.38	0	12	0.27	0.13	0.03	0.07	0.13	-0.02	-0.01	1.00		
IntMkt	0.23	0.42	0	1	0.30	0.16	0.15	-0.01	0.30	-0.02	-0.21	0.11	1.00	
Svc	0.41	0.49	0	1	0.07	-0.07	0.05	-0.01	-0.05	0.08	0.04	-0.02	-0.07	1.00
Retail	0.19	0.40	0	1	-0.15	-0.06	-0.12	0.08	-0.21	0.03	0.05	-0.05	-0.20	-0.38

Note: all correlations above the absolute value of 0.1 are significant at the 0.01 level.

Estimation Equation

We estimate the following ordinary least squares (OLS) specification in our analysis (Wooldridge 2016):
$Y_i = \boldsymbol{X_i}\beta + \varepsilon_i$ (1),

where Y represents the dependent variable (logarithm of the total sales), $\boldsymbol{X}$ represents a vector of an independent or control variable, such as technology intensity or competition intensity, and β is a vector of parameters to be estimated, and ε is the error term associated with each observation i. The result of Breusch-Pagan and White's test led to the rejection of the null hypothesis. Therefore, in the presence of heteroscedasticity, we use robust regression to estimate our models. Multicollinearity was calculated using variance inflation factor (VIF), which showed a value of less than 1.5 across all models. Therefore, multicollinearity should not be a concern. Additionally, TechIntst was mean-centered prior to calculating the interaction terms (Wooldridge 2016). A set of additional analyses were conducted for robustness checks and further insights.

Results

The first two columns in Table 3 show the estimation results for direct and interaction effects of *TechIntst* and *MgmtIntExp* on *LTotSales*. Column 1 shows that *TechIntst* (Table 3, column 1, β= *0.263, p<0.01*) and *MgmtIntExp* (Table 3, column 1, β= *0.206, p<0.05*) have positive and significant direct effect on *LTotSales*. **Therefore, hypotheses H1 and H2 are supported** suggesting a higher level of technology intensity and having a top manager with prior international related experience are associated with an increase in performance during a crisis. Column 2 shows the result for the interaction effect. The interaction effect of *TechIntst* and *MgmtIntExp* is significant and positive on *LTotSales* (Table 3, column 2, β= *0.186, p<0.05*). **The result supports hypothesis H3** and suggests that management with international related experience complement technology for a higher level of performance during a crisis. We perform a robustness check to examine if this complementarity contributes to differential performance impacts among firms by comparing pre-crisis and crisis stages. Columns 3 and 4 show the interaction effect of *TechIntst* and *MgmtIntExp* for the sample of firms that improved sales during the COVID-19 crisis as compared to 2019 and the sample of firms where sales declined or remained the same. To test whether the

interaction coefficients are comparable, we followed McDowell (2005) and multiplied *TechIntst×MgmtIntExp* with *Sales Growth* as a dummy variable to create a three-way interaction term. We then performed a Wald test which gave us a significant value. Therefore, the interaction coefficients in columns 3 and 4 are comparable. Columns 3 and 4 show that the interaction of *TechIntst* and *MgmtIntExp* has a significant and positive impact on total sales for the sample of firms that improved their sales level during the COVID-19 crisis as compared to 2019. While the interaction is not significant for the sample of firms that their sales decreased or remained the same during the COVID-19 crisis. Therefore, the results of the robustness check support the complementarity between technology and international related management experience and how this complementarity can contribute to differential performance impacts among firms during a crisis. Table B2 in Appendix B provides detailed estimation results for baseline models. Also, figure B1 in Appendix B shows the interaction of international related management experience and technology intensity on total sales.

Table 3. Direct and Interaction Effects

	(1)	(2)	(3)	(4)
Variables	Direct Effect	Interaction Effect	Sales Growth	Sales Decline/Same
DV: Log of Total Sales (LTotSales)				
TechIntst	**0.263***(0.024)**	0.254***(0.024)	0.154***(0.032)	0.258***(0.030)
MgmtIntExp	**0.206**(0.087)**	0.204**(0.088)	0.145(0.134)	0.243**(0.108)
TechIntst×MgmtIntExp		**0.186**(0.092)**	**0.227**(0.094)**	0.136(0.137)
Control Variables	All included	All included	All included	All included
Observations	1,287	1,287	334	953
R-Squared	0.309	0.316	0.493	0.313

Note: This table is parsimonious. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Domestic versus International Supply and Market and Sectors Comparison

We conducted an explorative examination to see if the impact of technology intensity and international related management experience varies based on the scope of a market (domestic market versus international market) and supply dependency (dependent on a domestic supply versus international supply). The first two columns in Table 4 show the estimation results for firms with more dependency (more than 50 percent) on a domestic supply versus firms with more dependency on an international supply. We performed the Wald-test to verify that the interaction coefficients in columns 1 and 2 are comparable. The results in columns 1 and 2 shows that the interaction of *TechIntst* and *MgmtIntExp* for firms that have more dependency on a domestic supply is not significant; while it is significant and positive for firms that have more dependency on an international supply. Additionally, Columns 3 and 4 in Table 4 show the results of the estimations for firms that operate and sell their products or services in a domestic market versus firms that operate internationally. The results in columns 3 and 4 show that the interaction of *TechIntst* and *MgmtIntExp* for firms that are operating internationally is more significant and greater as compared to firms that operate in a domestic market. We also compared the interaction term across manufacturing, retail, and service firms. The results in Table 5 show that the interaction of *TechIntst* and *MgmtIntExp* is more significant and greater for service firms as compared to manufacturing and retail firms.

Table 4. Domestic versus International Supply and Market

	(1)	(2)	(3)	(4)
Variables	Domestic Supply	International Supply	Domestic Market	International Market
DV: Log of Total Sales (LTotSales)				
TechIntst	**0.240***(0.034)**	**0.260***(0.036)**	**0.194***(0.025)**	**0.288***(0.059)**
MgmtIntExp	0.140(0.117)	**0.244*(0.131)**	0.095(0.088)	**0.432**(0.190)**
TechIntst×MgmtIntExp	0.127(0.121)	**0.222**(0.109)**	**0.182**(0.087)**	**0.302***(0.100)**
Control Variables	All included	All included	All included	All included
Observations	691	596	998	289
R-Squared	0.310	0.322	0.359	0.317

Note: This table is parsimonious. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5. Industry Sectors Comparison			
	(1)	(2)	(3)
Variables	Service	Manufacturing	Retail
TechIntst	0.191***(0.042)	0.268***(0.037)	0.095*(0.055)
MgmtIntExp	-0.043(0.137)	0.283**(0.128)	0.204(0.277)
TechIntst×MgmtIntExp	**0.390*****(0.110)**	**0.239****(0.103)**	-0.112(0.236)
Control Variables	All included	All included	All included
Observations	505	515	267
R-Squared	0.408	0.440	0.208

Note: This table is parsimonious. Robust standard errors in parentheses.

Theoretical Contribution, Conclusion and Future Work

Our study makes several contributions to the extant literature. Firstly, our study contributes to the management and information systems literature, extending the prior work on the role of technology (Dong, Xu, and Zhu 2009; Gu, Yang, and Huo 2021; Rai, Patnayakuni, and Seth 2006) and management experience (Hsu, Chen, Cheng 2013; Piaskowska et al. 2021; Rodenbach and Brettel 2012) and that these factors can combine to build a resilient mechanism in times of crisis (Wong et al. 2020). Secondly, our study provides empirical evidence on the role of technology and international related management experience in times of extreme uncertainty.

Our results provide evidence of how international related management experience and technology intensity complement each other to build resiliency and impact the firm performance. We find that management with international related experience and technology intensity have positive direct and complementary effects on the performance of a firm during the COVID-19 crisis. Additionally, we find that firms that improved their sales as compared to pre-COVID-19 time were able to harness the advantages offered through these complements. Moreover, their complementarity has a greater impact on the performance of a firm that is operating and selling products or services internationally, has more dependency on international supplies, and service firms. In sum, our study provides insight into the complementarity of management experience and technology factors and their roles in building resiliency and contribution to organizational performance, especially during times of crisis. Still, other organizational complements such as company culture, strategy, and top management commitment can influence the effectiveness of organizational capabilities and how changes are taking place. Future research should examine the impact of these factors and other complements. In future work, we will examine the role of production technology in the manufacturing sector and how international related management experience can complement production-level IT capabilities.

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Appendix

Appendix A: Research Model

Figure A1 shows our research model. In the first two hypotheses, we examine the direct effects of technology intensity and international related management experience on firm performance. In the third hypothesis, we examine the interaction effect of technology intensity with international related management experience on firm performance.

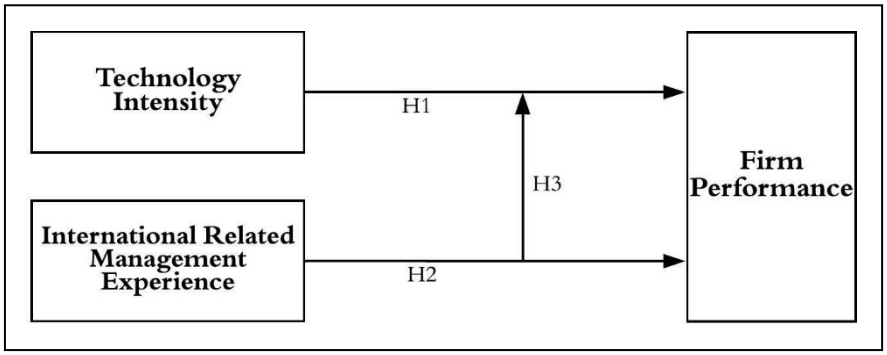

Figure A1. Research Model

Appendix B: Description of Variables and Estimation Results

Description of Variables

Table B1 provides a detailed description of our study variables.

Table B1. Description of Variables

Variable	Description
Logarithm of Total Sales (LTotSales)	The logarithm of firm total sales in dollars in 2020.
Technology Intensity (TechIntst)	It demonstrates the level of technology that exists within a firm supply chain. More advanced technologies demonstrate a higher intensity. This variable is measured through two questions (Each question score varies from 1 to 4): 1. What is the main technology used by this firm for planning product/service provision (From handwritten processes to enterprise resource planning or other organizational integration systems)? 2. What is this firm's main technology to manage procurement and suppliers' chain (From manual process to E-procurement, electronic order integrated, or specialized supply chain management systems)?
Management International Related Experience (MgmtIntExp)	It shows the prior international experience of top management in the same sector. This variable is measured through a question: Does the top manager have previous experience working in a multinational firm or in a prominent firm in this sector? Coding scheme: 1=Yes; 0=No.
Multi-Established Size (MultiEstSz)	The size of the multi-establishment firm (The value for a single firm is 1).
Logarithm of R&D Investment (LR&DInvt)	The logarithm of the total monetary amount spent on research and development activities, either in-house or contracted with other companies in 2019.
Competition Intensity (CompIntst)	The square number of competitors of the firm in million. Higher values show more intense competition.
Domestic Supply Percentage (DomSupPerc)	The percentage of the firm's supply of raw materials, inputs, and finished goods were purchased from domestic sources in 2020.
Number of Employees (NoOfEmpl)	The total number of firm's full-time employees in thousands.
International Market (IntMkt)	If the firm is operating and selling its products or services in an international market. Coding scheme: 1=Yes; 0=No.
Service Sector (Svc)	If the firm sector type is service. Coding scheme: 1=Yes; 0=No.
Retail Sector (Retail)	If the firm sector type is retail. Coding scheme: 1=Yes; 0=No.

Estimation Results for the Baseline Model and Interaction Plot

Table B2 provides the estimation results for our baseline models. The control variables are in the expected direction. For instance, competition intensity has a negative effect on the total sales; confirming our conjecture that a higher intensity in competition leads to more negative consequences on the performance of firms. Also, firm size has a positive impact on total sales. Moreover, international supply chain indicators have positive impacts on total sales. Figure B1 provides the interaction plot between technology intensity and international related management experience variables.

Table B2. Direct and Interaction Effects				
	(1)	(2)	(3)	(4)
Variables	Direct Effect	Interaction Effect	Sales Growth	Sales Decline/Same
DV: Log of Total Sales (LTotSales)				
TechIntst	**0.263***(0.024)**	0.254***(0.024)	0.154***(0.032)	0.258***(0.030)
MgmtIntExp	**0.206**(0.087)**	0.204**(0.088)	0.145(0.134)	0.243**(0.108)
TechIntst×MgmtIntExp		**0.186**(0.092)**	**0.227**(0.094)**	0.136(0.137)
MultiEstSz	0.004***(0.001)	0.004***(0.001)	0.001(0.001)	0.005***(0.001)
LR&DInvt	0.036***(0.008)	0.036***(0.008)	0.007(0.011)	0.038***(0.010)
CompIntst	-0.047**(0.023)	-0.047**(0.023)	-0.028(0.032)	-0.053*(0.027)
DomSupPerc	-0.004***(0.001)	-0.004***(0.001)	-0.003*(0.001)	-0.005***(0.001)
NoOfEmpl	0.908**(0.452)	0.894**(0.440)	9.480***(2.656)	0.802**(0.380)
IntMkt	0.690***(0.108)	0.696***(0.109)	0.582***(0.170)	0.685***(0.131)
Svc	0.356***(0.089)	0.365***(0.090)	0.591***(0.138)	0.308***(0.107)
Retail	-0.113(0.103)	-0.110(0.103)	-0.008(0.142)	-0.150(0.141)
Constant	13.586***(0.139)	14.693***(0.098)	14.712***(0.149)	14.687***(0.119)
Observations	1,287	1,287	334	953
R-Squared	0.309	0.316	0.493	0.313
F-Statistics	54.82	49.74	22.57	33.83

Note: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

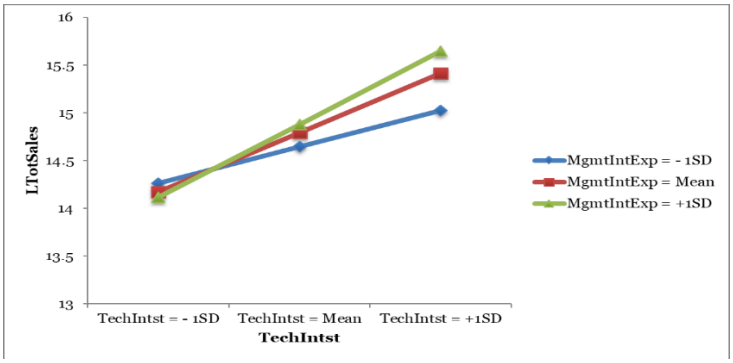

Figure B1. Interaction of MgmtIntExp and TechIntst