A Dissertation

entitled

Dynamic Drivers, Risk Management Practices, And Competitive Outcomes: Applying Multiple Research Methods

by

Xiyue Deng

Submitted to the Graduate Faculty as partial fulfillment of the requirements for the Doctor of Philosophy Degree in Manufacturing and Technology Management

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August 2021

An Abstract of

Disruption and Risk Drivers, Strategic and Operations Practices, and Performance Outcomes: Applying Multiple Research Methods

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Since the outbreak of the COVID-19 pandemic in December 2019, the world has gradually appeared markedly different compared with the pre-crisis era. There is no doubt that the COVID-19 pandemic has triggered dynamic changes, but the long-lasting turbulence across the business world was not merely caused by this global crisis. In the first two months of the outbreak, regional shutdowns led to a dramatic supply shock, followed by a demand shortage due to the increasing need for pharmaceuticals and critical medical products (Sherman, 2020; Shih, 2020). In addition, panic buying behaviors of essential living supplies, together with the demand shortage, increase the difficulty of handling supply chain disruptions. These sudden changes caused by COVID-19 are extremely challenging for companies to react appropriately, especially in such a short period of time. However, at the time of writing, it has been more than ten months since the first confirmed case, and the business world is still affected by supply chain disruptions. So, risk management needs breadth and depth investigation to identify potential risk

sources beyond the initial disruptions, to assess the risk impacts of subsequent vulnerabilities, to mitigate and predict unnecessary risks, and to improve resilience capabilities from a dynamic view (DuHadway et al., 2019; Ivanov et al., 2017; Ivanov & Dolgui, 2020).

This dissertation aims to identify the accelerated risk forces that occur during and after a significant disruption event (i.e., disruption event itself is not the main focus of this investigation), examine how those risks drive the advancement of firm resilience capabilities through strategic and operational practices, and then evaluate the associated performance outcomes.

This study first explored the trending topics and business issues from major business newspapers and media sites to obtain research relevant. It results in 1,660 news articles from 11 different sources (e.g., Financial Times, Wall Street Journal, The New York Times, CNN, etc.) being analyzed. And a further statistical text analysis method (Latent Semantic Analysis of text mining) is used to detect the research themes. Next, A set of semi-structured interview questions are derived from the text mining results for a qualitative case study. The insights and findings from both text mining and case studies contribute to the theoretical development phase. Furthermore, the research model generated from the theoretical formulation stages is then validated by the large-scale survey method (Hong et al., 2019; Singh & Hong, 2011).

This dissertation contributes to both the academic and practitioner communities. From the practitioner's perspective, this research synthesizes business issues, trends, response mechanisms, consumer reactions, and future directions that are related to COVID-19 through the text mining technique. By analyzing the entire event's changing pathway, this

study generalizes a risk management guideline for practitioners. This approach helps practitioners to anticipate, respond to, and overcome disruptions in the long run. From an academic point of view, this dissertation (1) presents a research framework that tackles the dynamic idea of risk management and resilience, (2) incorporates the qualitative (case interview) and quantitative (text mining and large scale survey) methods to validate the dynamic risk management framework, (3) implement a systematical procedure to conduct research which consists of exploration (i.e., topic exploration)- confirmation (i.e., topic confirmation)- formulation (i.e., theoretical framework formulation) - validation (research model validation) stages.

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Chapter 1

1 Introduction

Since the outbreak of the COVID-19 pandemic in December 2019, the world has gradually appeared markedly difference compared with the pre-crisis era. There is no doubt that the COVID-19 pandemic triggers dynamic changes, but this global crisis is not the only cause of long-lasting turbulence across the business world. In the first two months of the outbreak, the unexpected regional shutdowns led to a dramatic supply shock, followed by demand shortage due to the increasing needs of pharmaceuticals, critical medical products (Sherman, 2020; Shih, 2020). In addition, panic buying behaviors of essential living supplies, together with the demand shortage, increases the difficulty of handling supply chain disruption. These sudden changes caused by COVID-19 are extremely challenging for companies to react appropriately, especially in such a short period of time. However, it has been more than ten months (at the time of writing this dissertation) since the first confirmed case, and the business is still exposed to supply chain chaos. So, risk management needs breadth and depth investigation to identify potential risk sources beyond the triggered disruptions, to assess the risk impacts of subsequent vulnerabilities, to mitigate and predict unnecessary risks, and to improve resilience capabilities from a dynamic view (DuHadway et al., 2019; Ivanov et al., 2017; Ivanov & Dolgui, 2020).

1.1 Background

This dissertation is built upon both practical motivations and theoretical motivations. The practical motivations were explored and confirmed through a series of rigorous scientific procedures. We first conduct an extensive review of practical literature from the practitioner journals and business newspapers. After sensing the trends of current issues, this study applies the latent semantic analysis method, one of the text mining techniques, to confirm the relevance and necessity of this study. Then, the theoretical motivation served as a logical structure to formalize the detected trending topics from text mining into a plausible research framework, which falls under the areas of risk management and supply chain disruptions. This dissertation incorporates three research methods that complements and supports each other. We discussed method 1, text mining, in chapter to explore trending topics. From those trending topics we further analyzed and summarized a group of questions that served as interview questions for method 2 (focused group interviews). The results and findings derived from method 1 and 2 contributed to the theoretical framework and instrument development phase. Then the large-scale survey as the third method validated the dynamic risk response research model.

1.2 Research Motivation and Needs

We are in the stage of unprecedented challenges and uncertainties, along with the outbreak of coronavirus. The impacts of this health-related event are beyond the medical control perspective and have extended to the global economic scope. In the broad sense of running businesses, the pandemic has influenced the day-to-day operations in terms of planning, sourcing, making, delivering, and returning. To investigate and respond to this global crisis, both practitioners and scholars in the operations and supply chain

management domain are taking actions to study this “Black Swan” event (Butterfield, 2020; Craighead et al., 2020; Golan et al., 2020; Haren & Simchi-Levi, 2020; Sharma et al., 2020; Shih, 2020). After reviewing extensive literature, we observed several relevant, trending, and practically meaningful topics: supply chain disruptions, risk management, business continuity planning, and resilience. The practical motivation of this study is to investigate (1) the major drivers leading to the business environment changes under the pandemic era, (2) why some firms could survive or even seize more opportunities in the pandemic while some firms were made obsolete, and (3) what could be the new indicators of measuring the successful performances in this dynamic environment. Those motivation together contributes to the formulation of the dynamic risk response framework.

The observed topics (e.g., supply chain disruption, risk management, business continuity planning, resilience, etc.) are the general research directions that cannot explicitly explain specific issues, strategies, practices, and insights. Instead of subjective summarizing and syncretizing those informative and instructional topics, the text mining technique with latent semantic analysis (LSA) method and case study served as a combination of the quantitative and qualitative methodologies to validate the importance of this study. The theoretical framework will then be developed through a literature review of academic journals and followed by the hypothesis and research model development chapters. Lastly, the general model is tested by the survey method. This dissertation is complementing and expand the previous literatures in the area of risk management and supply chain disruption management.

1.3 Research Aim and Research Questions

This dissertation aims to identify the magnified risks that arise during and after the

major disruption events (i.e., disruption events are not the main focus to investigate), investigate how those risk forces drive to the advancement of firm resilience capabilities, and evaluate the associated performance outcomes. First, from dynamic market survival pressures, social-technical requirements, and a global trend shifting perspective, this study investigates the change accelerating drivers caused by major disruption events. Second, this study explores the best associate business practices and strategies to respond to the challenges in risk source identification, potential risk evaluation, and risk prediction and mitigation.

This dissertation, therefore, attempts to answer the following questions:

R1: What is an appropriate conceptual framework to understand market challenges during and after major disruption events?

R2: What are the major drivers of change induced by disruption events, and how can we measure those drivers in an empirical study?

What practices should companies consider in business continuity plans and competitive survival strategies for current and future challenges?

How could those practices translate business efforts into business performance (i.e., competitive benchmarking outcomes, process innovation outcomes, supply chain outcomes)?

1.4 Research Relevance and Contributions

This dissertation contributes to both academic and practitioner communities. This research synthesizes business issues, trends, response mechanisms, consumer reactions, and future directions of the COVID-19 pandemic from the practitioner's standpoint. By analyzing the change processes of the entire event, this study generalizes a risk

management guideline for practitioners from the aspects of anticipating, responding, and mitigating disruptions in the long run. From an academic point of view, this dissertation (1) presents a research framework that tackles the dynamic idea of risk management and resilience, (2) incorporates qualitative (case interview) and quantitative (text mining and large scale survey) method to validate the dynamic risk management framework, (3) and implement a systematical procedure to conduct research with exploration (i.e., topic exploration)- confirmation (i.e., topic confirmation)- formulation (i.e., theoretical framework formulation) - validation (research model validation) stages. Overall, this dissertation opens extensive discussions of dynamic risk management of major disruptions.

1.5 Summary

This dissertation proceeds as follows. Chapter 2 presents the trend exploration and confirmation phases by implementing the text mining method. Chapter 3 describes the theoretical framework and construct development. Chapter 4 focuses on the research model and hypotheses development. Chapters 5 and 6 illustrate the research methods of focus group interviews and survey. Hypothesis testing and result are discussed in Chapter 7. Lastly, implications, limitations and future research directions are discussed in chapter 8.

Chapter 2

2 Trend exploration and confirmation by Text Mining

This study uses text mining for the extraction of trending topics from major business news media resources (e.g., The Economic Times, Financial Times, Wall Street Journal, The New York Times, CNN, Business Insider, Associated Press, Forbes, Strategy Business, BBC, Fox Business Network, NBC Network, and CNBC Network). Previous literature (Finch, 2004; Jüttner, 2005; O. Tang & Nurmaya Musa, 2011) focuses on the discussions in specific topic and area. But this text mining method helps zooming out the lens of studying risk management in a more dynamic perspective. Then, those extracted topics were further transformed into a list of interview questions for the case study.

2.1 Method 1: Text Mining

Text mining is a quantitative technique for uncovering the intellectual structure of a discipline. There are different ways to perform text mining. This dissertation implements Latent Semantic Analysis (LSA) as the quantitative method for exploring emerging trends in the supply chain management domain. LSA combines statistical techniques and scholarly judgment as it proceeds to extract and decipher key latent factors that possess the ability to analyze large volumes of unstructured textual data (Kulkarni et al., 2014; Kundu et al., 2015; S. Lee et al., 2010). LSA was initially implemented to improve the information retrieval system for library indexing and search engine query performance. Recently, this

technique was gradually adopted by other research areas, such as artificial intelligence, cognitive sciences, education, and information systems (Ashton et al., 2014; Cosma & Joy, 2012; N. Evangelopoulos et al., 2012; N. E. Evangelopoulos, 2013; Kulkarni et al., 2014). This study will implement the LSA technique to extract hidden knowledge from a set of unstructured texts.

2.1.1 Data Collection and Sample Description

The major business newspapers are the most representative sources to reflect the current hot topics, issues, and future directions in the business world, and they previously have been used by other researchers as a tool to derive research insight (Doyle, 2013; Sampei & Aoyagi-Usui, 2009). With this in mind, we search for news within those prementioned business newspapers from the Factiva database to analyze the text pattern of that news. The search keywords are Supply Chain Disruption, Risk Management, Resilience, Business Continuity Planning, and Agility since there is a significant amount of news related to politics, individual interviews, confirmed cases updates of coronavirus, etc. This study applied a filter to focus on Corporate/Industrial News. There are 1,710 news articles that have been collected from the sample database; after eliminating the duplicated articles, we obtained a total sample of 1,660 for the text mining analysis.

Table 1 presents the frequency distribution of the collected news across different news sources from December 2019 to September 2020. There are 30.2% of news (n= 502) come from The Economic Times, 25.7% of news (n=426) from Financial Times, 19.7% of news (n=327) from Wall Street Journal, 8% of news (n=133) from The New York Times, 16.4% news from other news sources (CNN, Business Insider, Associated Press, Forbes, Strategy Business, BBC, Fox Business Network and NBC Network)

Table 2.1. News Distribution: Dec. 2019- Sep. 2020

Sources	Frequency	Probability Distribution
The Economic Times	502	30.2%
Financial Times	426	25.7%
Wall Street Journal	327	19.7%
The New York Times	133	8.0%
CNN	82	4.9%
Business Insider	55	3.3%
Associated Press	53	3.2%
Forbes	49	3.0%
Strategy Business	26	1.6%
BBC	4	0.2%
Fox Business Network	3	0.2%
NBC Network	0	0%
CNBC Network	0	0%
Total	1660	100%

2.1.2 Latent Semantic Analysis

To further examine the prementioned topic trends, LSA has been conducted as an exploration phase to detect relevant research themes and topics. Figure 2-1 illustrates the logic of implementing LSA. It processes text ("documents") from a set of files ("corpus"), identify keywords ("term"), and further detect latent factors ("topics") from these extracted terms. The rationale behind LSA is bounded by the assumption that words that are similar in meaning will occur in similar segments of text (Kulkarni et al., 2014; Kundu et al., 2015). LSA approach begins with a Vector Space Model (VSM) to parse the data into terms and filter out common words (e.g., "the," "and," "of," etc.) from the list of terms to formulate the term-frequency matrix (f_{ij}). This TF matrix is further normalized to TF-IDF matrix by using equation (1).

$$a_{ij} = f_{ij} \times \log_2(\frac{N}{n_i}) \quad (1)$$

In a similar manner to traditional factor analysis techniques, the researcher can impose the number of factors within LSA and therefore determine the level of granularity themes are identified. A collection of contexts, identified as either specific individual unique words or a group of meaningful terms in the collected data, is extracted. A context can consist of unique terms and synonyms, as simple as "cyber," "hacker," and "security" to describe "cybersecurity issues" or a single multiple-word term such as "risk management system." More complex context can be generated using a mixture of both single and multiple words such as "supply," "production," "factory," "chain," "supplier," and "monitoring" to describe "supply monitoring." Thus, in corollary with primary LSA assumptions, contexts with similar meaning will occur in similar meaning documents.

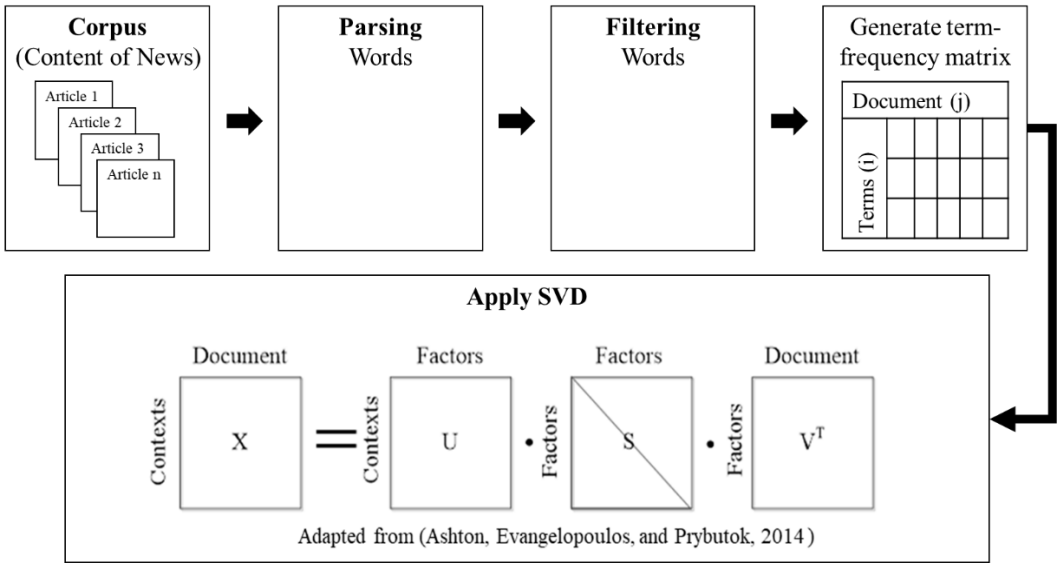

Figure 2–1

Then, singular value decomposition (SVD) operations determine unique terms that represent the underlying concepts manifest within the data based on the normalized term-frequency matrix (Ashton et al., 2014; Kulkarni et al., 2014). SVD decomposes the IT-IDF

matrix into three matrices – U, S, V^T. Like principal component analysis (PCA), SVD produces simultaneous principal components for two sets of variables, contexts which are based on the term eigenvectors (U) and documents which are based on the document eigenvectors (V^T). The S matrix is a diagonal matrix of singular values (i.e., square roots of common eigenvalues between terms and documents in the least squares manner). The next step of LSA is to find out term load and document load for each factor. In order words, two separate sets of factor loadings, one for the U and V^T matrices, are produced with each latent factor associated with both a set of corresponding high-loading terms and a paired set of corresponding high-loading documents. These two sets of results can then be interpreted concurrently to develop the fundamental word usage and association patterns, which are termed Factors or Themes. Like traditional factor analysis, the researcher can indicate the number of factors within LSA to extract and therefore specify the level of granularity for tthe extract (Ashton et al., 2014; Deerwester et al., 1990).

Once the theme is extracted, the clustering analysis could be performed. In this study, the Euclidean distance measures the distance between cluster to generate the hierarchical clustering analysis. The hierarchical clustering algorithm is interactively grouped Themes into cascading sets of clusters so that clusters within a step are nested within a cluster from a previous step. This can be achieved in a top-down or bottom-up manner (Chakraborty et al., 2013).

2.1.3 Analysis and results

In this study, SAS Enterprise Miner was used to analyze text clusters through a series of steps. Initially, the aggregated data from multiple news resources have been organized into one file. The Text Import node has been used to import the aggregated data file into

SAS Enterprise (Sarma, 2017; SAS Institute Inc, 2012). The data file was then converted from text format into a SAS table as a SAS data file. This SAS data set is used as the input for the Text Parsing node (which reflects the second step in figure 2-1) decomposes the data file into a quantitative representation required for text mining purposes (SAS Institute Inc, 2012). Terms with corresponding synonyms are aggregated, and non-essential descriptors (i.e., parts of speech, including Aux, Conj, Det, Interj, Part, Prep, and Proper Noun), Numeric, and Punctuation Attributes are excluded. Any of these terms with the parts of speech that are selected in the Ignore Parts of Speech dialog box during the Text Parsing step are ignored. It ensures that the document analysis will ignore words considered to be low content, such as prepositions and determiners (Sarma, 2017; SAS Institute Inc, 2012). The resulting terms in each observation were then parsed through the Text Parsing node (shortened to its base root), resulting in 13,427 out of 20,001 unique "terms." A Text Filter node (which reflects the third steps in Figure 2-1) was connected with the Text Parsing node to realize the transformation or dimension reduction of the text data. This node allows for the reduction of parsed terms to be analyzed by additionally filtering extraneous information, such as removing "copyright," "document number," "cent" terms, and location word groupings. The Text filter node takes the quantitate representation from the Text Parsing node and transforms it into an informative format to permit documentation analysis (Chakraborty et al., 2013; SAS Institute Inc, 2012), which would allow for the analysis of that most valuable and pertinent information.

The remaining term list was then run through LSA with a maximum of twenty-five multi-term correlated topics. This document analysis performs classification or concept linking of the text to the document collection through Text Cluster node (Chakraborty et

al., 2013; Sarma, 2017; SAS Institute Inc, 2012)

The Text Cluster node groups the documents into non-overlapping clusters, and the documents within a cluster are similar to each other to the frequencies of the terms (Chakraborty et al., 2013). The text Cluster node also reports on the descriptive terms contained in each of the clusters created. A tree hierarchy is created with a k-means clustering algorithm with High SVD resolution, which transforms the original term frequency matrix into a dense representation of text. A maximum of 15 descriptive terms and 20 clustered topics highlight potential additional groupings used during the Text Cluster node running process. Table 2.2 shows the final extracted 15 clusters in five hierarchical level topics. Figure 2-3 presents the nested hierarchical diagram.

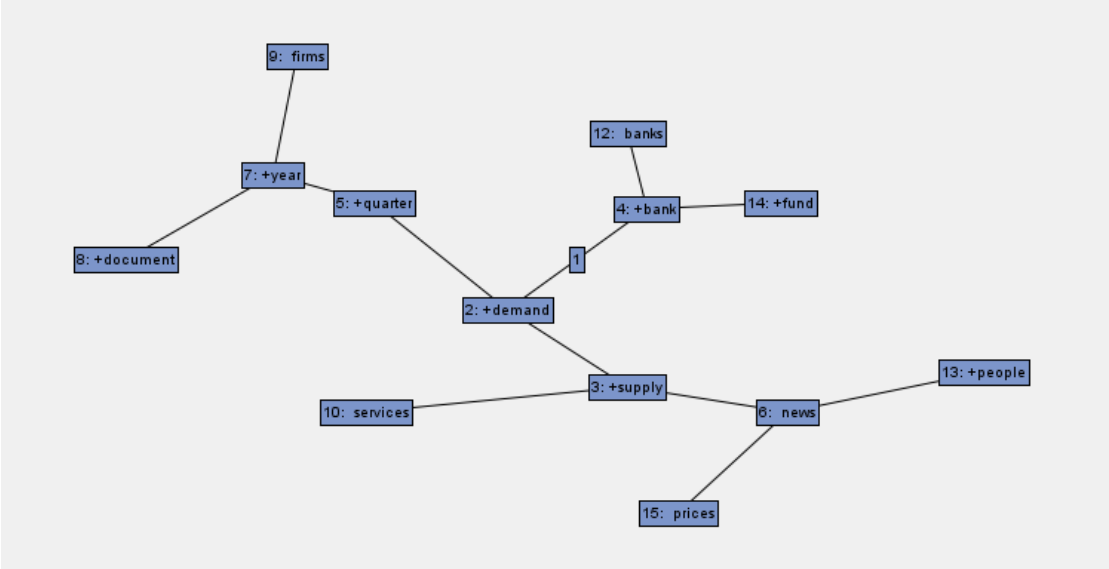

Figure 2–2 Hierarchy Cluster Diagram

Referring to Figure 2-3 and Table 2.2, level 1 is the overarching topic that represents the central theme of the entire dataset. There are two clusters to form up the second level topics: “demand” and “risk management.” Cluster 1, “demand,” was grouped by the similar and close terms of “demand rights,” “company resilience,” “world growth,” etc. We

interpreted this cluster as with the world's growing demand in the past year, there are increasing needs in a particular area (e.g., food supply, face mask, toilet paper, cleaning supply, healthcare, etc.), companies should be dedicated to building responsive and resilient operations. Cluster 4, "bank," was grouped by terms of "firms funds," "risk management," "investment," "data," investor," etc. We interpreted this cluster as risk management has become crucial for the fund's investment in the banking industry. Since more than half of the data sources are from Economic Times, Financial Times, and The Wall Street Journal, it is acceptable that the most reported industry or firms were coming from the finance area. We could infer that risk management and data security investment have caught relatively large attention nowadays. Thus, this study proposes that according to the extracted first-level topic, it reveals that companies should pay attention to risk management and company resilience to manage demand.

From Figure 2-3, we observed the "demand" cluster could be extended into two clusters, which are cluster 3 ("supply") and cluster 5 ("quarter"). These two clusters together formed the second-level topics. If we deep dive into cluster 3 from Table 2.2. In that case, we can see "supply" (i.e., supply issues impacted by the world crisis, constrained working conditions of people, and fluctuating demand) is another important topic. It is supported by three sub-topics, which are "news," "people," and "price." The meaning behind the "news" cluster discusses the impacts of the new coronavirus. Cluster "people" further explains that with the hit of new coronavirus, people's health has been exposed to many risky conditions, and it is imperative for companies to monitor the working conditions to keep people safe. Moreover, cluster "price" covers coronavirus's side effects on the dramatic cost changes of supplies. The cluster of "service" describes that

implementing new technology will support the implementation of risk management. In this case, we argue that supply risks in the coronavirus pandemic crisis primarily come from the safety concern of employees' working conditions and the supply and demand shock caused by the regional shutdown policy. To manage the supply risks, companies start implementing new technologies to visualize the product transition flow and enable the company to strengthen its capability in risk management. Cluster 5 begins with the term "quarter," which talks about the demand change from revenue shares, quarterly, and yearly sales growth perspectives.

2.1.4 Findings

According to the interpretation of the hierarchical clustering analysis, we observed three major themes. First, risk management in the finance industry is essential during the coronavirus pandemic. Since half of the data comes from the Financial Times and the Economic Times, we can generalize that risk management is also critical for most industries to keep a healthy financial condition. Second, employees' health and emerging technology implementation are two fundamental criteria in managing the dynamic supply and demand changes. In other words, the social-technical aspect is an essential driver to foster the changes in this global crisis. Third, to monitor the demand changes, we should quantify the degree of increasing or decreasing revenue and sales. Therefore, companies may consider incorporating data analytic tools to identify disruption-induced challenges and opportunities.

Table 2.2. Hierarchy Clusters

Hierarchy Level	Cluster ID	Parent	Descriptive Terms	Frequency	Graph Description
1	1			1665	1
2	2	1	+demand rights +impact +quarter +world growth +company resilience +end +share +work +document services times months	1217	2: +demand
2	4	1	+bank banks firms funds +risk +management +investment data investors +group years +help markets +market businesses	448	4: +bank
3	3	2	+supply +work +people +government +world +help rights +time +back +fund +crisis times companies services +demand	797	3: +supply
3	5	2	+quarter growth sales +share +profit +cent reported +revenue shares june expected +demand +company +year +impact	420	5: +quarter
3	12	4	banks +risk +bank banking +credit loans information +management +interest firms data markets +government +sector years	226	12: banks
3	14	4	+fund funds investors +deal +investment +people shares firms +group +market +interest times +back +help +industry	222	14: +fund
4	6	3	news coronavirus +people health +week +world +back +hit times +group +time +government +work +crisis +risk	481	6: news
4	10	3	services rights timescontent.com +help +management +technology +focus employees +document businesses +work +support +risk +business companies	316	10: services
4	7	5	+year +quarter growth sales +share +profit +cent reported +revenue shares june expected +company +market +impact	420	7: +year
5	13	6	+people health +work news weeks +help +country +day +time +supply coronavirus times +back +government +week	337	13: +people
5	15	6	prices +oil +energy funds +climate investors +investment +cut 'this year' +price markets companies +risk +sector +increase	144	15: prices
5	8	7	+document +quarter growth +share +profit sales +cent +revenue reported rights shares timescontent.com june +price earnings	311	8: +document
5	9	7	firms +report +sector investors markets april companies +government years +group +market services +hit +increase +impact	109	9: firms

Chapter 3

3 Theoretical framework and construct development

This chapter discusses the theoretical foundation of this research (section 2.1) through an extensive literature review, presents the conceptual model (section 2.2), and defines the constructs/sub-constructs (section 2.3).

3.1 Literature Review

The research themes identified from the research motivation section consist of risk management, supply chain disruption, and resilience. The literature review aims to clarify the research gap and provide a literature base to answer the research questions further to align with the research themes. A comprehensive literature review in risk management (RM), supply chain disruption management (SCDM), and supply chain resilience (SCR) are conducted. Keywords of "supply chain disruption", "risk management", "supply chain resilience", "uncertainty", "business continuity planning", "collaboration", "integration", and "dynamic capability" have been used for literature search. Prominent journals include Journal of Operations Management (JOM), Journal of Supply Chain Management (JOSM), European Journal of Operational Research (EJOR), Strategic Management Journal (SMJ), Management Science (MS), International Journal of Operations and Production Management (IJOPM), International Journal of Production Economics (IJPE), and Production and Operations Management (POM). The time horizon of the search is from

the year 2000 to 2020. There are 100 articles are collected for the analysis.

3.1.1 Risk management and supply chain disruption

Risk management has drawn increasing attention as supply chains became vulnerable to turbulence after major global crises (e.g., coronavirus pandemic). This globally dynamic, complex, and risky business environment has induced radical market and culture changes. Supply chain risk management is an emerging supply chain research area that connects supply chain management and risk management (Manuj & Mentzer, 2008a; C. S. Tang, 2006; Thun & Hoenig, 2011). Manuj & Mentzer (2008b) defined supply chain risk management as the mechanism to identify potential sources of risk, implement appropriate strategies through a coordinated approach among supply chain members, and in turn to reduce supply chain vulnerability. From the collected literature, we observed that most commonly, researchers tend to investigate risk management under certain disruption events (Jüttner & Maklan, 2011; Leat & Revoredo-Giha, 2013; Urciuoli et al., 2014). Because supply chain disruptions are viewed as the primary source of supply chain risk, any forms of unanticipated incidents that impact normal operations would be considered disruption events, but the extent of impacts varies. DuHadway et al. (2019) categorize supply chain disruption by behavioral intent and disruption location. He argues that if the disruption source is endogenous and inadvertent intended (e.g., poor quality controls, scheduling failure), the reactive risk management practices are most likely to be implemented by companies. However, suppose the disruption is induced from an exogenous location (e.g., natural disasters, terrorism) or intentionally creating the conflict (e.g., contract breaches, political intervention). In that case, companies need to proactively build capabilities to cut the damage to the possible low level against those disruptions. With the dynamic nature of

various supply chain disruption types, supply chain risk managers show an increasing need for decision-making support tools (e.g., any digital analytical tools) to identify disruption scenarios. The support tools such as digital dashboard would help to specify the disruption sources, to monitor and recognize the disruption in real time, to access the damages of the disruptions, and to predict and mitigate the negative impact caused by the disruption (DuHadway et al., 2019; Ivanov & Dolgui, 2020; X. Wang et al., 2017). Therefore, this study will continue to fill this research needs to investigate a research framework that can explain different degrees of risk management from a contingent aspect.

3.1.2 Risk management and resilience

There is no doubt that some firms recover from supply chain disruptions more effectively in the dynamic changing phenomenon than others, which means the measurement and evaluation of a particular type of risk management deserve attention. That is the motivation for studying supply chain resilience. In most cases, supply chain resilience proposed to deal with unexpected and unforeseeable disruptions, and companies should possess the capability to survive, adapt and grow when confronted with uncertainties or changes (Ambulkar et al., 2015; Golan et al., 2020; Knemeyer et al., 2009; Pettit et al., 2010). Supply chain resilience is the consequence of supply chain risk management, which requires the company to equip adaptive capabilities to prepare for unexpected events, respond to disruption, and recover from them by maintaining continuity of operations at the desired level (Scholten et al., 2014; Sheffi & Rice, 2005). The associated capabilities have been discussed extensively by the researchers, such as collaboration and integration capabilities, agility, transparency, supply chain (re-)engineering, risk awareness, etc. (Christopher & Peck, 2004; Golan et al., 2020; Sheffi

& Rice, 2005; Urciuoli et al., 2014). Therefore, the risk management and resilience aspects would be the core elements to formulate the theoretical framework.

3.2 Theoretical foundation

Substantial research links supply chain disruption, risk management, and resilience to realize operational and financial outcomes. However, limited research systematically investigates the disruption-induced ripple effect of changes, responsive resilience practices, and performance outcomes. The present study proposes a combinational theoretical foundation based on Contingency Theory, Dynamic Theory, and Risk Management Framework to abridge this research gap.

3.2.1 Dynamic Theory

The dynamic theory has long been dominated by a paradigm that conceptualizes in the organizational strategy domain (Porter, 1991) and organizational knowledge-creating perspective (Nonaka, 1994; Spender, 1996). Dynamic theory played a crucial role in developing resource-based review, dynamic capability theory, and knowledge learning approach (Cavusgil et al., 2007; Enrriquez-De-La-O, 2015; Helfat & Peteraf, 2003). It is also one of the origin theories that studied the formulation of competitive advantage. Porter (1991) discusses the origins of origins in building competitive advantages in his famous journal article “Towards A Dynamic Theory of Strategy”. This paper illustrates that to understand the critical factors of firms to succeed, three crucial problems should be addressed upfront. The first one is that the firm must deal simultaneously with internal and external issues that contain the industry and even the broader environment in which it operates. Second, provide latitude to the firm among those well-defined and familiar

choices and create new ones. Third, be clear with internal and gradual changes related to or even come from exogenous changes (Porter, 1991). This study designs the theoretical framework from an external reinforcement perspective (i.e., maintain and strengthen the external competitive position in the dynamic changing market), innovative response perspective (i.e., improve innovation capabilities by incorporating social and technical aspects in internal operation processes), and macro-trend impel perspective (i.e., adjust business strategies to global or national economic tendency) from adapting the pre-mentioned three dimensions.

3.2.2 Contingency Theory

Literature of organizational structure is the predecessor of studying contingency theory (Donaldson, 2006; Pugh et al., 1968; Volberda et al., 2012). The very nature of contingency theory captures how the different contextual environments drive organization structure changes and impact organizational performances. A critical issue for organization designers and higher-level managers in this framework is the core idea of fit in the organizational domain (Umanath, 2003). Weill and Olson (Weill & Olson, 1989) summarized contingency theory from a set of organizational study literature as “the contingency approach attempts to understand the interrelationships within and among organizational subsystems as well as between the organizational system as an entity and its environments. It emphasizes the multivariate nature of the organization and attempts to interpret and understand how they operate under varying conditions….”. There are three streams of contingency theory. The first stream studied the association between contingency and organizational structural variables and attributes (Hall et al., 1968; Ruekert et al., 1985). The second stream investigates the exchange process that contextual

change causes an organizational structural change (Bate et al., 2000; Birkinshaw et al., 2002). And the third frame discusses the fit of structure to a contingency that affects performance (Flynn et al., 2010; Gordon et al., 2009; Umanath, 2003).

Contingency theory has been applied to multiple disciplines other than organizational studies, such as marketing, IS/IT, human resource, accounting, finance, operations, and supply chain, etc. The organizational study among marketing literature has studied the macro-organizational structural form (functional, product, market, and matric organizations) used by the firm to plan, implement, and monitor marketing tasks (Ruekert et al., 1985; Vorhies & Morgan, 2003). Contingency theory provides foundations for marketing research to recognizes the diversity of organizational structures, to identify the likely impacts of organizational structure on a variety of performance dimensions, to examines a set of contingent internal and external environmental factors that moderates the effects of structure on performance (Ferrell & Gresham, 1985; Ruekert et al., 1985; Song, 2006; Yadav et al., 2013). Information System scholar Weill and Olson (Weill & Olson, 1989) summarizes the several characteristic of contingency theory: (1) the better fit among the contingency variable (e.g., strategy, external environment, technology, organizational structure) the better performance outcomes would be (K. K. Hong & Kim, 2002); (2) performance should not be constrained to certain level of financial outcomes, multi-dimensions of performance outcomes together would explain more variance of organizational performance(Burton et al., 2004; Vorhies & Morgan, 2003); (3) IS development, use and implementation are highly influenced by organizational actors, the fit between those IS variables and organizational contingency variable would optimize the organizational performance (Bechor et al., 2010; Gordon & Miller, 1976). For instance, a

useful and ease of use IS application developed, organizational actors will willingly use it, thus improving their efficiency and effectiveness to generate better organizational performance.

From a methodology perspective, the context-structure-performance contingency relationships have been proposed as fit as congruence, fit as mediation, and fit as moderation (Umanath, 2003). In other words, contingency theory should not be limited in a linear or correlation manner among each relationship's level variables. Fit can be tested in a holistic configuration that can assess multivariate co-variation among variables of different domains. This study will incorporate contingency theory into the three dimensions arguments derived from dynamic theory- external reinforcement, internal response, macro-trend impels- into the theoretical formulation. The contextual-structure-performance contingency framework will be applied to each of these three dimensions, and the inter-dependencies nature of these three contingency frameworks will be simultaneously tested. For example, the contextual drivers of external reinforcement aspects are not necessarily limited to external reinforcement structural practices. We tested the inter-relationships among those three contingency frameworks.

3.2.3 Risk Management Framework

This dissertation aims to study the accelerating forces that lead to the dynamic market changes besides the disruption event itself (culture shifts induced new market opportunities and challenges, the appearance of emerging technologies to cope with the changes) during and after a major disruption event hit. Risk management literature provides the best guideline for the theoretical development of this study. Risk management is a well-developed research area that has been applied to numerous perspectives in management.

Within the supply chain management domain, risk management has been studied under the context of supplier relationship management, customer relationship management, supply chain disruption management, supply chain resilience, etc. (DuHadway et al., 2019; Hallikas et al., 2004b, 2005; Ivanov et al., 2017; Ivanov & Dolgui, 2020; Jüttner & Maklan, 2011; Knemeyer et al., 2009; Pettit et al., 2010; Scholten et al., 2014; Urciuoli et al., 2014; X. Wang et al., 2017).

Risk management can be applied in multiple disciplines with different contexts. The mechanism of managing risks from other disruption events is heterogeneous. The risk management framework provides a general guideline of the logical response procedure to the disruption events across various contexts. Many existing risk classifications have been studied to examine supply chain disruptions. Jüttner et al. (2003) investigate the disruption sources from environmental, network, and organizational risk perspectives, Manuj & Mentzer (2008a) discuss the possible risk sources from supply, demand and operations dimensions. The specific origin of risk and the associated cost of militating strategies have been examined in the supply chain management domain (Scholten et al., 2014; X. Wang et al., 2017). Some of the literature classifies risk management by focusing on events surrounding a disruption, focusing on either the antecedents of the event (Braunscheidel & Suresh, 2018; Braunscheidel & Suresh, 2009) or the reaction to a disruption event(Sheffi & Rice, 2005). DuHadway et al. (2019) propose a supply chain risk classification from the perspective of the location causes (risk sources are within or outside of the supply chain network) of the risk and the behavioral intention causes (disruptions are intentionally induced or an accident event) of the risk. In summary, literature in risk management, supply chain disruption, and resilience domain fall into three broad categories: (1) identifications

of the potential disruption source, (2) assessment of the risk impact, and (3) mitigation strategies and prediction mechanism of the disruptions. In this study, the risk management framework will play an overarching guide role in developing the theoretical framework.

3.3 Theoretical Framework

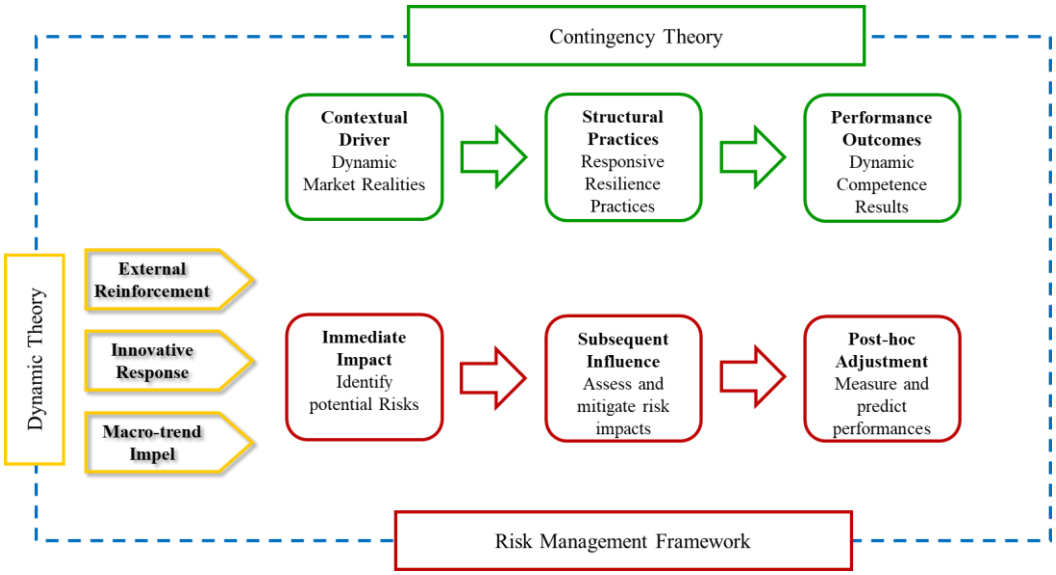

Figure 3–1 Theoretical Framework

The theoretical framework was developed by incorporating *Dynamic Theory* (i.e., three different perspectives of building competitive advantages: external reinforcement, internal integration, and macro trend impelling), *Contingency Theory* (i.e., contextual-structure-performance paradigm), and *Risk Management framework* (i.e., disruption source identification, risk impact assessment, and risk mitigation and prediction).

To build competitive advantages during and after major disruption events (e.g., hurricane, tsunami, global trade tension, coronavirus pandemic), companies should focus on the following intertwined dimensions: external reinforcement, innovative response, and macro-trend stimulation (adapted from Dynamic Theory). External reinforcement captures

the dynamic market drivers; innovative response holds the collaboration aspect of socio-technological drivers, and the macro-trend stimulation tackles the balance claim between internationalization and localization. The "context-structure-performance" framework proposed by Contingency Theory is applied in each of the three dimensions. We also investigate the inter-relationship across those three dimensions. Under the umbrella of the Risk Management Framework, the theoretical model reflects the phases of risk source identification, risk assessment, risk mitigation, and risk prediction. Considering the pre-mentioned theoretical perspectives, Figure 3-1 suggests the overarching relationships.

The following subsections illustrate the development process of constructs and sub-constructs which are based on the theoretical framework and the insights from text mining.

3.4 Constructs/sub-constructs Development and Definition

Nine primary constructs (second-order constructs) are developed to achieve the

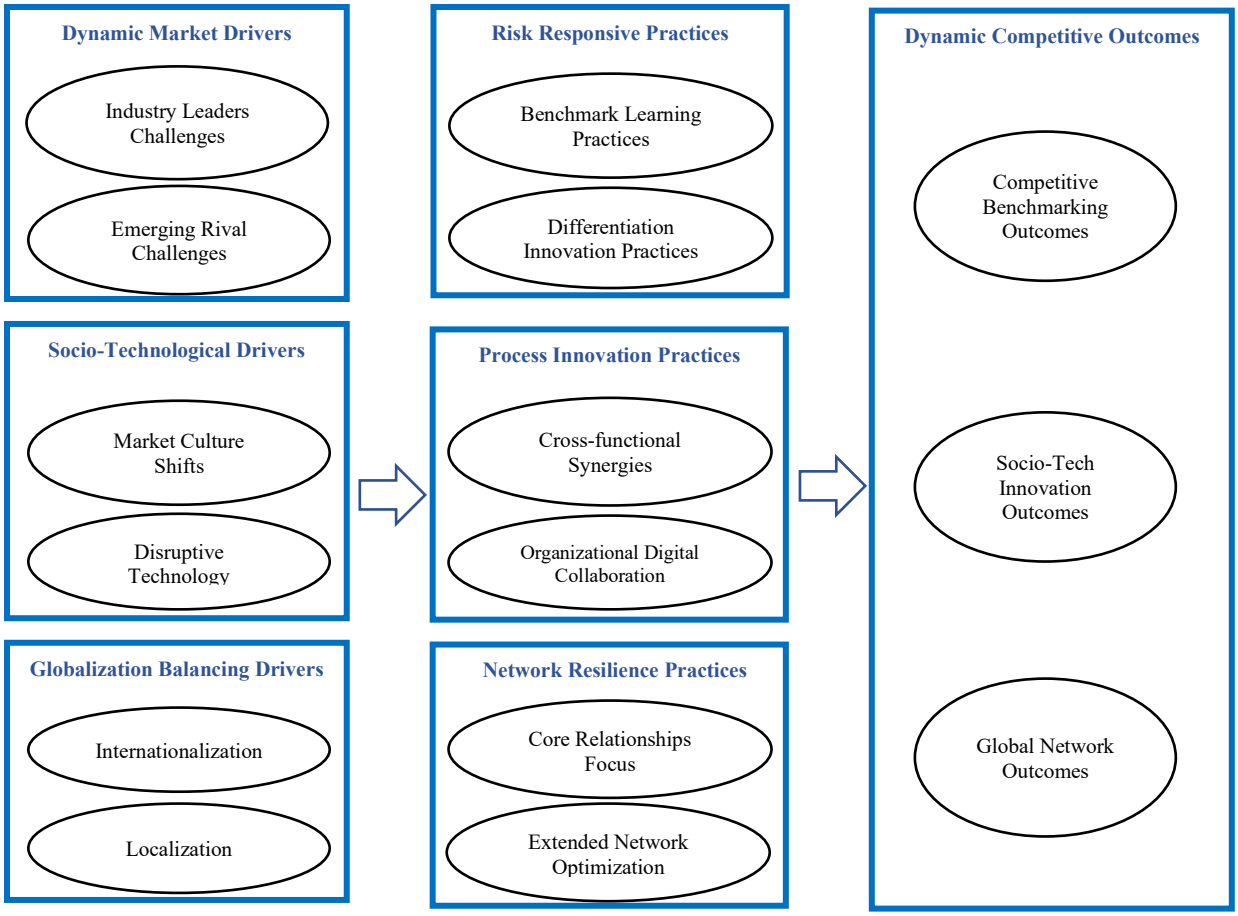

Figure 3–2 Conceptual Model

research objective, including Dynamic Market Drivers, Social Technological Drivers, Globalization Balancing Drivers, Risk Responsive Practices, Process Innovation Practices, Network Resilience Practices, Competitive Benchmarking Outcomes, Socio-Tech Innovation Outcomes, and Supply Chain Outcomes. The development of these constructs is supported by literature in supply chain management, operations management, strategic management, and risk management and the findings derived by the text mining results. We further expand the nine primary constructs to 15 sub-constructs (first-order constructs) to cover richer aspects. The definitions of constructs, subconstructs and associated indicators

are discussed in the following sub-sections. Figure 3.2 shows the conceptual model with constructs and sub-constructs.

3.4.1 Dynamic Market Drivers and the Sub-constructs

Companies should maintain and strengthen the competitive position in the disruption-induced dynamic changing market by mastering the external trend within their radar. The strategic movements of industry leaders (Dawar & Frost, 1999; Ferrier et al., 1999; Kagermann et al., 2013; Oberer & Erkollar, 2018) and the emerging rivals (McMullen et al., 2009; Polidoro, 2013) somewhat represent the next wave of the trend of that industry. Dynamic Market Drivers capture the contextual facet of external reinforcement dimension. It provides the rationale that merely focusing on building internal capabilities is not sufficient to maintain the competitive advantages; companies have to deal with external issues that contain the industry and the even broader environment in which they operate (Porter, 1991). From the risk management perspective, the disruption event is the trigger point of future changes, but it is not the only source causes the subsequent disruptions. We define Dynamic Market Driver as when a company experiences competitive disruptions that demand responses from two major leading groups, industry leader challenges and emerging rival challenges. Industry Leaders Challenges is the sub-construct of Dynamic Market Drivers, representing the competitive and aggressive intent, initiatives, and actions of companies that hold the outstanding market share position with a reputation of excellence (Ferrier et al., 1999). To keep up with the dynamic changes, firms should be sharp with the movement of leading firms. Because disruption events are very likely to break the existing competition environment, and industry leaders would play aggressively to keep their competitive positions. In this case, firms should foresee the new strategic

directions pursued by the leading firms, such as publicized plans of major initiatives, investment plans for market growth, announcement of new product and services, and the formation of partnership alliance with other firms that hold comparable capabilities of itself (Derfus et al., 2008; Haleblian et al., 2012; Ross & Sharapov, 2015; Walter, 2001). Emerging Rival Challenges as the other sub-construct of Dynamic Market Drivers defines the competitive and aggressive intent, initiatives and actions of growing firms and new entrants that hold the potentially threatening market share position with rapid growth track records (Hockerts & Wüstenhagen, 2010; Porter, 2008). Table 3.1 summarize the definition and indicators of Dynamic Market Drivers and the associated sub-constructs.

Table 3.1: Definitions of Dynamic Market Drivers and the Sub-constructs

Dynamic Market Drivers Definition: Firms experience competitive disruptions that demand their responses from two major leading groups: (1) industry leader challenges (i.e., drastic actions of leading incumbent groups that stir up the existing norms and standards of best practice firms in the upper level of industry hierarchy—top-down process); (2) emerging rival challenges (i.e., innovative actions of rising star groups that generate the attention of small and medium-sized business in the grass-root level—bottom-up process).		
Sub-construct and Definition	**Indicators**	**Literature Base**
Industry Leaders Challenges: Competitive and aggressive intent, initiatives and actions of major firms that hold the outstanding market share position with reputation of excellence.	1. Expressed aim of the new strategic direction of leading firms 2. Publicized plans for new significant initiatives of industry leaders 3. Planned investment plans for market growth by key firms. 4. Announcement of new products and services that appear in the market 5. News of the formation of partnership alliances with other firms with comparable capabilities.	(Derfus et al., 2008; Ferrier et al., 1999; Haleblian et al., 2012; Ross & Sharapov, 2015; Walter, 2001)
Emerging Rival Challenges Competitive and aggressive intent, initiatives and actions of growing firms and new entrants hold the potentially threatening market share position with rapid growth track records.	1. Expressed aim of new strategic directions of emerging star firms 2. Publicized plans for new major initiatives of innovative followers. 3. Planned investment plans for market growth by new entrant firms. 4. Announcement of new products and services that appear in the market 5. News of the formation of partnership alliances with firms with superior capabilities.	(Hite & Hesterly, 2001; Hockerts & Wüstenhagen, 2010; Porter, 2008; Talke & Hultink, 2010)

3.4.2 Socio-Technological Drivers and the Sub-constructs

Smith & Bijker (1996) once explains, "…society is not determined by technology, nor is technology determined by society. Both emerge as two sides of the sociotechnical coin…" Socio-Technological Drivers is the contextual background of innovative response dimension under the investigated research theme. During and after major disruption events, we often see the booming

of new technologies. Initially, those technologies are the tools that aim to support the business continuity strategy to survive or the innovation that tries to seize disruption generated unique opportunities. Once those technologies keep upgrading along with the market change requirements, we will see a new series of technologies emerging as disruptive technology (Bower & Christensen, 1995; Kostoff et al., 2004; Lyytinen & Rose, 2003). For example, since the outbreak of the coronavirus pandemic, market culture has shifted to a "low direct contact" pattern (e.g., increased online shopping and work-from-home), which is promoting the digital business model extensively. At the same time, digitalization has also boosted the formulation speed of a new market culture style. Under the pressure of the pandemic and the trade tension, firms relocated part of their supply chain back in-house. Whether transplanting a production line or setting up a new one, it will definitely bring opportunities to make significant process improvements (Shih, 2020). Thus, the market culture shifts and disruptive technology imperatives are the Socio-Technological Drivers of process innovation.

In this study, Socio-technological driver are measured by market culture shifts (i.e., gradual or sudden changes of mindsets, norms, and values that affect buying and selling patterns in the broad segment of the ecosystems) (Acharya, 2004; Amit & Zott, 2010; Flint et al., 2002; Paul Gao et al., 2016) and disruptive technology imperatives (i.e., radical applications of innovative knowledge, procedures and tools with enormous relevance and brad appeal) (Kostoff et al., 2004; UTTERBACK & ACEE, 2005). Table 3.2 presents the definition and indicators of Socio-technological Drivers and sub-constructs.

Table 3.2: Definitions of Socio-Technological Drivers and the Sub-constructs

Socio-Technological Drivers Definition: Socio-technological drivers are measured in terms of market culture shifts (i.e., Gradual or sudden changes of mindsets, norms, and values that affect buying and selling patterns in the broad segments of the ecosystems) and disruptive technology imperatives (i.e., radical applications of innovative knowledge, procedures and tools with enormous relevance and broad appeal).		
Sub-construct and Definition	**Indicators**	**Literature Base**
Market Culture Shifts: Gradual or sudden changes of mindsets, norms, and values that affect buying and selling patterns in the broad segments of the ecosystems	1. Changing mindsets 2. Norms 3. Values 4. Patterns 5. Trends	(Derfus et al., 2008; Ferrier et al., 1999; Haleblian et al., 2012; Ross & Sharapov, 2015; Walter, 2001)
Disruptive Technology Imperatives Radical applications of innovative knowledge, procedures and tools with enormous relevance and broad appeal.	1. Radical applications 2. Innovation knowledge 3. Well-defined procedure 4. Easy to use tools 5. Increased investment of technology	(Hite & Hesterly, 2001; Hockerts & Wüstenhagen, 2010; Porter, 2008; Slater et al., 2014; Venkatesh & Bala, 2008)

3.4.3 Globalization Balancing Drivers and the Sub-constructs

The term "globalization" or "globalisation" first appeared in the early 20th century. In the broader sense, globalization has been defined as the process of interaction and integration among people, businesses, and governments worldwide (Simpson et al., 1994). Countries have built a partnership to facilitate product and service movements over many countries from an economic perspective. In this study, globalization is focused on the area of international trade and the investment flows among countries.

Since the concept of globalization emerged, people always debate on the threats and opportunities of globalization. Firms have gradually shifted their trading focus since the trade tension. More and more countries and firms even focus on deglobalization, anti-globalization, or localization strategy after the COVID-19 pandemic, which due to the overlook of the threats of globalization (Gwynn Guilford, 2020; Marco Rubio, 2020; Neil Irwin, 2020). A series of actions,

such as reshoring and supply chain move in-house (Shih, 2020) has been taken. This phenomenon has also raised the concern of what extent a firm should minimize globalization's threat, especially during a crisis (Dawar & Frost, 1999; Dreher, 2006; Martin Sandbu, 2020; Minister S Jaishankar, 2020). In this study, Globalization Balancing Drivers discusses that to strategically respond to the post disruption impacts, a rational decision-making mindset is needed under the pressure of macro-level trends. Thus, Globalization Balancing Driver explains that firms aim to develop their international influence by expanding their business networks on an international scale to build competitive advantages. The degree of balancing a firm's internationalization and localization is crucial for long-term success. Any extreme preference of one of the two sides will dampen the ability to rise to global challenges. The sub-constructs of Globalization Balancing Drivers are Internationalization and Localization, which are two distinct directions of globalization strategy. Internationalization refers to the efforts and processes to discover, design, develop and deliver values across countries in the world to enlarge the scale and scope of business activities with a more significant customer pool (Lu & Beamish, 2001; Schweizer et al., 2010). While Localization refers to the efforts and processes to discover, design, develop and deliver values within specific countries to explore and enlarge the scale and scope of business activities with local, regional and domestic customers (Acharya, 2004; N. Singh, 2011). Table 3.3 summarizes the definition and indicators of Globalization Balancing Drivers and the sub-constructs.

Table 3.3: Definitions of Globalization Balancing Drivers and the Sub-constructs

Globalization Balancing Drivers Definition: Firms aim to develop their international influence or expand their business networks on an international scale to build competitive advantages. The degree of balancing a firm's internationalization and localization is crucial for long-term success, any extreme preference of one of the two sides (internationalization and localization) strategy will dampen the ability to rise to the global challenges.		
Sub-construct and Definition	**Indicators**	**Literature Base**
Internationalization: The efforts and processes of discovering, designing, developing and delivering values across countries in the world to enlarge the scale and scope of business activities with larger customers pools.	1. Discovery efforts new value creation potential beyond national boundaries 2. Design thinking and practices for translating new ideas into tangible products and innovative services in multiple countries 3. Development processes of individual, team and firm capabilities for target market segments of many countries 4. Differentiate customer and market segments by demographic factors 5. Delivering value to respond to cross-national customer needs	(Dawar & Frost, 1999; Dreher, 2006; Lu & Beamish, 2001; Martin Sandbu, 2020; Minister S Jaishankar, 2020; Schweizer et al., 2010)
Localization: The efforts and processes of discovering, designing, developing and delivering values within specific countries to explore and enlarge the scale and scope of business activities with local, regional and domestic customers.	1. Discovery efforts new value creation potential within a specific national boundary 2. Design thinking and practices for translating new ideas into tangible products and innovative services in a single target country 3. Development processes of individual, team and firm capabilities for domestic market segments 4. Differentiate customer and market segments by demographic factors of the target country 5. Delivering value to respond to domestic customer needs	(Acharya, 2004; Dreher, 2006; Irvine et al., 2009; Kumaraswamy et al., 2012; N. Singh, 2011)

3.4.4 Risk Responsive Practices and the Sub-constructs

Risk management as an emerging topic has been applied in many disciplines (e.g., accounting, marketing, finance, information system, supply chain and operations, etc.) (DuHadway et al.,

2019; Gordon et al., 2009; Ivanov & Dolgui, 2020). Risk Responsive Practices capture the structural facet of the external reinforcement dimension. In relation to broad risk management pressure identified by Dynamic Market Drivers (Industry Leader Challenges and Emerging Rival Challenges), firms take appropriate reactions to keep with the best and emerging leader practices (i.e., benchmark learning practices) and develop their unique positioning initiatives (differentiation innovation practices). Practices of responding to certain risks are discussed in previous literature. Wiengarten et al. (2016) investigate the effective risk management practices from a restructuring supply strategy perspective to assess and mitigate the supplier-induced disruption. Tang (C. S. Tang, 2006) synthesizes multiple sources of supply chain risks and their associated responding practices. For instance, (1) product bundling would reduce the negative impact of a sudden shift of demand across time, markets and products (W. Wang et al., 2013); (2) collaborative forecasting and inventory management are effective strategic practices in mitigating the disruptions cause by poor supplier and customer relationship management (Qi et al., 2004).

There are limited literature focus on responsive risk management practices from the challenges of industry leaders and emerging rivals. This study proposed that Risk Responsive Practices consist of two sub-constructs: Benchmark Learning Practices and Differentiation Innovation Practices. Benchmark Learning Practices argues that adopt the practices from current industry leaders (i.e., firms that represent the standard of excellence in the industry) in the form of innovative business model, advanced technology, cutting-edge knowledge practices, forward-thinking operational practices and effective leadership management practices can help firms to sustain market position in the industry (Ferrier et al., 1999; Haleblian et al., 2012). Differentiation Innovation Practices emphasized developing and implementing firm context-specific and unique practices in innovative business models, advanced technology, firm-driven operational practices,

and organizational-based leadership management to compete with emerging rivals and existing competitors (Hall et al., 1968; Zehir et al., 2015). Table 3.4 presents the definition and indicators of Risk Responsive Practices and the Sub-constructs.

Table 3.4: Definitions of Risk Responsive Practices and the Sub-constructs

Risk Responsive Practices Definition: Firms aim to develop their international influence or expand their business networks on an international scale to build competitive advantages. The degree of balancing a firm's internationalization and localization is crucial for long-term success, any extreme preference of one of the two sides (internationalization and localization) strategy will dampen the ability to rise to the global challenges.		
Sub-construct and Definition	**Indicators**	**Literature Base**
Benchmark Learning Practices Adopt the practices of current industry leaders (i.e., firms that represent the standard of excellence in the industry) in the form of innovative business models, advanced technology, cutting-edge knowledge practices, forward-thinking operational practices, and effective leadership management to sustain market position in the industry.	1. Leading innovative business model 2. Disruptive advanced technology 3. Industry cutting-edge knowledge 4. Trend setting operational practices 5. Leading effective leadership management	(Alavi & Leidner, 2001; Andriopoulos & Lewis, 2010; Ferrier et al., 1999; Haleblian et al., 2012)
Differentiation Innovation Practices Develop and implement firm context-specific and unique practices in innovative business models, advanced technology, cutting-edge knowledge practices, forward-thinking operational practices, and effective leadership management to develop unique products or services that stand out from the competitors.	1. Firm-specific revised business model 2. Specially adopted advanced technology 3. Newly adopted knowledge practices 4. Firm-driven operational practices 5. Organizational-based leadership management	(Amagoh, 2009; Geissdoerfer et al., 2018; Hall et al., 1968; Teece, 2010; Zehir et al., 2015)

3.4.5 Process Innovation Practices

Process innovation has been extensively investigated in manufacturing operations, reflecting changes in the way firms create and deliver products and services. Literature has studied the dynamic relationship between product innovation and process innovation (Adner & Levinthal, 2001; Murat Ar & Baki, 2011), investigated the impact of R&D expenditures on innovation process (Avermaete et al., 2004), examined the specific process innovation like re-engineering process and

closed-loop process on firm performance (Fondas, 1993; Reimann et al., 2019), and analysed how the newly introduced technologies support growth capabilities in operation process (Camisón & Villar-López, 2014; Najafi-Tavani et al., 2018). However, less literature studied process innovation from the socio-technological perspective. This study argues that process innovation involves manufacturing operations, but it should also expand to the collaboration aspect of all functional areas. Thus, we examine the process innovation process as the structural facets of the innovative response dimension by looking at the coordination of social and technical aspects.

In this study, Process Innovative Practices represents internal collaborative coordination practices. There are two sub-constructs of Process Innovation Practices, they are Cross-functional Synergies and Organizational Digital Collaboration. Cross-functional Synergies explains the social behavioral competencies of diverse functions through which people from different areas of an organization work together toward a common goal to generate outcomes greater than the sum of their separate effects (Allred et al., 2011; Aurand et al., 2005; Maruping & Magni, 2015; Tsai & Hsu, 2014). Organizational Digital Collaboration refers to the systematic linkages and interactive integration of technological capabilities (e.g., enabling descriptive, predictive and prescriptive analytic tools) to support value creation-deliver-capture processes and improve decision making quality for achieving desirable performance outcomes (Ivanov & Dolgui, 2020; Kane et al., 2017; McGrath & McManus, 2020; Sherman, 2020). Table 3.5 summarizes the definition and indicators of Process Innovation Practices and the sub-constructs.

Table 3.5: Definitions of Process Innovation Practices and the Sub-constructs

Process Innovation Practices

Definition: The Internal collaborative coordination practices of (1) behavioral competencies of diverse functions (i.e., cross-functional synergies) and (2) technological capabilities of digital infrastructure that enable systematic linkages and interactive integrations (i.e., digitalization).		
Sub-construct and Definition	**Indicators**	**Literature Base**
Cross-functional Synergies the internal collaborative coordination of behavioral competencies of diverse functions through which people from different areas of an organization work together toward a common goal to generate outcomes greater than the sum of their separate effects.	1. Communicate company-wide policy guidelines 2. Install systematic infrastructure linkages 3. Setup for interactive communication 4. Institute decision-making process system 5. Integrate enterprise-wide information platforms	(Allred et al., 2011; Aurand et al., 2005; Luca & Atuahene-Gima, 2007; Maruping & Magni, 2015; Tsai & Hsu, 2014)
Organizational Digital Collaboration Systematic linkages and interactive integration of technological capabilities (e.g., enabling descriptive, predictive and prescriptive analytic tools) to support value-creation-capture processes and improve decision making quality for achieving desirable performance outcomes.	1. Use of virtual platforms for shared common goals 2. Implement cross-functional on-line work practices 3. Aim interactive digital integration 4. Use AI-based descriptive analytical tools for problem definition 5. Apply programmed predictive analytic tools for managing supply chain risks. 6. Adopt digital prescriptive analytic tools for long-term goals implementation.	(Ivanov & Dolgui, 2020; Kane et al., 2017; McGrath & McManus, 2020; Ritala et al., 2014; Sherman, 2020)

3.4.6 Network Resilience Practices

Disruptive events, whether natural disasters, intentionally induced accidents, political changes, or common failures, could impact significantly when they lead to network-level failures. The concept of network resilience has been studied under vulnerable contexts; it is the ability of the network to “bounce back” to the desired performance. Previous literature focuses on how engineer networks are resilient to challenges from an internal process design perspective (Smith et al., 2011) and infrastructure networks collaboration perspective (Barker et al., 2013; Reggiani, 2013). Internet durability is another major area to study network resilience. It portrays the internet

as the critical infrastructure that business and daily life depend on to ensure resilience if fundamental design property of the internet (Henry & Emmanuel Ramirez-Marquez, 2012; Sterbenz et al., 2011). Kim et al. (2015) pointed out that a network-level understanding of supply disruption is vital for firms to prevent and mitigate a supply disruption's adverse effects. We adopt this argument (i.e., from network-level to overlook supply chain disruption) to extend the concept of network resilience to a broader sense, which considers both the supply side and demand side.

Network Resilience Practices proposed by this study is the structural facet of the Macro-trend impel dimension. With the increasing impacts of the coronavirus pandemic, localize supply and demand network has been pushed to an imperative position (Gwynn Guilford, 2020; Martin Sandbu, 2020). Does it worth to firm taking back or redeveloping its ecosystem because of a major disruption event? We argue that instead of taking extreme actions, firms should build up resilient network capabilities through optimizing the core relationship and extended network management. Core Relationship Focus talks about the internal functional cores within a focal firm that is instrumental in relating to key suppliers and customers (e.g., first tier) in terms of involving in the primary value creation process of strategic planning, product development, sourcing and operation (Banker et al., 2020; Shih, 2020). While Extended Network Optimization discusses that the internal enable functions within a focal firm that are fundamental in expanding customer and suppliers (second and third tiers) at large involving in the secondary value creation process of infrastructure development, logistics, performance measure, post-sales management, etc. (Crespin-Mazet & Dontenwill, 2012). Multiple sourcing in core relationships will somehow mitigate the side effects of supplier-induced disruptions. Qualifying alternative suppliers, collecting and measuring supplier continuity plans, and relying on suppliers and subcontractors who are specialists for the crucial components allow the firm to build resilient networks. Thus,

Core Relationship Focus and Extended Network Optimization are equally important practices to achieve network resilience. Table 3.6 presents the definition and indicators of Network Resilience Practices and the Sub-constructs.

Table 3.6: Definitions of Network Resilience Practices and the Sub-constructs

Network Resilience Practices Definition: External interactive collaboration within the overall ecosystem that consists of Core Relationship Focus (i.e., internal functional cores within a focal form that are instrumental in relating to key suppliers and key customers in terms of involving in primary value creation processes of strategic planning, product development, sourcing and operations) and. Extended Network Optimization (i.e., internal functional support or enable functions within a focal firm that are instrumental in expanding customers and suppliers at large involving in secondary value creation processes of infrastructure development, logistics, performance measurement and post-sales management)..		
Sub-construct and Definition	**Indicators**	**Literature Base**
Core Relationship Focus Internal functional cores within a focal firm (e.g., management, marketing and supply chain) that are instrumental in relating to key customers and key suppliers (e.g., 1st tier) in terms of involving in primary value creation processes of strategic planning, product development, sourcing and operations.	1. Collaboration between management, marketing and supply chain 2. Interactions with the first-tier supplier 3. Engagement with key customers (in terms of sales value) 4. Cross-functional activities in primary business processes (i.e., strategic planning, product development, sourcing and operations)	(Banker et al., 2020; Benton & Maloni, 2005; Hallikas et al., 2004a; Shih, 2020; Shin et al., 2000)
Extended Network Optimization Internal support/enable functions within a focal form (e.g., IT, HR, Accounting, Finance, logistics) that are instrumental in expanding customers and suppliers (2nd and 3rd tier suppliers) at large involving in secondary value creation processes of infrastructure development, logistics, performance measurements and post-sales management.	1. Collaboration between IT, HR, Accounting, Finance, and Logistics. 2. Interactions with the second and third-tier suppliers 3. Engagement with secondary customers (in terms of sales value) 4. Cross-functional activities in supportive business process (i.e., infrastructure development, logistics performance measurement and post sales management)	(Crespin-Mazet & Dontenwill, 2012; Ehrgott et al., 2011; Marshall et al., 2015; McDermott & Corredoira, 2010; M. Wang et al., 2016)

3.4.7 Competitive Benchmarking Outcomes

Business continuity is the priority of a firm during and after a major disruption. Maintaining competitive operational performances is the core of surviving in the vulnerable world (Voss et al., 1997). To evaluation a firm's competitiveness, firms should compare their performance against competitors. Industry leaders' excellent performances and emerging rivals set standards to the focal firm to improve its competence. Benchmarking performances are a set of fact-based performance measures that can accurately describe world-class business performances (Stewart, 1995; Vorhies & Morgan, 2005; Voss et al., 1997). Stewart (1995) illustrates that benchmarking performances in supply chain management consist of quantitative performances (e.g., cash-to-cash cycle time, logistics cost, etc.) and qualitative performances (e.g., flexibility, online delivery, responsiveness, etc.). In this study, Competitive Benchmarking Outcomes refers to the results of a firm's evaluation of their key traditional operational outcomes against the competitors or the "best-in-class companies" to determine how to achieve performance levels (Camp, 1989). It will be measured from cost competitiveness, product quality, delivery performance, manufacturing flexibility, logistic performance, and customer responsiveness aspects.

3.4.8 Process Innovation Outcomes

The success of process innovation is an important indicator and determinant of financial performance outcomes (Murat Ar & Baki, 2011; Song, 2006). Process innovation nowadays are benefits from the implementation of digital tools and machine learning (McGrath & McManus, 2020; Oberer & Erkollar, 2018; Sherman, 2020). We proposed that Process Innovation Outcomes is the performance facet of the theoretical framework's innovative response dimension. From the contextual facet of Socio-technological drivers to structural facts of Process Innovation Practices, this dimension aims to measure the internal results of cross-functional collaboration and

technology-driven value creation outcomes through interfaces of behavioral and technological practices. We will estimate it from technology adoption success, cross-functional problem solving, social-automation productivity aspects.

3.4.9 Supply Chain Outcomes

Supply chain management has been defined in different contexts, there are various definitions of supply chain management (Mentzer et al., 2001; Stewart, 1995; Stock & Boyer, 2009). The majority of those definitions perceive supply chain management as the management of a network of relationships within a firm and between interdependent business units. In this study, we define Supply Chain Outcomes as the external results of supplier and customer network-driven outcomes plus cross-industry network outcomes. It will measure supply chain competitiveness, integration, transparency, maturity, flexibility and responsiveness. Table 3.7 summarize the definition and indicators of performance outcomes constructs.

Table 3.7: Definitions of Performance Outcomes

Sub-construct and Definition	Indicators	Literature Base
Competitive Benchmarking Outcomes The Results of the firm's evaluation of their key traditional operational outcomes against the competitors or the "best-in-class companies" determine how to achieve performance levels.	1. Cost Competitiveness 2. Product Quality Reputation 3. Delivery Performance 4. Manufacturing Flexibility 5. Logistics Performance 6. Customer Responsiveness	(Gerwin, 1993; Reichhart & Holweg, 2007; Stewart, 1995; Vorhies & Morgan, 2005; Voss et al., 1997).
Process Innovation Outcomes The internal results of cross-functional collaboration and technology-driven value creation outcomes through interfaces of behavioral and technological practices.	1. Customer Satisfaction Ratings 2. Technology Adoption Success 3. Process Innovation Impacts 4. Cross-functional Problem Solving 5. Socio-Automation Productivity	(McGrath & McManus, 2020; Oberer & Erkollar, 2018; Sherman, 2020; Tsai & Hsu, 2014)
Supply Chain Outcomes The external results of supplier and customer network-driven outcomes plus cross-industry network outcomes.	1. Supply Chain Competitiveness 2. Supply Chain Integration 3. Supply Chain Transparency 4. Supply Chain Maturity 5. Supply Chain Flexibility 6. Supply Chain Responsiveness	(Egels-Zandén et al., 2015; Mentzer et al., 2001; Stewart, 1995; Stock & Boyer, 2009)

Chapter 4

4 Research Model and Hypotheses Development

Out research model in Figure 4.1 is developed based on the theoretical foundation and theoretical framework proposed in previous chapters. The hypothesis is developed from 18 distinct sets to investigate the relationship among constructs of the research model. Through hypothesis testing, we clarify the contingency relationship among external reinforcement dimension (e.g., immediate impacts from dynamic market challenges of major disruption event), innovative response dimension (e.g., subsequent influences from socio-technological coordination imperatives to respond major disruption event), and macro-trend impel dimension (e.g., post-hoc readjustment from global network changes perspective); identify the causal relationships that is governed by risk management framework from risk source identification and assessment stage (e.g., dynamic drivers), mitigation and prediction stages (e.g., responsive practices), and recovery measurement stages (e.g. performance outcomes); and enable us to formulize a guideline for academics and practitioners to response to the major disruption events.

The first three categories of hypothesis investigated the relationship between Dynamic Market Drivers with three responsive practices (Risk Responsive Practices, Process Innovation Practices, and Network Resilience Practices), respectively. These three sets of hypotheses are built on Risk Management Framework and Benchmarking theory. Hypothesis 4 to hypothesis 6 are supported by Institutional Theory and Socio-technological theory. Hypothesis 7 to 9 are developed based on Network Theory. The rest of the hypothesis primarily discusses the relationship between

responsive practices and dynamic competitive outcomes built on performance theory.

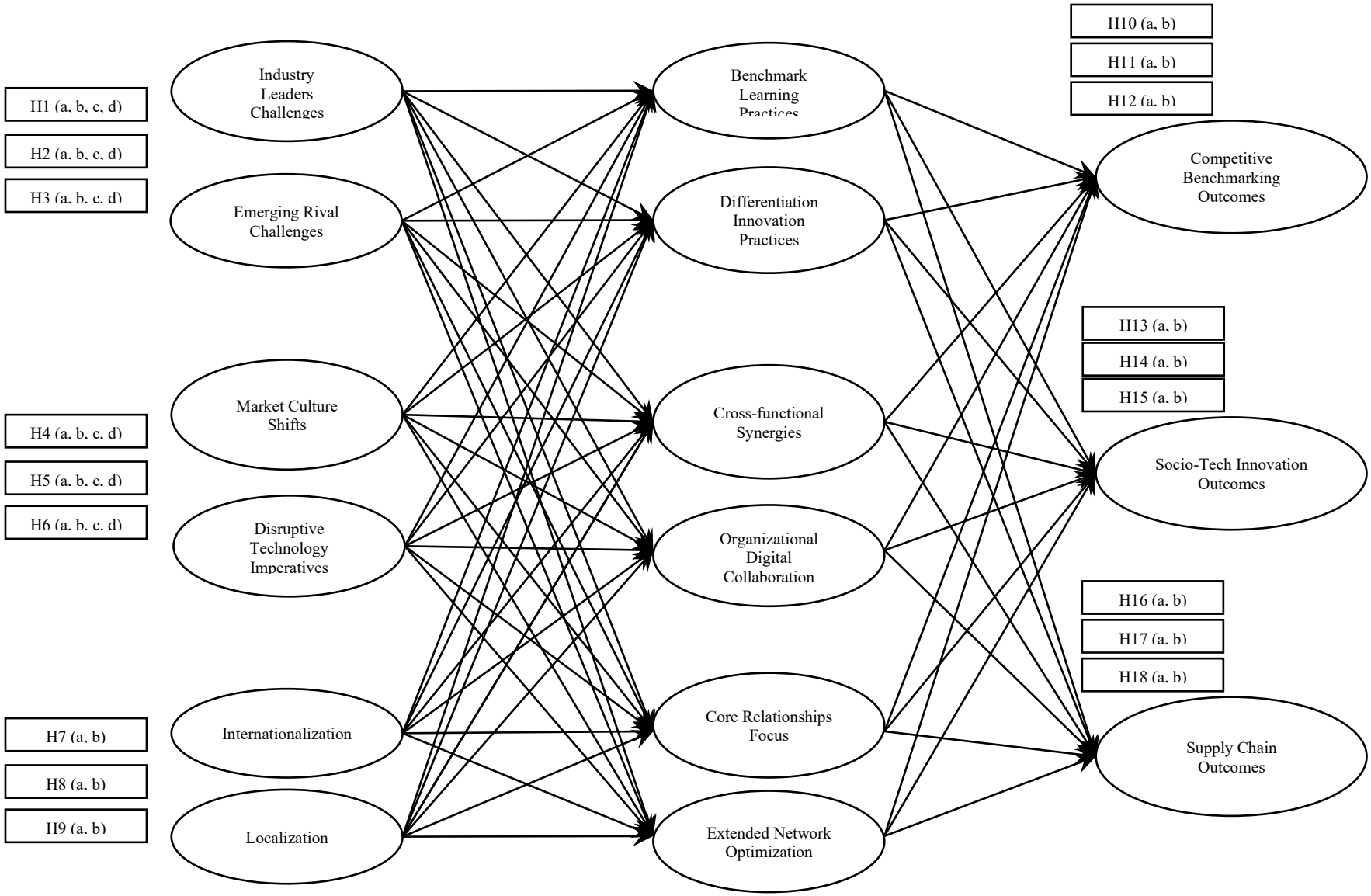

Figure 4–1. Research Model- Hypothesized Model

4.1 Dynamic Market Drivers and Responsive Practices

The Risk Management Framework suggests that the first step of risk management should be the identification of risk sources. This dissertation's main theme is the investigation of exacerbating sources of risk pressure after a major disruption event occurred. Dynamic Market Drivers is the direct and immediate risk sources we have identified in the theoretical formulation session, including Industry Leader Challenges and Emerging Rival Challenges. Right after the hit of major disruption events, the supply and demand network will change dramatically due to the disruptions' impacts. Seizing the optimal level of demand is the priority to maintain the business continuity status, industry leaders are more likely to implement aggressive competitive strategy than standard operations. In this case, small and medium-size firms within the industry will face more challenges from the industry leaders. On the other hand, with the dynamic changes of the market culture, new opportunities start emerging. New rivals hold disruptive technology and business models become significant challenges to incumbent firms.

Benchmarking has been described as a management tool that represents a systematic process of searching for best practices, innovative ideas and efficiencies that lead to continuous improvement (Camp, 1989; Peng Wong & Yew Wong, 2008). Dobrzykowski et al. (2012) conceptualize Benchmarking Theory into various schemes, organizational strategy-driven benchmarking, operational effectiveness-based and technical efficiency-based benchmarking, and Macro-level benchmarking.

4.1.1 Hypothesis 1: The impact of Dynamic Market Drivers on Risk Responsive Practices

Based on The Risk Management Framework and strategy-driven scheme of Benchmarking Theory, we further develop the hypotheses between Dynamic Drivers and Risk Responsive

Practices. The organizational strategy-driven benchmarking scheme provides a theoretical base of the relationships between Dynamic Market Drivers and Risk Responsive Practices. To enhance organizational competitiveness, learning practices are critical for the business continuities (Blome et al., 2014; García-Morales et al., 2012; Hernández-Espallardo et al., 2010). To stand out from competitors and formulate unique competence, differentiation innovation practices are essential for long-term survival (Jansen et al., 2009; Naidoo, 2010). Thus, we hypothesize:

H1a: The better recognition of Industry Leaders Challenges the better formulation and implementation of Benchmarking Learning practices.

H1b: The better recognition of Industry Leaders Challenges the better formulation and implementation of Differentiation Innovation Practices.

H1c: The better recognition of Emerging Rival Challenges the better formulation and implementation of Benchmarking Learning Practices.

H1d: The better recognition of Emerging Rivals Challenges the better formulation and implementation of Differentiation Innovation Practices.

4.1.2 Hypothesis 2: The impact of Dynamic Market Drivers on Process Innovation Practices

According to the Risk Management Framework and operational effectiveness-based and technical efficiency-based scheme of Benchmarking Theory, we hypothesize the relationship between Dynamic Market Drivers and Process Innovation Practices. Benchmarking needs to be supported by a proper system conducive to managing relationships and increasing the level of coordination (P. Hong et al., 2012; Voss et al., 1997). Cross-functional Synergies have been conceptualized as part of Process Innovation Practices that contribute to operational effectiveness (J. Lee et al., 2019). Technical efficiency-based benchmarking illustrates the importance of

implementing particular techniques and tools to improve technical outcomes or facilitate functional collaboration (A. Ahmed et al., 2007; P. Hong et al., 2012). Organizational Digital Collaboration as an essential aspect of the Process Innovation Process describes the imperatives of implementing digital tools to improve organizational collaboration (Doyle, 2013; McGrath & McManus, 2020; Sherman, 2020). Coordination thery refers to how coordination could occur in diverse systems and that coordination manages dependencies between activities to achieve a holistic objective (Crowston, 1997; Malone, 1988; Malone & Crowston, 1990). Therefore, we hypothesize,

H2a: The better recognition of Industry Leaders Challenges the better formulation and implementation of Cross-functional Synergies.

H2b: The better recognition of Industry Leaders Challenges the better formulation and implementation of Organizational Digital Collaboration.

H2c: The better recognition of Emerging Rival Challenges the better formulation and implementation of Cross-functional Synergies.

H2d: The better recognition of Emerging Rival Challenges the better formulation and implementation of Organizational Digital Collaboration.

4.1.3 Hypothesis 3: The impact of Dynamic Market Drivers on Network Resilience Practices

The macro-level scheme of Benchmarking Theory proposed by Dobrzykowski et al. (2012) argues that benchmarking has been moved beyond the organizational level as the competitive battleground has expanded into the global market. Macro-level benchmarking that incorporates networks in a broader ecosystem is needed to help recover major disruptions (Gao & Li, 2010; Ribeiro & Cabral, 2006). Network Resilience Practices from a macro-level network benchmarking aspect decompose two dimensions: Core Relationship Focus and Extended Network Optimization.

It reveals that firms should maintain and strengthen the relationships with primary suppliers and customers to formulate a resilient network (Hallikas et al., 2005; Sheffi & Rice, 2005), as well as extend and optimize the chain structure through validating potential and alternative suppliers and customers (Sherman, 2020; Urciuoli et al., 2014). Hence, we hypothesize.

H3a: The better recognition of Industry Leaders Challenges the better formulation and implementation of Core Relationships Focus practices.

H3b: The better recognition of Industry Leaders Challenges the better formulation and implementation of Extended Network Optimization practices.

H3c: The better recognition of Emerging Rival Challenges the better formulation and implementation of Core Relationships Focus practices.

H3d: The better recognition of Emerging Rival Challenges the better formulation and implementation of Extended Network Optimization practices.

4.2 Socio-Technological Drivers and Responsive Practices

The second source we identified by following the Risk Management Framework is the subsequent influence after the major disruptions which have been conceptualized as Socio-Technological Drivers. It takes time to appear for the social and technical impacts after the disruption. The market culture will gradually shift along with the changing pattern of buying and selling behavior. For example, at the beginning of the COVID19 pandemic, people with a panic buying mindset clean up the toilet paper, sanitizing products or food on the grocery store's shelf. Since people begin to realize that crowded grocery stores will increase the possibility of getting the virus, people switch to curbside pick-up and online shopping. Therefore, we argue that Market Culture Shifts as the social driver of the dynamic changes after the major disruptions would impact the formulation of disruption responsive practices. On the other hand, disruptive technology most

often emerges with the realization of the new market culture. The new disruptive technology plays as a supportive force to speed up the dynamic changes after the disruption events.

The Socio-technological Theory provides a framework for successful organizational change with respect to technology (Berkhout et al., 2004; Rohracher, 2001; Scillitoe et al., 2018). To expand socio-technological theory, a stream of literature studies it as a systems approach that proposes to utilize new technologies to gain competitive advantages by aligning organizational change methods and techniques to help individuals and groups make the best performances (Appelbaum, 1997).

4.2.1 Hypothesis 4: The impact of Socio-Technological Drivers on Risk Responsive Practices

Based on Risk Management Framework and Socio-Technological Theory, Market Culture Shifts and Disruptive Technology Imperatives represent the subsequent social-technological influences of the major disruptions. With both market and technical pressure, firms are more likely to learn the best available practices from industry leaders (Doyle, 2013; Yadav et al., 2013). Fostering the new market culture and emerging technologies to respond to disruption-induced pressure, innovative coordination mechanisms between these two aspects are essential to the firm. Thus, we hypothesize,

H4a: The better recognition of Market Culture Shifts the better formulation and implementation of Benchmarking Learning Practices.

H4b: The better recognition of Market Culture Shifts the better formulation and implementation of Differentiation Innovation Practices.

H4c: The better recognition of Disruptive Technology Imperatives the better formulation and implementation of Benchmarking Learning Practices.

H4d: The better recognition of Disruptive Technology Imperatives the better formulation and

implementation of Differentiation Innovation Practices.

4.2.2 Hypothesis 5: The impact of Socio-Technological Drivers on Process Innovation Practices

According to the Risk Management Framework and Socio-technological Theory, we hypothesize the relationship between Socio-Technological Drivers and Process Innovation Practices are positive. This paper's theoretical foundation illustrates that the innovative response dimension tackle that firm should provide latitude among those well-defined and familiar choices and create new ones (Porter, 1991) from a dynamic theory perspective. Refers to the "context-structure-performance" framework proposed by contingency theory, Socio-technological Drivers is the contextual element and Process Innovation Practices is the structural element of the innovative response dimension. Thus, we hypothesize

H5a: The better recognition of Market Culture Shifts the better formulation and implementation of Cross-functional synergies.

H5b: The better recognition of Market Culture Shifts the better formulation and implementation of Organizational Digital Collaboration.

H5c: The better recognition of Disruptive Technology Imperatives the better formulation and implementation of Cross-functional synergies.

H5d: The better recognition of Disruptive Technology Imperatives the better formulation and implementation of Organizational Digital Collaboration.

4.2.3 Hypothesis 6: The impact of Socio-Technological Drivers on Network Resilience Practices

Network resilience means developing capabilities to quickly respond and recover from a disruption event from stable and strong relationships within your supply chain members (Barker et al., 2013; Golan et al., 2020). Firms should equip resilient network capabilities through

optimizing the core relationship and extended network management. The Core Relationship Focus talks about the internal functional cores within a focal firm that are instrumental in relating to key suppliers and customers (e.g., first tier) who involve in primary value creation process of strategic planning, product development, sourcing and operation (Banker et al., 2020; Shih, 2020). While Extended Network Optimization discusses that the internal enable functions within focal firm that are fundamental in expanding customer and suppliers (second and third tiers) at large involving in secondary value creation process of infrastructure development, logistics, performance measure, post sales management, etc. (Crespin-Mazet & Dontenwill, 2012). Market Culture shifts are more than likely to drive the improvement of relationship management between focal firms and their suppliers and customers at all levels to survive from the disruptions. Disruptive Technology will facilitate a more transparent, flexible communication process among the supply chain members in a timely manner. Therefore, we hypothesize,

H6a: The better recognition of Market Culture Shifts the better formulation and implementation of Core Relationship Focus.

H6b: The better recognition of Market Culture Shifts the better formulation and implementation of Extended Network Optimization.

H6c: The better recognition of Disruptive Technology Imperatives the better formulation and implementation of Core Relationship Focus.

H6d: The better recognition of Disruptive Technology Imperatives the better formulation and implementation of Extended Network Optimization.

4.3 Globalization Balancing Drivers and Responsive Practices

Globalization Balancing Drivers is defined as a range between internationalization and localization. The combination of these two business development processes should coexist instead

of holding a preference of either extreme. Globalization is interdependent with markets, and incumbents or entrants' strategic actions strongly influence market structures. The entire business world has reached some level of globalization, meaning markets in different regions are directly and indirectly connected. The connections among markets can be positive when they have a cooperative relationship (e.g., joint activity, alliance, common ownership). It can also be negatively connected because they compete to develop exchange relationships with a third party (Mattsson, 2003). Globalization Balancing Drivers is the macro-level pressure for firms to identify potential risks in globalization's process and status.

The interdependence between globalization and markets falls into the scope of Network Theory that considers multidimensional networks. The dynamic relationship in the networks between economic actors who control resources and carry out activities determines the application of strategic and operational practices in different scenarios. The economic actors here can be cooperative or competitive.

4.3.1 Hypothesis 7: The impact of Globalization Balancing Drivers on Risk Responsive Practices

From Risk Management Framework and Network Theory, we argue that Globalization Balancing Drivers are macro-level impacts to control or adjust firm-level strategic and operational practices. There are two opposite directions of globalization, which are internationalization and localization. A high level of internationalization involves relatively complicated and broad markets; it provides more resources and knowledge to facilitate learning practices and differentiation practices. However, it also obtains more extensive competition to force a firm to make changes. When the competition level exceeds the firm's ability to handle, then the impact will turn negative (Dreher, 2006; Polsa & Fan, 2011). While a high level of localization firms would be constrained in a relatively narrow market, it would also impact on the initiation of continuous learning and

differentiation practices. Thus, we hypothesize,

H7a: The better recognition of the level of Internationalization the better formulation and implementation of Benchmarking Learning Practices.

H7b: The better recognition of the level of Localization the better formulation and implementation of Benchmarking Learning Practices.

H7c: The better recognition of the level of Internationalization the better formulation and implementation of Differentiation Innovation practices.

H7d: The better recognition of the level of Localization the better formulation and implementation of Differentiation Innovation Practices

4.3.2 Hypothesis 8: The impact of Globalization Balancing Drivers on Process Innovation Practices

From social (i.e., Cross-functional Synergies) and technical (i.e., Organizational Digital Collaboration) collaboration perspectives, we developed Process Innovation Practices. From both internationalization and localization perspectives, process innovation is the critical success factor to develop competitive capabilities to enable socio-technical collaboration (e.g., hold common goal to search new technologies, quick adoption of potential technologies, better implementation of emerging technologies) (Appelbaum, 1997; Spender, 1996). With the balanced concentration among the internationalization and localization development processes, firms could obtain more flexibility in optimizing the resource allocation plan.

Therefore, we hypothesize,

H8a: The better recognition of the level of Internationalization the better formulation and implementation of Cross-functional Synergies Practices.

H8b: The better recognition of the level of Localization the better formulation and implementation of Cross-functional Synergies Practices.

H8c: The better recognition of the level of Internationalization the better formulation and implementation of Organizational Digital Collaboration practices.

H8d: The better recognition of the level of Localization the better formulation and implementation of Organizational Digital Collaboration practices.

4.3.3 Hypothesis 9: The impact of Globalization Balancing Drivers on Network Resilience Practices

Network Resilience Practices capture the dimensions of Core Relationship Focus and Extended Network Optimization. Core Relationship Focus means firms should prioritize the management within the pool of their suppliers and customers. For example, functional departments of management, marketing, and supply chain should maintain regular communication with first-tier partners to enable the ongoing improvement of the primary value creation process. Simultaneously, the internal support functions should always be dedicated to expanding the firms' customers and suppliers' pool to optimize customer relationship management and supplier relationship management.

Globalization provides network management a diverse foundation of utilizing the available global resources and knowledge (Bromiley & Rau, 2016; Mahoney & Pandian, 1992). The more balance between Internationalization and Localization, the better for optimizing the use of those resources' ad knowledge. Hence, we hypothesize,

H9a: The better recognition of the level of Internationalization the better formulation and implementation of Core Relationship Focus Practices.

H9b: The better recognition of the level of Localization the better formulation and implementation of Core Relationship Focus Practices.

H9c: The better recognition of the level of Internationalization the better formulation and implementation of Extended Network Optimization Practices.

H9d: The better recognition of the level of Localization the better formulation and implementation of Extended Network Optimization Practices.

4.4 Risk Responsive Practices and Performance Outcomes

Risk Responsive Practices as the contextual aspect of the external reinforcement dimension argues that firms have to hold comprehensive understandings of the industry it operates in to respond to the immediate impact of disruption events. Without understanding the external factors, firms could not get the best results out of a set of strong internal capabilities. Performance theory affirms that organizational outcomes result from implementing multi-dimensional practices, while one contextual approach will not be limited to the only impact on the performance within the same norms (Donaldson, 2006; Sousa & Voss, 2008; Umanath, 2003; Yadav et al., 2013). Thus, we hypothesize,

4.4.1 Hypothesis 10: The impact of Risk Responsive Practices on Competitive Benchmarking Outcomes

H10a: The better implementation of Benchmark Learning Practices the better chance to achieve Competitive Benchmarking Outcomes.

H10b: The better implementation of Differentiation Innovation Practices the better chance to achieve Competitive Benchmarking Outcomes.

4.4.2 Hypothesis 11: The impact of Risk Responsive Practices on Process Innovation Outcomes

H11a: The better implementation of Benchmark Learning Practices the better chance to achieve Process Innovation Outcomes.

H11b: The better implementation of Differentiation Innovation Practices the better chance to achieve Process Innovation Outcomes.

4.4.3 Hypothesis 12: The impact of Risk Responsive Practices on Supply Chain Outcomes

H12a: The better implementation of Benchmark Learning Practices the better chance to achieve Supply Chain Outcomes.

H12b: The better implementation of Differentiation Innovation Practices the better chance to achieve Supply Chain Outcomes.

4.5 Process Innovation Practices and Performance Outcomes

The proposed performance outcomes of this study are Competitive Benchmarking Outcomes (i.e.., the result of firm's evaluation of their key traditional operational outcomes against the "best-in-class companies" to determine how to achieve performance levels), Process Innovation Practices (i.e., the internal results of cross-functional collaboration and technology-driven value creation outcomes through interfaces of behavioral and technological practices), and Global Network Outcomes (i.e., the external results of supplier and customer network-driven outcomes plus cross-industry network outcomes). Process Innovation Practices is the fundamental operational practice to build internal capabilities hypothesized to influence the outcomes from operations, internal integration, and external collaboration dimensions (Allred et al., 2011; Ambulkar et al., 2015; Bode & Wagner, 2015; C. S. Tang, 2006). Thus,

4.5.1 Hypothesis 13: The impact of Process Innovation Practices on Competitive Benchmarking Outcomes

H13a: The better implementation of Cross-functional Synergies Practices the better chance to achieve Competitive Benchmarking Outcomes.

H13b: The better implementation of Organizational Digital Collaboration Practices the better chance to achieve Competitive Benchmarking Outcomes.

4.5.2 Hypothesis 14: The impact of Process Innovation Practices on Process Innovation Outcomes

H14a: The better implementation of Cross-functional Synergies Practices the better chance to achieve Process Innovation Outcomes.

H14b: The better implementation of Organizational Digital Collaboration Practices the better chance to achieve Process Innovation Outcomes.

4.5.3 Hypothesis 15: The impact of Process Innovation Practices on Supply Chain Outcomes

H15a: The better implementation of Cross-functional Synergies Practices the better chance to achieve Supply Chain Outcomes.

H15b: The better implementation of Organizational Digital Collaboration Practices the better chance to achieve Supply Chain Outcomes.

4.6 Network Resilience Practices on Performance Outcomes

Network Resilience Practices are the macro trend impelled practices that aim to build resilient capabilities from an external network collaboration perspective. A resilient network would facilitate firms to establish high standard operational outcomes than the average performed companies (Ahmed et al., 2014; Miller-Hooks et al., 2012). The internal strategic social and technical integration performances also benefit from a resilient external network environment (Paul Gao et al., 2016; Rohracher, 2001; Sidorova et al., 2008). Moreover, network resilience determines the external collaboration performance outcomes with the global chain members (Ivanov & Dolgui, 2020; P. Smith et al., 2011; Sterbenz et al., 2011). Therefore, we hypothesize,

4.6.1 Hypothesis 16: The impact of Network Resilience Practices on Competitive Benchmarking Outcomes

H16a: The better implementation of Core Relationships Focus Practices the better chance to achieve Competitive Benchmarking Outcomes.

H16b: The better implementation of Extended Network Optimization Practices the better chance to achieve Competitive Benchmarking Outcomes.

4.6.2 Hypothesis 17: The impact of Network Resilience Practices on Process Innovation Outcomes

H17a: The better implementation of Core Relationships Focus Practices the better chance to achieve Process Innovation Outcomes.

H17b: The better implementation of Extended Network Optimization Practices the better chance to achieve Process Innovation Outcomes.

4.6.3 Hypothesis 18: The impact of Network Resilience Practices on Supply Chain Outcomes

H18a: The better implementation of Core Relationships Focus Practices the better chance to achieve Supply Chain Outcomes.

H18b: The better implementation of Extended Network Optimization Practices the better chance to achieve Supply Chain Outcomes.

Chapter 5

To test the hypothesis, this study implemented two methods. The first method was conducted by focus group interviews. The second method was conducted by a large-scale survey.

5 Method 2: Focus Group Interviews (Case Study)

In this chapter, we conducted four focused group interviews from various industries. The interview questions came from the first research method of text mining. Based on the text mining results, we categorize interview questions into three major areas. The first set of questions are related to the social and technical impacts of employees' working conditions and health conditions. The second set of questions builds on the macro-level impacts of firms that related to globalization strategies. The last set of questions focus on the impact of digitalization and the use of data. Since we were in the phase of the COVID-19 pandemic time when we conducted this study, the major disruptions we were looking at is the COVID-19. Therefore, some of those questions are specifically looking at that are the major changes and challenges caused by this major disruption events. Besides those three sets of questions, we also asked our interviewees some general questions (e.g., industry type, position, responsibilities, etc.) to understand the background and content of the interviewee. The Interview questions are shown in Table 5.1.

Our target respondents are middle-level managers (e.g., procurement manager, operations and supply chain management manager, etc.), high-level managers, and c-level managers (e.g., CEO,

CFO, COO, etc.). The interview manuscript can be found in Appendix A, and the interview details are discussed in the following.

Table 5.1. Focus group interview questions

General Questions	
Know about the person and the context	
	Explain the objectives of the interview
	Could you please tell us your position and responsibility?
Know about the company	
	Do you mind I ask that what are the three major challenges your organization has experienced because of Covid-19?
	How did your organization respond to those challenges?
	Did you make adjustments to those products or services to respond to those challenges?
	Would you share the main differences between pre-and post- Covid-19 in terms of challenges and opportunities?
The second group of questions is related to the social and technical impacts of employees' working conditions and health conditions.	
	Could you share how did your firm implement the work-from-home policy?
	What online communication platform do you use for work (e.g., internal meeting system or subscribe from a third party)?
	Since social distancing is required in most workplaces, what did your firm implement (e.g., rotated schedule)?
	How did your company implement cross-functional problem-solving collaboration during the pandemic?
	Are there any changes regarding the way of communicating with suppliers and customers between pre-and post-COVID-19?
Consider the pressure from the worldwide coronavirus pandemic and the trade tension. The following group of questions is related to what do you think about reshoring (e.g., from China, Mexico, or other developing countries) and near-shoring?	
	What are your offshoring strategies? How are your strategies changing over time (e.g., reshoring)? Why did your company make the changes?
	What level of R&D or innovation of your firm compare with your competitors?
Digitalization and digital transformation Utilize digital technologies to increase process efficiency and improve data transparency, etc. For example, we can use a digital platform to visualize the inbound and outbound product flows, track supplier status, monitor real-time data, predict potential disruptions, etc. This set of questions is about how to take advantage of data.	
	What types of data does your company collect and keep in the record (e.g., employee's working performance, machine-generated production data, etc.)? How does your firm use/analyze those data (e.g., process visualization, process automation, dashboard, etc.) How could that analysis help your firm in decision-making (e.g., predict demand, future trend, risk, etc.) What do you think about the digital transformation for business after the COVID-19?
	Compare with your goal, how would you rate the effectiveness of using data?
	Does your firm consider any investment in data/business analytic (e.g., improve internal analytical capability or hire third-party)
	What other questions I did not ask, but you think they actually set your company apart from others.

5.1 Interviewee 1: Jason Hood- Stratascale, CTO

Jason Hood is the CTO of Stratascale. Stratasclae belongs to High-tech Industry and it is part of an 11.5-billion-dollar provider of technology called SHI. SHI is the largest privately held woman and minority-owned business in the United States. Jason's primary responsibilities are at the strategic level, such as bringing new technologies onboard, seeking new partnerships, observing market trends, dipping into the venture capitalist communities, etc.

Jason has shared four major challenges that cause by the disruption of COVID-19. The first challenge is the supply chain challenge. His main company SHI is a technology provider selling PCs, servers and network equipment. They have faced challenges in predicting the sudden demand changes, holding enough material and inventories for production, and managing lead time. Those supply chain-related challenges also lead to the second challenge of labor shortage. Under the pressure of the disruption, Jason's firm had a hard time bringing people into the factory safely at the beginning of the pandemic. It became a major issue to meet clients' requirements. In the meantime, Stratascale is a company that builds around sales. The selling model change was the third challenge. He also shared a unique challenge that his company has faced, which is the utilization of newly built facility. Stratascale opened a brand new headquarter in Austin, Texas, which can hold thousands of people with modern style. The waste of such nice new office space is very challenging financially and emotionally.

Stratascale implemented risk management and buy ahead strategy to deal with the supply chain challenge to respond to those challenges. In order to ensure a safe working environment to solve labor shortage, Stratascale conducted several safety ensure policies, such as regular temperature check on the site, provide PPEs to workers, enable social distancing, rotated work schedule, work-from-home, and brought in Sonde app to daily work. Sonde app is a voice

frequency detector which can observe unhealthy conditions of employees through regular voice check. In addition, we cope with the selling model change, Stratascale incorporated digital tools and online communication platforms to enable communication with customers.

Besides challenges caused by disruptions, especially COVID-19, Jason also mentioned that opportunities also came along. He stated that this global pandemic had accelerated the transformation to the digital world. Companies have paid more attention to utilize digital platforms and data in their business. It creates tremendous business opportunities in various new areas. Technology and innovation definitely are key players in those opportunities.

To better implement work-from-home (WFH) policy, Stratascale encourages employees to work from home, even provide permanent work-at-home positions, allow flexible working environment, and provide working equipment. During the WFH time, Stratascale primarily use Microsoft Teams as their both internal and external communication tool. Compared with the pre- and post- COVID-19 world, Jason discussed that automation is another area that would change the world. Stratascale provided an automated self-service function to improve service efficiency, which also create an opportunity to allocate workforce in more necessary areas. They also tried to develop innovative techniques to improve customer services' effectiveness by incorporating a higher level of automation.

Regarding the second set of questions related to the level of globalization, Jason mentioned that Stratascale is currently focused on the domestic market, but they have plans to expand globally. In terms of supplier network, Stratascale did have suppliers from Asia and Europe. They have a multi-sourcing strategy to enable contingent plans in turbulent time.

We asked some questions related to their innovation level. Jason shared that Stratascale is built around innovation where highly connected with researchers who worked at universities and

professional labs. They also implemented a “get out and try things” culture to facilitate learning and encourage their talents to discover new technologies.

Jason has strongly agreed that digitalization would be the next wave after or even in the COVID-19 world. Stratascale collected data to track the new technology adoption level of their clients. They also realize the power of data to do risk prediction, demand prediction and future trend detection.

5.2 Interviewee 2: Yuepeng Deng- First Solar, Head of Performance Prediction Analytics

Yuepeng Deng is the Head of Performance Prediction Analytics of First Solar Inc. First Solar is an American manufacturer of solar panels and a provider of utility-scale PV power plants and supporting services that include finance, construction, maintenance and end-of-life panel recycling. The department that Yuepeng in charge is responsible for analyzing the solar panel performance through advanced analytics is the primary way in first solar to figure out how the energy yield and productions look like in the outdoor large utility-scale power plants. He also works closely with the R&D department to optimize the processes and improve the solar panel performance.

Yuepeng has pointed out two major challenges caused by the COVID-19 pandemic. The first challenge was labor shortage, and the second one was supply shortage. The labor shortage was heavily impacted on First Solar at the beginning of the pandemic, especially in March and April 2020. Unlike Stratasclae, First Solar only provide one product which is the solar panel and has manufacture facility in multiple countries. There are numbers of shop floor workers who got tested positive in the time frame, and those who had direct contact with those confirmed workers also need to be properly quarantined. But First Solar handled it very quickly and effectively by applying the social distancing policy. And the workforce actually restored also very fast. Since First Solar

was deemed as an essential business by the government, they didn't experience completely shutdown during the pandemic.

First Solar as a leading global provider of solar solutions has suppliers in multiple countries. At the early stage of the pandemic, China took very strong action on quarantine and shutting down business in Wuhan area. Their suppliers in China got impacted by this policy. First Solar also had to shut down one production line in Malaysia to follow the local requirements. Build on a very resilient supply chain network, First Solar found alternative suppliers in a very short period of time and went back to normal very soon. Although it led to approximately 1 week or 2 of the production losses, it was very limited to First Solar.

Regarding the second set of questions related to the level of globalization, Yuepeng mentioned that First Solar is a global company with manufacturing production lines in the US and Malaysia. From the market standpoint, a big chunk of the market they are selling to is in the US. But they do have products that go into Europe, Japan, Australia, Africa, Middle East, etc. In terms of the supply base, First Solar has suppliers overseas and local. They are more favorable in holding contingent plans, especially in a turbulent situation. There is no clear localization policy initiated due to the current disruptions (i.e., COVID-19 pandemic). Yuepeng also shared with us that First Solar didn't have product changes to cope with the pandemic disruptions. But they did incorporate virtual services into the traditional maintenance.

In terms of the WFH policy, Yuepeng said the leadership team of First Solar responded to the pandemic very well and quickly by implementing the WFH policy. The policy applied to whoever can WFH should work from home, and if people have to go to the office and the floor to get things done, people have to make sure to discuss with the manager to get permission and approval to do that. After June 2020, First Solar has started rotated schedule among office workers to gradually

return to office and kept social distancing policy to the shop flow workers.

Since people were working from home, First Solar used different online communication types among different functional teams. Cisco Jabber is the major communication platform that they use during the pandemic. They were even used Cisco Jabber before the pandemic for major internal communication for managers. When the pandemic took place, it became more helpful with instant messaging, phone call and other functions. They also use Microsoft Teams and WebEx as supporting platforms for both internal and external (e.g., suppliers and customers) collaborations.

Technology and innovation are the critical success factors for a firm, especially during a time full of changes. Yuepeng expressed that, in his opinion, the R&D and innovation level of First Solar is phenomenal compare with his competitors. Many countries have started to invest in solar energy development, such as the U.S., European countries, Australia, China, Korea, and other countries. But when it comes down to solar panel production, it really comes from either First Solar and Crystal Silicon Companies in China. So the main competitors are primary from China, Korea, and Japan. Competitors from those countries pretty much share the same set of innovation, technology and knowledge of know-how with each other to reduce the requirements of innovations. However, First Solar is the only solar company that invests over 100 million dollars anally in R&D and innovation.

In the meantime, First Solar emphasizes the cross-functional collaboration between data analytics and R&D. Basically, First Solar creates ID for every single Solar Panel and keeps tracking the panel's performance. Then Yuepeng has access to review and pull out the data to do performance analysis and prediction to see if an improvement is needed from the R&D department. Yuepeng also mentioned that First Solar is a data-driven company and use the best out of data is part of their company culture. During the pandemic time and even before, most meetings involving

Yuepeng are related to reviewing data. Data analytics was and will be continuously an important part of their decision-making process. In the very near future, Yuepeng and his team is planning to incorporate machine learning into performance analytics and prediction processes.

5.3 Interviewee 3: Danielle Long- Magna International, Inc., Purchasing Manager

Danielle Long is the purchasing manager at Magna Norplas and her responsibilities are managing $400 million supply chain spend, ensuring supply continuity and sourcing and quoting new projects. Magna Norplus is the subdivision of Magna International which located in Northwood, Ohio. Magna is a mobility technology company for automakers. Their suppliers consist of GM, Honda, Chrysler, and etc. During the interview, Danielle shared that Magna Norplas has experienced four major challenges during the pandemic caused disruptions, they are supplier insolvency, logistic constraints, material constraints, and labor shortage. There are some of Magna Norplas's suppliers have experienced different level of financial distress at the beginning of the pandemic. The mandated shutdown other additional constraints placed on business overall cause the supplier insolvency. The second challenge of logistics constraints was due to multiple reasons. The first one would be the port congestion for products coming from overseas. Second reason is lacking driver availability and truck availability of domestic transportation. The third one is the increased cost of transportation. Danielle pointed out it was common for other companies in automobile industries about the material shortage challenge. It was largely stemming from COVID but exacerbated by disruptions of the big winter storm that hit Texas in February 2021. The last challenge that Danielle mentioned was the labor shortage. The first reason that cause labor shortage was the safety working issue, and the second reason might be the benefit of unemployment policy from the US government.

Magna Norplas spent more efforts in developing contingency plans to respond to those challenges, identifying alternative supply options and logistic partners. In order to identify the red flag of their supplier, Danielle mentioned that they increase the frequency of supplier auditing, especially in missing shipments and major staffing turnovers. In addition, Magna Norplas and the majority of its suppliers have always historically worked with the just-in-time habit, which is another reason to cause supply shortage. After the COVID taking place, Magna Norplas has started building more safety stock and buffer inventories to respond to those challenges.

Besides those challenges, Danielle also pointed out that incorporating information systems and data analytics is an opportunity for her company to improve the overall performance. They have emphasized capturing information effectively into their ERP system, maintaining database, analyzing data, and involving data prediction into their decision-making process.

In terms of those questions related to the level of globalization, Danielle shared with us that Magna overall is a global entity and definitely plays in the global market. However, the Norplas division was taking action to localize their suppliers to reduce the uncertainties that cause by the long distance between overseas suppliers.

5.4 Summary and Findings

In this dissertation, we have interviewed middle or higher-level managers in different industries (e.g., High-tech, energy, and automobile) and studied how those managers see the challenges and opportunities from one of the major disruptions events COVID19 pandemic. There are some common views, as well as unique insights from those interviewees. We observed that supply and labour shortage are the most influential impact from COVID19 regardless of the company from automobile, High-tech, and Energy. Due to the nature of this disruption event of the COVID19 pandemic, the entire world needs to take action and apply social distancing or even

regional shut down to ensure the safety of people. It is unavoidable to cause labour shortage and the breakdown of the global supply chain. Companies start to develop new ways of doing business to respond to the challenges, such as applying work-from-home policy, rotated schedule, and social distancing policy. In this regard, companies have been dedicated to looking for a better way of doing business and keeping the business's continuity. There are two major approaches to learn about the new norms. One is to borrow the best practices from the industry leader who has represented the best model in the industry. The other one is observing how the new entrances have broken through the challenges and won a spot in the area. Thus, from the interview, we further confirmed that the construct of Dynamic Market Driver, which consists of Indudstry Leader Challenges and Emerging Rival Challenges, is a very important driver for a company to survive from a major disruption event.

According to the interviews, we are also aware that adapting disruptive technology quickly and effectively is extremely crucial for companies to survive in the turbulent environment. We have learned that the COVID19 has accelerated the transformation of digitalization, especially drive by automation, data analytics, and all sort of virtual environments. Stratascale was founded during the COVID19 pandemic, who was riding the wave of digitalization to discover new technologies and sell those new technologies to their clients. This idea has proved that Socio-Technical Drivers plays a vital role in finding and implementing the most suitable technology under certain disruption scenarios to survive or even succeed. This idea also compatible with constructs of Market Culture Shifts and Disruptive Technology Imperatives in our model.

We also observed that different companies have different views of globalization. Magna Norplas was shifting towards localizing their suppliers to control the uncertainties at a lower level. However, First Solar was trying to maintain its international level to ensure adequate contingent

planning ability. In this dissertation, we argue that to survive and further success under disruptive environment, the company should find a balance point of their globalization level. Either extreme emphasis on localization or internationalization seems to be the critical success factors. The interview shed light on the necessity of balancing globalization and the research model reflected this view.

The prementioned findings from the interviews support the theoretical logic of this dissertation. We further tested the research model by using the survey method. In the next chapter, the processes and results of Q-sort, pilot study, and large-scale survey validation are discussed.

Chapter 6

6 Method 3: Survey

The third method of this study will apply the survey analysis. Survey instrument development, Q-sort, and pilot study will conduct in the first phase of the survey, which will follow the steps: (1) item generation, (2) Q-sort, (3) pilot study, (4) and results of the pilot study. The second phase of survey analysis is large-scale data collection and analysis. We will determine the target sample, conduct a sequence of bias tests (e.g., non-response bias test, normality test, multicollinearity test), reliability and validity test for the measurement and structural models. Then the research results will be present in the last section. Appendix B presents the originally developed instrument of this study.

6.1 Instrument Development and Validation

6.1.1 Q-sort

First, judges sorted the questionnaire items into construct categories. Items were listed on the left-hand side of the online sorting systems (i.e., Qualtrics) and constructs were posted on the right-hand side. Randomly shuffled instrument items need to be grouped into the correct construct boxes based on judges' perceptions. A "I don't know" category definition was included to ensure that the judges did not force any item into a particular category. During the two sorting rounds, two judges were utilized. Judges are academic professionals from the operations and supply chain domain.

Prior to sorting the items, judges were briefed with a standard set of instructions. Judges were allowed to ask as many questions as necessary to ensure they understood the procedure (Nahm et al., 2002).

Second, two different measures were made to assess the reliability of the Q-sort. For each judge in each sorting step, their level of agreement in categorizing items was measured using Cohen's Kappa. Constructs and the number of items in each construct are summarized in Table 6.1

Table 6.1 Constructs and Number of Items

Drivers	**Number of items**
Dynamic Market Drivers	
Industry Leaders Challenges	5
Emerging Rival Challenges	5
Socio-Technological Drivers	
Market Culture Shifts	5
Disruptive Technology	6
Globalization Balancing Drivers	
Level of Internationalization	6
Level of Localization	6
Sub-Total	33
Practices	
Risk Responsive Practices	
Benchmark Learning Practices	5
Differentiation Innovation Practices	5
Process Innovation Practices	
Cross-functional Synergies	5
Organizational Digital Collaboration	7
Network Resilience Practices	
Core Relationships Focus	8
Extended Network Optimization	6
Sub-Total	36
Dynamic Competitive Outcomes	
Competitive Benchmarking Outcomes	10
Socio-Tech Innovation Outcomes	7
Supply Chain Network Outcomes	7
Sub-Total	24
Total	93

6.1.1.1 First sorting round

In the first round, the inter-judge raw agreement score averaged 77 (Table 6.2), the initial overall placement ratio of items within the target constructs was 82.8%% (Table 6.3), and the Kappa scores averaged 0.72 (Table 6.4). Following the guidelines of Landis and Koch (1977) for interpreting the Kappa coefficient, the value of 0.72 indicates a moderate, but almost excellent level of agreement beyond chance for the judges in the first round. The level of item placement ratios averaged 88.7%, the lowest item placement ratio value was 71.0% for the "Organizational Digital Collaboration" construct, indicating a low degree of construct validity. On the other hand, several constructs ("Industry Leaders Challenges", "Emerging Rival Challenges", "Level of Internationalization", etc.) obtained a 100% item placement ratio, indicating a high degree of construct validity.

In order to improve the Cohen's Kappa measure of agreement, an examination of the off-diagonal entries in the placement matrix was conducted. Any ambiguous items or too indeterminate items were either deleted or recorded. Overall, 12 items were reworded.

Table 6.2 Inter-judge raw agreement score: First round Q-sort

		Judge 1															
Constructs[a]		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	NA
Judge 2	1	**5**						1									
	2		**5**														
	3			**3**													
	4				**4**			2									
	5					**6**							1				
	6						**6**										
	7				2			**3**	2								
	8			2					**3**		1						
	9									**5**	1						
	10				1						**4**				1		
	11											**8**	1				
	12										1		**3**				
	13												1	**10**	1		
	14				1						1				**5**		
	15															**7**	
	NA																**0**

Note. Total items placement, 93; number of agreements, 77; agreement ratio, 82.8%.

[a]Constructs:

1 Industry Leaders Challenges
2 Emerging Rival Challenges
3 Market Culture Shifts
4 Disruptive Technology Imperatives
5 Level of Internationalization
6 Level of Localization
7 Benchmark Learning Practices
8 Differentiation Innovation Practices
9 Cross-functional Synergies
10 Organizational Digital Collaboration
11 Core Relationships Focus
12 Extended Network Optimization
13 Competitive Benchmarking Outcomes
14 Socio-Tech Innovation Outcomes
15 Supply Chain Network Outcomes

Table 6.3 Items placement ratio- First round Q-sort

		Actual Categories																
	Constructs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	%
Theoretical	1	**10**						1									10	100.0%
	2		**10**														10	100.0%
	3			**8**													10	80.0%
	4				**9**			2							1		12	75.0%
	5					**12**							1				12	100.0%
	6						**12**										12	100.0%
	7				2			**7**	2								10	70.0%
	8			2					**8**		1						10	80.0%
	9									**10**	2						10	100.0%
	10				1						**10**				2		14	71.4%
	11											**16**	1				16	100.0%
	12										1		**9**				12	75.0%
	13												1	**20**	1		20	100.0%
	14														**10**		14	71.4%
	15															**14**	14	100.0%

Note. Total items placement, 186; number of agreements, 165; agreement ratio, 88.7%.
The names of constructs are listed in Table 6.3

Table 6.4 Cohen's Kappa calculation- First round Q-sort

		Judge 1		
		Accept	Reject	Total
Judge 2	Accept	67	7	74
	Reject	12	7	19
	Total	79	14	93
Cohen's Kappa $\boldsymbol{K} = \frac{[(93*67)-(79+74)]}{[93^2-(79+74)]} = 0.7154$				

6.1.1.2 Second Round Q-sort

Again, two judges were involved in the second sorting round, including the reworded items developed after the first sorting round. In the second round, the inter-judge raw agreement score averaged 87.1% (Table 6.5), the overall placement ratio of items within the targets constructs was 90.9% (Table 6.6), and the Kappa scores averaged 85.74%. A summary of the second-round inter-judge agreement indices is shown in Table 605. The value for Kappa coefficient of 90.09% is

higher than the value obtained in the first round and indicates an excellent fit, based on the guidelines of Landis and Koch (1977) for interpreting the Kappa coefficient. The level of item placement ratios averaged 87.34, the lowest item placement ratio value was that of 71.41% for the Organizational Digital Collaboration construct, indicating a low degree of construct validity.

In order to further improve potential reliability and construct validity, an examination of the off-diagonal entries in the placement matrix (Table 6.6) was conducted. Again, any ambiguous items (fitting in more than one category) or too indeterminate items (fitting in no category) were analysed. Overall, no item was further deleted, and eight items were reworded.

Table 6.5 Inter-judge raw agreement score: Second-round Q-sort

		Judge 1															
Constructs		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	NA
Judge 2	1	**5**															
	2		**5**														
	3			**4**													
	4				**6**												
	5					**6**			1								
	6						**6**										
	7				1			**4**	1								
	8							1	**3**								
	9									**5**					1		
	10										**6**					1	
	11											**8**				1	
	12												**6**				
	13													**8**		2	
	14			1										2	**4**		
	15													1		**5**	
	NA																**0%**

Note. Total items placement, 93; number of agreements, 81; agreement ratio, 87.1%.

Table 6.6 Items placement ratio- Second round Q-sort

		Actual Categories																
	Constructs	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total	%
Theoretical	1	**10**															10	100.0%
	2		**10**														10	100.0%
	3			**9**													10	80.0%
	4				**12**			1									12	75.0%
	5					**11**											12	100.0%
	6						**12**										12	100.0%
	7							**9**	2								10	70.0%
	8					1			**8**								10	80.0%
	9									**10**							10	100.0%
	10										**13**						14	71.4%
	11											**16**				1	16	100.0%
	12												**9**				12	75.0%
	13													**18**		1	20	100.0%
	14			1											**10**		14	71.4%
	15										1			2		**12**	14	100.0%

Note. Total items placement, 186; number of agreements, 169; agreement ratio, 90.9%.
The names of constructs are listed in Table 6.2

Table 6.7 Cohen's Kappa calculation- Second round Q-sort

		Judge 1		
		Accept	Reject	Total
Judge 2	Accept	80	4	84
	Reject	9	0	9
	Total	89	4	93
Cohen's Kappa $\boldsymbol{K} = \frac{[(93*80)-(89+84)]}{[93^2-(89+84)]} = 0.8574$				

6.1.2 Pilot study

The purpose of doing a pilot study before the large-scale data is to test the quality of the model and ensure the reliability and validity of measurement scales. Instrument items were modified based on the results of the pilot study. Previous literature has suggested that a sample size of 30 for a pilot study is acceptable (Johanson & Brooks, 2010; Leon et al., 2011). However, considering a relatively large size of items is involved in this study, we undertook a pilot study with 99 respondents. The survey questionnaire was stored and distributed through Qualtrics online platform.

Based on the Q-sort, the survey items developed using a theoretical basis were further validated and refined. In this section, a total of 406 respondents completed the survey. This research implemented three steps screening processes. In the first screening process, we filtered out 257 responses which are completed in less than 8 minutes. The second screening process captures the non-response bias by removing responses with a standard deviation of less than 0.5. In this step, 22 are removed. In the third screening process, we involved two questions to detect individuals who were not paying attention to the survey (e.g., please select “strongly agree” if you still pay attention to this survey) and 28 are excluded. Thus, 99 completed responses are used for analysis. It involves various industries spanning the U.S. and E.U. 15 constructs with 93 instrument questions, 11 demographics questions, and two screening questions for the data collection. Refer to the detailed questions from Appendix B.

The results show that 61 respondents come from the U.S. (62%), 32 from European countries (32%), and 6 from other areas (6%). There are there 7 respondents from the Educational industry (7%), 22 respondents from the Financial Service industry (22%), 7 respondents from Food and Hospitality industry (7%), 9 respondents from Governmental are (9%), 5 respondents from Health

Services industry (5%), 12 respondents from Hi-tech Industry (12%), 20 respondents from manufacturing industry (20%), 6 respondents from transportation industry (6%), and 11 respondents from other industries (11%). Among those respondents, 48 of them are self-identified as CEO or owners of companies (48%), 11 of them are self-identified as VP (11%), 36 of them are self-identified as Manager (36%), and 4 of them reported as others (4%). Detailed statistics are provided in Table 6.8 and Table 6.9. Another set of questions within the survey attempted to identify the length of respondents who have worked within the firm. It provided us a better idea of whether answers that given by the respondent are valid for this study. Table 6.10 illustrates that 92% of respondents have more than 5 years of working experience in a firm.

Table 6.8 Pilot industry demographics

Industry	Number	Percentage
Educational	7	7%
Financial Services	22	22%
Food and Hospitality (hotels/restaurants)	7	7%
Governmental	9	9%
Health Services	5	5%
Hi-Tech	12	12%
Manufacturing	20	20%
Transportation	6	6%
Others	11	11%
Total	99	100%

Table 6.9 Respondent position

Position	Number	Percentage
CEO/Owner	48	48%
Manager of	36	36%
VP in	11	11%
Others	4	4%
Total	99	100%

Table 6.10 Working experience in year

Working Length	Number	Percentage
0-2 years	3	3%
2-5 years	4	4%
6-10 years	14	14%
>10 years	77	78%
Others	1	1%
Total	99	100%

6.1.2.1 Pilot study: Pre-test Results

An Exploratory Factor Analysis (EFA) was conducted using IBM SPSS Statistics 24 to determine the reliability and validity of the items. Reliability was assessed using correlated item total correlation (CITC) score and Cronbach's Alpha(Cronbach, 1951; Cronbach & Meehl, 1955). COTC of greater than 0.3 and Cronbach's Alpha greater than 0.7 are considered acceptable (Nunnally, 1978). Validity was assessed through factor loadings and factor correlations. Maximum likelihood was chosen as the extraction method and Promax was selected as the rotation method. The results for each construct are outlined below.

6.1.2.1.1 Dynamic Market Drivers

Dynamic Market Drivers as a higher-order construct has two first-order constructs, which are Industry Leaders Challenges (ILC) and Emerging Rival Challenges (ERC). Both ILC and ERC have five items with an overall score of more than 0.3 in CITC. The Cronbach's Alphas of these two constructs are 0.897 and 0.921. Refer to Table 6.11 for the details. KMO of ILC and ERC together was 0.905. The total variance explained was 64.72%. The communalities of OLC and ERC together were excellent in which all the values are higher than 0.4 for each item. Thus, we observed very good reliability of Dynamic Market Drivers.

Table 6.11 CICT scores and Cronbach's α of ILC and ERC

Codes	Survey Items	CITC	Cronbach's α
ILC1	Our firm knows about the new strategic aim/direction of the industry-leading firms.	0.829	0.897
ILC2	Our firm recognizes the publicized new significant initiatives of the industry-leading firms.	0.852	
ILC3	Our firm notes the market growth investment initiative of industry-leading firms.	0.819	
ILC4	Our firm is aware of the new products/services introduction of the industry-leading firms	0.769	
ILC5	Our firm collects news about the partnership alliance of the industry-leading firms.	0.746	
ERC1	Our firm knows about the new strategic aim/direction of emerging rival firms.	0.799	0.921
ERC2	Our firm recognizes the publicized new major initiatives of emerging rival firms.	0.881	
ERC3	Our firm notes the market growth investment initiative of emerging rival firms.	0.846	
ERC4	Our firm is aware of the new products/services introduction of emerging rival firms.	0.777	
ERC5	Our firm learns about the news about the partnership alliance of emerging rival firms.	0.871	

Table 6.12 Communalities of Market Dynamic Drivers

Code	Initial	Extraction
ILC_1	.683	.571
ILC_2	.653	.578
ILC_3	.687	.681
ILC_4	.632	.499
ILC_5	.606	.577
ERC_1	.679	.589
ERC_2	.775	.698
ERC_3	.757	.763
ERC_4	.611	.607
ERC_5	.758	.708

6.1.2.1.2 Socio-Technological Drivers

Socio-Technological Drivers as a higher-order construct has two first-order constructs, which are Market Culture Shifts (MCS) and Disruptive Technology Imperatives (DTI). Six of MCS items and five of DTO items have an overall score of more than 0.3 in CITC. The Cronbach's Alphas of these two constructs are 0.896 and 0.883. Refer to Table 6.13 for the details. KMO of ILC and ERC was 0.898. The total variance explained was 60.25%. The communalities of MCS and DTI were excellent in that all the values are higher than 0.4 except DTI7 (see Table 6.13). Thus, after we took out DTI7 we observed acceptable reliability of Socio-Technological Drivers.

Table 6.13 CICT scores and Cronbach's α of MCS and DTI

Codes	Survey Items	CITC	Cronbach's α
MCS1	Our firm observes changing customer requirements for new products and services.	0.826	0.896
MCS 2	Our firm recognizes the shifted market norms of new products and services.	0.882	
MCS 3	Our firm senses increasing value proposition changes of new products and services.	0.747	
MCS4	Our firm is aware of the changing patterns of successful products and services.	0.751	
MCS5	Our firm realizes to growing expectations of new products and services.	0.638	
DTI1	Our firm is aware of radical technological applications.	633	0.883
DTI2	Our firm discovers innovation knowledge.	0.804	
DTI 3	Our firm recognizes well-defined operating procedures that facilitate by new technology.	0.966	
DTI 4	Our firm recognizes the increasing investment need for new technology.	0.765	
DTI 6	Our firm explores possible useful technological tools.	0.713	
~~DTI7~~	~~Our firm searches for easy-to-use technological tools.~~	~~0.602~~	

Table 6.14 Communalities of Socio-Technological Drivers

Code	Initial	Extraction
MCS_1	.524	.530
MCS_2	.650	.719
MCS_3	.592	.639
MCS_4	.719	.768
MCS_5	.597	.611
DTI_1	.488	.477
DTI_2	.626	.657
DTI_3	.695	.787
DTI_4	.582	.579
DTI_6	.611	.596
~~DTI_7~~	~~.460~~	~~.375~~

6.1.2.1.3 Globalization Balancing Drivers

Globalization Balancing Drivers as a higher-order construct has two first-order constructs, which are Level of Internationalization (LOI) and Level of Localization (LOL). Both of LOI and LOL have six items with an overall score of more than 0.3 in CITC. The Cronbach's Alphas of these two constructs are 0.897 and 0.921. Refer to Table 6.15 for the details. KMO of LOI and LOL together is 0.864. The total variance explained was 66.42 %. The communalities were excellent in which all the values are higher than 0.4 except LOL 6 (see Table 6.16). Thus, after

deleting LOL6, we observed acceptable reliability of Globalization Balancing Drivers.

Table 6.15 CICT scores and Cronbach's α of LOI and LOL

Codes	Survey Items	CITC	Cronbach's α
LOI1	Our firm initiates efforts in increasing revenue potential in global markets.	.911	0.9446
LOI 2	Our firm observes new business opportunities in multiple countries.	.954	
LOI 3	Our firm assesses global capabilities to target market segments of multiple countries.	.956	
LOI 4	Our firm segments target customers by income levels (upper, middle, lower) of different countries.	.726	
LOI 5	Our firm compares customer value requirements of different countries.	.834	
LOI 6	Our firm searches for suppliers from a global base.	.757	
LOL 1	Our firm initiates localization efforts in increasing revenue potential in specific the country we operate.	.788	0.905
LOL 2	Our firm plans to develop local talents in specific countries.	.843	
LOL 3	Our firm examines local managerial capabilities.	.815	
LOL 4	Our firm values the innovative ideas of the local focus group for business development efforts.	.799	
LOL5	Our firm evaluates local customer value requirements of specific countries.	.778	
~~LOL 6~~	~~Our firm prefers to work with suppliers from a specific region.~~	~~.481~~	

Table 6.16 Communalities of Globalization Balancing Drivers

Code	Initial	Extraction
LOI_1	.789	.787
LOI_2	.855	.869
LOI_3	.846	.869
LOI_4	.677	.595
LOI_5	.797	.731
LOI_6	.655	.599
LOL_1	.592	.599
LOL_2	.651	.683
LOL_3	.702	.732
LOL_4	.631	.646
LOL_5	.677	.656
~~LOL_6~~	~~.277~~	~~.206~~

6.1.2.1.4 Risk Responsive Practices

Risk Responsive Practices as a higher-order construct has two first-order constructs, which are Benchmark Learning Practices (BLP) and Differentiation Innovation Practices (DIP). Both of BLP and DIP have six items with an overall score of more than 0.3 in CITC. The Cronbach's

Alphas of these two constructs are 0.863 and 0.876. Refer to Table 6.17 for the details. KMO was 0.914. The total variance explained was 55.68 %. The communalities were excellent in which all the values are higher than 0.4 (see Table 6.18). Thus, there is acceptable reliability of Risk Responsive Practices.

Table 6.17 CICT scores and Cronbach's α of BLP and DIP

Codes	Survey Items	CITC	Cronbach's α
BLP1	Our firm learns the best practices from industry leaders.	.772	0.863
BLP2	Our firm assesses disruptive advanced technologies for our firm needs.	.813	
BLP3	Our firm examines the cutting-edge knowledge practices in our industry.	.627	
BLP4	Our firm sends middle managers for operational practices benchmarking in annual conferences.	.755	
BLP5	Our firm involves senior managers for benchmarking innovative leadership practices.	.772	
DIP1	Our firm revises our business model in response to market changes to stand out from competitors.	.677	0.876
DIP2	Our firm adopts invests in specific advanced technologies for to improving improve the uniqueness of our firm.	.729	
DIP3	Our firm keeps investigating new knowledge to meet customers' requirements.	.781	
DIP4	Our firm improves forward-thinking operational practices to address competitor challenges that stand out from competitors.	.819	
DIP5	Our firm develops exceptional leadership capabilities in response to competitor challenges.	.796	

Table 6.18 Communalities of Risk Responsive Practices

Code	Initial	Extraction
BLP_1	.578	.596
BLP_2	.465	.444
BLP_3	.661	.661
BLP_4	.533	.393
BLP_5	.655	.570
DIP_1	.450	.458
DIP_2	.532	.531
DIP_3	.647	.610
DIP_4	.694	.671
DIP_5	.620	.634

6.1.2.1.5 Process Innovation Practices

Process Innovation Practices as a higher-order construct has two first-order constructs: Cross-functional Synergies (CFS) and Organizational Digital Collaboration (ODC). Both BLP and DIP

have six items with an overall score of more than 0.3 in CITC. The Cronbach's Alphas of these two constructs are 0.863 and 0.876. Refer to Table 6.19 for the details. KMO was 0.914. The total variance explained was 55.68 %. The communalities were excellent in which all the values are higher than 0.4 (see Table 6.20). Thus, there is acceptable reliability of Process Innovation Practices.

Table 6.19 CICT scores and Cronbach's α of CFS and ODC

Codes	Survey Items	CITC	Cronbach's α
CFS1	Our firm communicates organization-wide policy guidelines across all functional areas.	.788	0.831
CFS2	Our firm adopts common communication platforms for all functional areas.	.837	
CFS3	Our firm clarifies interactive rules of engagements among diverse functional areas.	.700	
CFS4	Our firm uses joint decision-making mechanisms (e.g., shared leadership council) that affect all functional areas.	.539	
~~CFS5~~	~~Our firm makes enterprise-wide information platforms (e.g., performance dashboards) accessible to all functions.~~	~~.755~~	
ODC1	Our firm uses virtual platforms to share common functional goals.	.752	0.929
ODC2	Our firm installs a cloud-based software system for real-time communication.	.813	
ODC3	Our firm adopts interactive digital coordination (e.g., access to customer feedback/satisfaction ratings).	.759	
ODC4	Our firm applies descriptive analytical tools for problem assessment.	.821	
ODC5	Our firm implements standard predictive analytic tools for managing supply chain risks.	.819	
ODC6	Our firm tests digital prescriptive analytic tools for long-term goals the implementation of long-term goals.	.909	
ODC7	Our firm develops supply chain traceability (e.g., product authentication, product origin) for effective visualization.	.734	

Table 6.20 Commonalities of Process Innovation Practices

Code	Initial	Extraction
CFS_1	.501	.575
CFS_2	.506	.604
CFS_3	.529	.576
CFS_4	.504	.527
~~CFS_5~~	~~.596~~	~~.606~~
ODC_1	.613	.519
ODC_2	.709	.628
ODC_3	.701	.681
ODC_4	.743	.753
ODC_5	.695	.671
ODC_6	.769	.811
ODC_7	.588	.542

6.1.2.1.6 Network Resilience Practices

Network Resilience Practices as a higher-order construct has two first-order constructs, which are Core Relationship Focus (CRF) and Extended Network Optimization (DIP). Eight items of CRF and six items of ENO have an overall score of more than 0.3 in CITC. However, CRF1, CRF2, CRF6, CRF7, ENO5 (screening question), and ENO7 were removed due to the cross-loading issue. The Cronbach's Alphas of these two constructs are 0.850 and 0.870. Refer to Table 6.21 for the details. KMO was 0.895. The total variance explained was 55.01 %. The communalities were excellent in which all the values are higher than 0.4 (see Table 6.22). Thus, there is acceptable reliability of Network Resilience Practices.

Table 6.21 CICT scores and Cronbach's α of CRF and ENO

Codes	Survey Items	CITC	Cronbach's α
~~CRF1~~	~~Our sourcing department works well with strategic suppliers.~~	.788	0.850
~~CRF2~~	~~Our marketing and sales department communicates effectively with first-tier suppliers~~	.837	
CRF3	Our supply chain department engages actively with first-tier suppliers.	.724	
CRF4	Our firm involves with key suppliers in the strategic planning process.	.824	
CRF5	Our firm involves primary suppliers in the product development process.	.811	
~~CRF6~~	~~Our firm includes operational managers in major contract design processes with primary suppliers and customers.~~		
~~CRF7~~	~~Our firm involves primary customers in the product development process~~		
DRF8	Our firm involves key customers (in terms of sales value) in the strategic planning process.	.624	
ENO1	Our firm networks with lower tiers (2nd and 3rd tier) suppliers	.698	0.870
ENO2	Our firm expands (supply) logistics network in a global base.	.569	
ENO3	Our firm implements contingent multiple-sourcing network plans.	.758	
ENO4	Our firm deploys a broad communication network (multi-tier relationships) in new product development process.	.839	
~~ENO5~~	~~Please select "Strongly agree" if you still pay attention to this survey.~~		
ENO6	Our firm involves lower-tier network members in post-sales services.	.784	
~~ENO7~~	~~Our firm networks with potential customers.~~		

Table 6.22 Commonalities of Network Resilience Practices

Code	Initial	Extraction
CRF_3	.561	.525
CRF_4	.740	.680
CRF_5	.753	.657
CRF_8	.424	.390
ENO_1	.507	.487
ENO_2	.386	.323
ENO_3	.610	.575
ENO_4	.698	.704
ENO_6	.628	.615

6.1.2.1.7 Dynamic Competitive Outcomes

Process Innovation Practices as a higher-order construct has three first-order constructs: Competitive Benchmarking Outcomes (CBO), Socio-Tech Innovation Outcomes (SIO) and Supply Chain Outcomes (SCO). Twelve of CBO, seven of SIO, and seven of SCO have an overall score of more than 0.3 in CITC. However, CBO3, CBO4, CBO9, CBO11, and SIO4 were removed due to the cross-loading issue. The Cronbach's Alphas of these three constructs are respectively 0.908, 0.903, and 0.930. Refer to Table 6.23 for the details. KMO was 0.910. The total variance explained was 62.25 %. The communalities were excellent in which all the values are higher than 0.4 (see Table 6.24). Thus, there is acceptable reliability of Dynamic Competitive Outcomes.

Table 6.23 CICT scores and Cronbach's α of CFS and ODC

Codes	Survey Items	CITC	Cronbach's α
CBO1	Our firm attains a high product quality reputation.	.664	0.808
CBO2	Our firm achieves high delivery performance.	.843	
~~CBO3~~	~~Our firm obtains high manufacturing flexibility~~	~~.837~~	
~~CBO4~~	~~Our firm attains good logistics performance.~~		
CBO5	Our firm excels in customer responsiveness.	.912	
CBO6	Our firm obtains high customer satisfaction ratings.	.896	
CBO7	Our firm are cost competitiveness.	.617	
CBO8	Our firm secures a desirable return on asset (ROA) performance.	.646	
~~CBO9~~	~~Our firm maintains a steady sales growth.~~		
CBO10	Our firm achieves profitability growth targets	.534	
~~CBO11~~	~~Out firm is committed to social responsibility~~		
CBO12	Our firm looks after the well-being of its employees	.606	
SIO1	Our firm implements obtains a high level of human-computer interactions.	.623	0.903
SIO2	Our firm succeeds in the technology adoption process.	.901	
SIO3	Our firm attains high process innovation impacts.	.820	
~~SIO4~~	~~Our firm reports high product innovation results.~~	.821	
SIO5	Our firm excels in cross-functional problem solving through digital platforms.	.755	
SIO6	Our firm achieves high productivity by socio-automation collaboration.	.801	
SIO7	Our firm succeeds in training employees to use newly developed software.	.599	
SCO1	Our firm attains supply chain competitiveness	.657	0.930
SCO2	Our firm maintains a high level of integration with supply chain members.	.761	
SCO3	Our firm operates in a mature supply chain.	.734	
SCO4	Our firm operates in a supply chain with flexibility.	.836	
SCO5	Our firm excels in supply chain responsiveness.	.943	
SCO6	Our supply chain achieves agility in response to changes	.901	
SCO7	Our firm operates in a resilient supply chain can recover from disruptions quickly.	.698	

Table 6.24 Commonalities of Process Innovation Practices

Code	Initial	Extraction
CBO_1	.683	.592
CBO_2	.766	.739
CBO_5	.698	.692
CBO_6	.654	.638
CBO_7	.653	.534
CBO_8	.612	.517
CBO_10	.607	.507
CBO_12	.532	.422
SIO_1	.599	.520
SIO_2	.720	.717
SIO_3	.728	.717
SIO_5	.696	.589
SIO_6	.672	.595
SIO_7	.657	.640
SCO_1	.638	.578
SCO_2	.741	.648
SCO_3	.638	.519
SCO_4	.707	.700
SCO_5	.765	.792
SCO_6	.759	.753
SCO_7	.719	.664

6.1.3 Summary

The objective of this section was to highlight the methodology that will be adopted to answer the research question and develop the instrument that will be able to best capture the relationships hypothesized in the model. Using existing literature support, a mixed methodology that incorporates both qualitative and quantitative aspects were adopted. In order to measure the hypothesized relationships, a survey methodology was proposed, and an instrument was developed that would be able to best capture such relationships. In addition, case study methodology was also suggested as another process by which we could triangulate our results and effectively flesh out

the various firm-specific capabilities and practices that would enable us to answer the research question most effectively. The case study was extremely helpful in ensuring that the construct was well-aligned, and the hypothesized model was in keeping with the literature. A pre-test was also conducted to confirm the validity of the scales. Based on the pre-test of each hypothesized construct, we showed that the items in the survey instrument were quite reliable and able to effectively capture the relationships hypothesized during the literature review and model development process. The next chapter deal with the quantitative analysis of the entire survey that was conducted post the pre-test.

6.2 Large-Scale Survey and Instrument Validation

A large-scale survey was conducted after a series of instrument development and pre-test process, which start from measurement instrument development, Q-sort and pilot study. The main purpose of this survey was to collect data and further validate the measurement instrument and test the proposed hypothesis. The population of this research embraced firms in various industries ranges from the U.S. and European countries. The survey targeted majorly towards operations and supply chain related middle and higher-level managers (e.g., purchasing manager, operations manager, business analyst manager, CEO, COO, CIO, etc.). The survey was executed in two stages. The first stage was targeted using a convenient sample. The list of respondents included my personal contacts and professional references provided by the University of Toledo. The second stage of the survey was distributed through the online survey portal and agencies (Qualtrics and Dynata). Total 1,439 responses are collected, 101 are marked as incomplete (i.e., more than 10 questions are left blank), 954 are screened out due to response duration less than 8 mins, 63 are screened out due to selecting the same options with more than 95% questions, and 57 responses are eliminated by two screening questions (e.g., if you still pay attention to the survey please

choose “strongly agree”). Thus, this research ends up with 319 valid responses (220 of U.S. and 99 of U.K.) for the data analysis

Table 6.25 Invalid responses screening process

Total Responses	Incompletes	Screen out < 8 mins	Screen out SD<0.5	Two screening questions	Valid Responses	
					US	**UK**
1439	101	954	63	57	220	99
					319	

6.2.1 Large Scale Data Collection

There are three screening criteria of sample selection which show in the following:

1. The respondent must be a middle and senior-level manager related to the operations and supply chain field.
2. The respondent must have more than two years of working experience in the current company.

These selection criteria were used for the online survey to select panel participants. The targeted industries consist of manufacturing, financial services, food and hospitality, health care, education, government, transportation, and Hi-tech.

1. c

6.2.2 Non-response Bias Test

This dissertation tested and validated hypotheses in two waves. The first wave is the pilot study which consists 99 responses. After pilot study, we collected another 220 responses in the second wave. The large-scale survey validation involved the responses from both waves. Since the data were collected in two separated time, chi-square test was conducted to ensure these two waves of data are congruent. We compared means differences between first wave and second wave in

terms of industry types, respondent working position, and target markets. Results are presented in Table 6.26.

The result shows that there were no significant differences between the respondents of the first wave and second wave (the p-values as seen in Table 6.26 are greater than 0.05). Therefore, the analysis presented in the following sections of this dissertation is free from non-response bias. We can also combine both waves together to obtain a larger dataset of 319 respondents for large-scale survey.

Table 6.26

Variables	Early Respondents (1st Wave) (n=99)	Late Respondents (2nd Wave) (n=220)		Chi-square Test
	Frequency (%)	Observed Frequency (%)	Expected Frequency (%)	
Industry Types (n=319)				
Manufacturing	21 (21.2)	42 (19.1)	43.4 (19.7)	χ^2=9.6 $d.f.$= 8 p= 0.294
Financial Services	21 (21.2)	35 (15.9)	38.6 (17.5)	
Food and Hospitality	6 (6.1)	19 (8.6)	17.2 (7.8)	
Health Services	6 (6.1)	11 (5.0)	11.7 (5.3)	
Educational	8 (8.1)	29 (13.2)	25.5 (11.6)	
Government	9 (9.1)	13 (5.9)	15.2 (6.9)	
Transportation	6 (6.1)	13 (5.9)	13.1 (6.0)	
Hi-Tech	11 (11.1)	44 (20.0)	37.9 (17.2)	
Others	11 (11.1)	14 (6.4)	17.2 (7.8)	
Position (n=319)				
CEO/Owner	46 (46.5)	90 (40.9)	93.8 (42.6)	χ^2=1.087 $d.f.$= 3 p= 0.780
VP	10 (10.1)	22 (10.0)	22.1 (10.0)	
Manager	38 (38.4)	93 (42.3)	90.3 (41.0)	
Others	5 (5.1)	15 (6.8)	13.8 (6.3)	
Target Markets (n=319)				
At one site in this country	54 (54.5)	96 (43.6)	103.4 (47.0)	χ^2=5.765 $d.f.$= 3 p= 0.124
At more than one site in this country	26 (26.3)	86 (39.1)	77.2 (35.1)	
At sites in a few countries	7 (7.1)	10 (4.5)	11.7 (5.3)	
Globally, at sites in various continents	12 (12.1)	28 (12.7)	27.6 (12.5)	

6.2.3 Sample demographic

This section explains the sample's demographic to enable us to understand the respondent profile better. We analyse the respondents by industry type, job position, firm size by the number of employees, firm size by annual sales, target markets, the impact of the pandemic on operations, and acceleration of digital transformation.

6.2.3.1 Respondents by industry type

The table below represents data distribution based on the respondent's industry type. It can

be noted that 19.7% of the respondents are from manufacturing, 17.6% are from financial services, 17.2% are from the Hi-Tech industry, 11.6% are from the educational industry, and 33.9% from other industries.

Table 6.27 Respondent profile by industry type

Industry Type	Number	Percentage
Manufacturing	63	19.7%
Financial Services	56	17.6%
Food and Hospitality	25	7.8%
Health Services	17	5.3%
Educational	37	11.6%
Governmental	22	6.9%
Transportation	19	6.0%
Hi-Tech	55	17.2%
Others	25	7.8%
Total	**319**	**100.0%**

6.2.3.2 Respondents by job function

The survey was targeted to middle and senior-level managers. CEO or owners consisted of 43% of total responses, director and vice president level consisted of 10%, middle-level manager consisted of 41%, and 6% of responses were not specified. Table 6.28 presents the respondents' profile by job tier.

Table 6.28 Respondents profile by job tier

Job Tier	Frequency	Percentage
CEO/Owner	136	43%
VP	32	10%
Manager	131	41%
Others:	20	6%
Total	**319**	**100%**

6.2.3.3 Firm size by the number of employees

Next, the frequency distribution of the sample based on the firm sized by the number of employees was studied. There are 45% of the respondents from organizations with a number of employees between 1 to 100, 16% of the respondents were from the organizations with a number

of employees between 101 to 500, 14% of the respondents were from the organizations with a number of employees between 501 to 1000 employees, and 24% of respondents were from the organizations with more than 1000 employees.

Table 6.29 Firm size by number of employees

# of Employees	Frequency	Percentage
1-100	145	45%
101-500	51	16%
501-1000	46	14%
>1000	77	24%
Total	**319**	**100%**

6.2.3.4 Firm by annual sales

The frequency distribution of the sample based on their annual sales was also checked. Companies with annual sales of less than 1 million represented 32% of the portion, companies with sales between 1 million and 10 million were about 23%, companies with annual sales between 10 million and 100 million dollars represented 16% of the sample, companies with annual sales between 100 million to 1 billion contains 15% of the sample, and the rest 15% of companies are with the annual sales more than 1 billion dollars.

Table 6.30 Firms by annual sales

Annual Sales	Frequency	Percentage
<1 million	102	32%
1-10 million	72	23%
10-100 million	50	16%
100-1,000 million	48	15%
> 1billion	47	15%
Total	**319**	**100%**

6.2.3.5 Target markets

This research collected data regards the level of firms' globalization. There were 47% respondents worked in a firm that provide products and services at one site in the operating country, 35% of respondents worked in a firm that sell products and services at more than one site in the

operating country, 5% of respondents worked in a firm that sell products and services at sites in a few countries, and 13% of respondents worked in a firm that sell products and services in a global base.

Table 6.31 Target markets

Target Markets	Frequency	Percentage
At one site in this country	150	47%
At more than one site in this country	112	35%
At sites in a few countries	17	5%
Globally, at sites in various continents	40	13%
Total	**319**	**100%**

6.2.3.6 Impact of the pandemic on operations

This research also studied the level of impacts of the pandemic on firms' everyday operations. Within 319 valid responses, 23% of responses indicated the low impacts of the pandemic on their normal operations, 34% of responses indicated the medium impacts of the pandemic on their normal operations, 27% of responses indicated the high impacts of the pandemic on their normal operations, and 16% of respondents indicated the very high impacts of the pandemic on their normal operations.

Table 6.32 Impact of pandemic

Impact of pandemic	Frequency	Percentage
Low impacts on normal operations	73	23%
Medium impacts on normal operations	108	34%
High impacts on normal operations	86	27%
Very high impacts on normal operations	52	16%
Total	**319**	**100%**

6.2.3.7 Acceleration of digital transformations

Firms start to pay more attention to the utilization of data compare with the pre-COVID19 world. This research captures the impact of the pandemic on digital transformation. There are 16% of respondents mentioned the negative impact of the pandemic on the digital transformation, 46%

of respondents indicated no real change of the pandemic on their digital transformation process, 31% of respondents indicated a 1 to 2 years acceleration of the digital transformation process, and 7% of respondents pointed that more than three years of acceleration of transformation by the pandemic.

Table 6.33 Digital transformation impact

Acceleration of digital transformation	Frequency	Percentage
Negatively impacted	51	16%
No real change	148	46%
Accelerated by 1 to 2 years	99	31%
accelerated by more than 3 years	21	7%
Total	**319**	**100%**

6.2.4 Measurement model analysis and results

This section reports various stages of analysis of measurement models. 15 constructs are analyzed, which include industry leader challenges, emerging rival challenges, market culture shifts, disruptive technology imperatives, level of internationalization, level of localization, benchmark learning practices, differentiation innovation practices, cross-functional synergies, organizational digital collaboration, core relationships focus, extended network optimization, competitive benchmarking outcomes, socio-tech innovation outcomes, and supply chain outcomes.

As suggested by Anderson and Gerbing (1988), this research tested Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA) in sequence.

6.2.5 Exploratory factor analysis (EFA)

The purpose of conducting an EFA is to identify the correlations among variables and prepare the variables for CFA. Reliability and validity are crucial for an empirical study to ensure the results are statistically meaningful (Hair et al., 2016; Nunnally, 1978; Nunnally & Bernstein, 1994). In the EFA, reliability, discriminant validity, and convergent validity are measured to ensure

rigorous of this research.

The first step in the instrument validation is time purification. In order to purify scale items, CITC was used. The acceptable threshold for CITC is 0.3 (Johanson & Brooks, 2010; Nunnally & Bernstein, 1994). Items with CITC lower than 0.3 were removed for later analysis. The next step of validating the instrument is to check the reliability of each construct. Cronbach's alpha is used to ensure reliability. Cronbach's alpha score of 0,7 or higher indicated as an acceptable reliability measure. Both CITC and Cronbach's alpha are tested in two sets of analysis. We first separately analysed divers, practices and outcomes for CITC and Cronbach's alpha to ensure validity and reliability. Then we run the analysis with all the constructs together to calculate CITC and Cronbach's alpha.

In the factor lading test, Maximum Likelihood was used as extraction based on eigenvalue less than 1 and Promax was used for the rotation method. The Kaiser-Meyer-Olkin (KMO) statistics which tests the partial correlations among variables are also checked. A High KMO score shows a small correlation among the variables. KMO of less than 0,5 was considered unacceptable (Hair et al., 2016). Communalities were checked to determine the extent to which items were correlated with all other items. Higher communalities are preferable since low communalities indicate items have difficulty in loading significantly on any factor. Score of less than 0.4 of communalities was considered unacceptable.

Validity was assessed in terms of convergent validity and discriminant validity. Convergent validity refers to the degree of correlation among items within a single factor. It can be revealed through factor loadings. It is desirable to have factor loadings greater than 0.5 in each factor. However, when the sample size is greater than 250, factor loadings of 0.35 can be used as the threshold (Hair et al., 2016; Nunnally, 1978; Shin et al., 2000).

Discriminant validity refers to the extent to which factors are distinct and uncorrelated. It is expected items are related more strongly to their own factor rather than to other factors. Discriminant validity can be assessed by examining the pattern matrix in EFA of cross-loading issues. Discriminant validity can also be assessed by checking the factor correlation matrix. If the correlation between factors exceeds 0.7, it means that two factors share a large amount of variance (Hair et al., 2016; Johanson & Brooks, 2010; Nunnally, 1978)

6.2.5.1 Construct reliability analysis

EFA was conducted using IBM SPSS Statistics 25. to determine reliability and validity of the item. This study run factor analysis by drivers, practices and outcomes. There are six contextual drivers, six structural practices, and three performance outcomes that first run separately to check CITC and Cronbach's alpha.

There are six contextual drivers which are Industry Leader Challenges (ILC), Emerging Rival Challenges (ERC), Market Culture Shifts (MCS), Disruptive Technology Imperatives (DTI), Level of Internationalization (LOI) and Level of Localization (LOL). To conduct an EFA for these six constructs, 33 questions were tested for CITC scores and Cronbach's alpha values to ensure scale reliability. Items that had an overall score of less than 0.3 in CICT and score of less than 0.4 in communality were eliminated to ensure higher reliability. Cross-loadings among multiple factors with differences less than 0.2 are also deleted. Refer to Table 6.34, ILC and ERC together as dynamic market drivers were loaded together with 8 items. The rest drivers are loaded separately with CITC values of 0.3 or higher and Cronbach's alpha of 0.7 or higher. The communalities of those extracted items are all greater than 0.4 that shows in Table 6.36. KMO was 0.95 and the total variance explained was 66.817%. All these values indicate very good reliability.

Table 6.34 CITC score and Cronbach's alpha for contextual drivers

Codes	Survey Items	CITC	Cronbach's α
ILC3	Our firm notes the market growth investment initiative of industry-leading firms.	.765	0.928
ILC4	Our firm is aware of the new products/services introduction of the industry-leading firms	.654	
ILC5	Our firm collects news about the partnership alliance of the industry-leading firms.	.507	
ERC1	Our firm knows about the new strategic aim/direction of emerging rival firms.	.762	
ERC2	Our firm recognizes the publicized new major initiatives of emerging rival firms.	.792	
ERC3	Our firm notes the market growth investment initiative of emerging rival firms.	.883	
ERC4	Our firm is aware of the new products/services introduction of emerging rival firms.	.842	
ERC5	Our firm learns about the news about the partnership alliance of emerging rival firms.	.780	
MCS1	Our firm observes changing customer requirements for new products and services.	.734	0.887
MCS 2	Our firm recognizes the shifted market norms of new products and services.	.819	
MCS 3	Our firm senses increasing value proposition changes of new products and services.	.654	
MCS4	Our firm is aware of the changing patterns of successful products and services.	.706	
MCS5	Our firm realizes to growing expectations of new products and services.	.731	
DTI 1	Our firm is aware of radical technological applications.	633	0.860
DTI 2	Our firm discovers innovation knowledge.	0.804	
DTI 3	Our firm recognizes well-defined operating procedures that facilitate by new technology.	0.966	
DTI 4	Our firm recognizes the increasing investment need for new technology.	0.765	
LOI1	Our firm initiates efforts in increasing revenue potential in global markets.	.911	0.953
LOI 2	Our firm observes new business opportunities in multiple countries.	.954	
LOI 3	Our firm assesses global capabilities to target market segments of multiple countries.	.956	
LOI 4	Our firm segments target customers by income levels (upper, middle, lower) of different countries.	.726	
LOI 5	Our firm compares customer value requirements of different countries.	.834	
LOI 6	Our firm searches for suppliers from a global base.	.757	
LOL 1	Our firm initiates localization efforts in increasing revenue potential in specific the country we operate.	.788	0.876
LOL 2	Our firm plans to develop local talents in specific countries.	.843	
LOL 3	Our firm examines local managerial capabilities.	.815	
LOL 4	Our firm values the innovative ideas of the local focus group for business development efforts.	.799	
LOL5	Our firm evaluates local customer value requirements of specific countries.	.778	

Table 6.35 Communalities for contextual drivers

Code	Initial	Extraction
ILC_3	.629	.619
ILC_4	.558	.537
ILC_5	.585	.541
ERC_1	.611	.612
ERC_2	.658	.658
ERC_3	.723	.746
ERC_4	.673	.679
ERC_5	.721	.720
MCS_1	.551	.565
MCS_2	.626	.690
MCS_3	.584	.608
MCS_4	.621	.635
MCS_5	.590	.633
DTI_1	.543	.532
DTI_2	.623	.650
DTI_3	.639	.773
DTI_4	.557	.566
LOI_1	.758	.778
LOI_2	.820	.858
LOI_3	.856	.893
LOI_4	.720	.748
LOI_5	.806	.871
LOI_6	.707	.712
LOL_1	.488	.488
LOL_2	.613	.662
LOL_3	.593	.664
LOL_4	.617	.613
LOL_5	.619	.661

There are six structural practices which are Benchmark Learning Practices (BLP), Differentiation Innovation Practices (DIP), Cross-functional Synergies (CFS), Organizational Digital Collaboration (ODC), Core Relationship Focus (CRF), and Extended Network Optimization (ENO). To conduct an EFA for these six constructs, 36 questions were tested for

CITC scores and Cronbach's alpha values to ensure scale reliability. Items that had an overall score of less than 0.3 in CICT and a score of less than 0.4 in communality were eliminated to ensure higher reliability. Cross-loadings among multiple factors with differences less than 0.2 are also deleted. Refer to Table 6.36, items in BLP were not loaded in one factor, and the loadings were not good. So construct of BLP was deleted for further analysis. The rest drivers are loaded separately with CITC values of 0.3 or higher and Cronbach's alpha of 0.7 or higher. The communalities of those extracted items are all greater than 0.4 that shows in Table 6.37. KMO was 0.945 and total variance explained was 63.056%. All these values indicate very good reliability.

Table 6.36 CITC score and Cronbach's alpha for structural practices

Codes	Survey Items	CITC	Cronbach's α
DIP1	Our firm revises our business model in response to market changes to stand out from competitors.	.502	0.852
DIP3	Our firm keeps investigating new knowledge to meet customers' requirements.	.755	
DIP4	Our firm improves forward-thinking operational practices to address competitor challenges that stand out from competitors.	.916	
DIP5	Our firm develops exceptional leadership capabilities in response to competitor challenges.	.686	
CFS1	Our firm communicates organization-wide policy guidelines across all functional areas.	.849	0.823
CFS2	Our firm adopts common communication platforms for all functional areas.	.733	
CFS3	Our firm clarifies interactive rules of engagements among diverse functional areas.	.628	
ODC1	Our firm uses virtual platforms to share functional common goals.	.621	0.914
ODC2	Our firm installs a cloud-based software system for real-time communication.	.739	
ODC3	Our firm adopts interactive digital coordination (e.g., access to customer feedback/satisfaction ratings).	.841	
ODC4	Our firm applies descriptive analytical tools for problem assessment.	.912	
ODC5	Our firm implements standard predictive analytic tools for managing supply chain risks.	.640	
ODC6	Our firm tests digital prescriptive analytic tools for long-term goals the implementation of long-term goals.	.846	
CRF1	Our sourcing department works well with strategic suppliers.	.466	0.860
CRF3	Our supply chain department engages actively with first-tier suppliers.	.542	
CRF4	Our firm involves with key suppliers in the strategic planning process.	.884	
CRF5	Our firm involves primary suppliers in the product development process.	.931	
ENO1	Our firm networks with lower tiers (2nd and 3rd tier) suppliers	.608	0.861
ENO2	Our firm expands (supply) logistics network in a global base.	.846	
ENO3	Our firm implements contingent multiple-sourcing network plans.	.836	
ENO4	Our firm deploys a broad communication network (multi-tier relationships) in the new product development process.	.419	
ENO6	Our firm involves lower-tier network members in post-sales services.	.733	

Table 6.37 Communalities for structural practices

Code	Initial	Extraction
DIP_1	.496	.511
DIP_3	.560	.615
DIP_4	.605	.724
DIP_5	.566	.613
CFS_1	.570	.703
CFS_2	.491	.561
CFS_3	.536	.572
ODC_1	.533	.490
ODC_2	.592	.540
ODC_3	.629	.654
ODC_4	.733	.781
ODC_5	.671	.693
ODC_6	.750	.793
CRF_1	.474	.440
CRF_3	.567	.539
CRF_4	.718	.806
CRF_5	.686	.780
ENO_1	.488	.499
ENO_2	.536	.606
ENO_3	.638	.712
ENO_4	.669	.664
ENO_6	.535	.576

There are three performance outcomes which are Competitive Benchmarking Outcomes (CBO), Socio-Tech Innovation Outcomes (SIO), and Supply Chain Outcomes (SCO). To conduct an EFA for these six constructs , 26 questions were tested for CITC scores and Cronbach's alpha values to ensure scale reliability. Items that had an overall score of less than 0.3 in CICT and score of less than 0.4 in communality were eliminated to ensure higher reliability. Cross-loadings among multiple factors with differences less than 0.2 are also deleted. Refer to Table 6.38, there are 20 items loaded into three factors with CITC values of 0.3 or higher and Cronbach's alpha of 0.7 or higher. The communalities of those extracted items are all greater than 0.4 that shows in Table 6.39.

KMO was 0.941 and total variance explained was 62.578%. All these values indicate very good reliability.

Table 6.38 CITC score and Cronbach's alpha for performance outcomes

Codes	Survey Items	CITC	Cronbach's α
CBO1	Our firm attains a high product quality reputation.	.846	0.862
CBO2	Our firm achieves high delivery performance.	.790	
CBO3	Our firm obtains high manufacturing flexibility	.369	
CBO4	Our firm attains good logistics performance.	.750	
CBO5	Our firm excels in customer responsiveness.	.800	
CBO6	Our firm obtains high customer satisfaction ratings.	.846	
SIO1	Our firm implements obtains a high level of human-computer interactions.	.822	0.918
SIO2	Our firm succeeds in the technology adoption process.	.825	
SIO3	Our firm attains high process innovation impacts.	.823	
SIO4	Our firm reports high product innovation results.	.659	
SIO5	Our firm excels in cross-functional problem solving through digital platforms.	.815	
SIO6	Our firm achieves high productivity by socio-automation collaboration.	.740	
SIO7	Our firm succeeds in training employees to use newly developed software.	.694	
SCO1	Our firm attains supply chain competitiveness	.731	0.924
SCO2	Our firm maintains a high level of integration with supply chain members.	.730	
SCO3	Our firm operates in a mature supply chain.	.705	
SCO4	Our firm operates in a supply chain with flexibility.	.862	
SCO5	Our firm excels in supply chain responsiveness.	.903	
SCO6	Our supply chain achieves agility in response to changes	.889	
SCO7	Our firm operates in a resilient supply chain can recover from disruptions quickly.	.650	

Table 6.39 Communalities for performance outcomes

Code	Initial	Extraction
CBO_1	.604	.685
CBO_2	.600	.674
CBO_4	.497	.453
CBO_5	.563	.596
CBO_6	.532	.570
SIO_1	.558	.561
SIO_2	.611	.603
SIO_3	.688	.715
SIO_5	.642	.655
SIO_6	.661	.648
SIO_7	.653	.653
SCO_1	.575	.578
SCO_2	.583	.581
SCO_3	.670	.639
SCO_4	.579	.510
SCO_5	.640	.675
SCO_6	.736	.776
SCO_7	.713	.732

6.2.5.2 Validity and reliability of the completed model

Factor loadings of contextual drivers, structural practices and performance outcomes were considered very good. We further examined the convergent validity, discriminant validity, and reliability of the completed model.

To ensure the convergent validity, we checked the cross-loading issue by involving all 15 constructs together. Cross-loadings indicate that an item is correlated with other items of more than one construct. Items with cross-loading in more than two factors and the score differences less than 0.2 were eliminated for further analysis. The analysis has been done by using SPSS with Maximum Likelihood extraction and Promax rotation. There are five constructs, namely ILC, DTI, BLP, DIP, and ENO. Table 6.40 presents the final retained items to conduct confirmatory factor

analysis. The resulting pattern matrix revealed 10 distinct factors. The resulting KMO measure of sampling adequacy was 0.952 and total variance explained was 66.833%. The next model evaluation parameter we looked at is communalities to ensure the convergent validity. "A communality is the extent to which an item correlates with all other items. Higher communalities are better. If communality for a particular item is lower than 0.4 means that item may struggle to load significantly on any factor (Gaskin, 2016). Table 6.41 shows the items communalities of the completed model, which are all greater than 0.4.

Table 6.40 Factor loading from the exploratory factor analysis (EFA)- completed model

Constructs	LOI	SIO	SCO	MCS	CBO	ERC	LOL	CRF	CFS	ODC
Cronbach's alpha	0.953	0.919	0.909	0.886	0.862	0.915	0.874	0.858	0.825	0.907
ERC_1						.803				
ERC_2						.791				
ERC_3						.762				
ERC_4						.806				
ERC_5						.726				
MCS_1				.610						
MCS_2				.714						
MCS_3				.794						
MCS_4				.649						
MCS_5				.795						
LOI_1	.871									
LOI_2	.974									
LOI_3	.969									
LOI_4	.730									
LOI_5	.857									
LOI_6	.786									
LOL_1							.502			
LOL_2							.914			
LOL_3							.772			
LOL_4							.668			
LOL_5							.838			
CFS_1									.891	
CFS_2									.664	
CFS_3									.566	

ODC_3				.635
ODC_4				.925
ODC_5				.594
ODC_6				.700
CRF_1			.526	
CRF_3			.609	
CRF_4			.879	
CRF_5			.869	
CBO_1		.850		
CBO_2		.823		
CBO_4		.451		
CBO_5		.740		
CBO_6		.799		
SIO_1	.853			
SIO_2	.853			
SIO_3	.773			
SIO_4	.578			
SIO_5	.655			
SIO_6	.492			
SIO_7	.602			
SCO_1		.713		
SCO_2		.645		
SCO_3		.541		
SCO_4		.940		
SCO_6		.962		
SCO_7		.770		

Extraction Method: Maximum Likelihood.

Rotation Method: Promax with Kaiser Normalization.

a. Rotation converged in 8 iterations.

Table 6.41 Communalities- completed model

	Initial	Extraction
ERC_1	.644	.660
ERC_2	.684	.687
ERC_3	.714	.727
ERC_4	.672	.707
ERC_5	.733	.722
MCS_1	.582	.522
MCS_2	.671	.658
MCS_3	.638	.647
MCS_4	.660	.632
MCS_5	.610	.623
LOI_1	.782	.779
LOI_2	.831	.843
LOI_3	.874	.894
LOI_4	.758	.726
LOI_5	.816	.792
LOI_6	.741	.698
LOL_1	.543	.516
LOL_2	.644	.681
LOL_3	.656	.644
LOL_4	.654	.615
LOL_5	.656	.658
CFS_1	.626	.762
CFS_2	.599	.578
CFS_3	.613	.580
ODC_3	.631	.623
ODC_4	.757	.831
ODC_5	.715	.694
ODC_6	.765	.764
CRF_1	.586	.540
CRF_3	.633	.602
CRF 4	.732	.778
CRF_5	.698	.722
CBO_1	.655	.686
CBO 2	.668	.699
CBO_4	.586	.506
CBO_5	.643	.623

CBO_6	.579	.556
SIO_1	.619	.584
SIO_2	.664	.632
SIO_3	.743	.725
SIO_4	.665	.636
SIO_5	.700	.664
SIO_6	.733	.689
SIO_7	.630	.607
SCO_1	.630	.603
SCO_2	.727	.679
SCO_3	.672	.595
SCO_4	.674	.693
SCO_6	.720	.733
SCO_7	.687	.626

Discriminant validity refers to the extent to which factors are distinct and uncorrelated with other factors. It can be measured by evaluating the results in the pattern matrix in EFA. If items load significantly only on one single factor, the discriminant validity is established. In addition. If the value in the correlation matrix is less than 0.7, then we can argue that the discriminant validity was not violated. Table 6.42 shows the factor correlations among extracted 10 constructs.

Table 6.42 Factor correlation matrix for discriminant validity- completed model

Factors	LOI	SIO	SCO	MCS	CBO	ERC	LOL	CRF	CFS	ODC
LOI	1.000	.534	.476	.358	.185	.510	.490	.481	.254	.552
SIO	.534	1.000	.637	.511	.502	.527	.565	.595	.497	.723
SCO	.476	.637	1.000	.457	.564	.468	.531	.718	.548	.571
MCS	.358	.511	.457	1.000	.426	.688	.501	.463	.553	.508
CBO	.185	.502	.564	.426	1.000	.308	.283	.433	.472	.283
ERC	.510	.527	.468	.688	.308	1.000	.575	.488	.500	.613
LOL	.490	.565	.531	.501	.283	.575	1.000	.597	.521	.624
CRF	.481	.595	.718	.463	.433	.488	.597	1.000	.537	.604
CFS	.254	.497	.548	.553	.472	.500	.521	.537	1.000	.436
ODC	.552	.723	.571	.508	.283	.613	.624	.604	.436	1.000

We also tested for reliability under EFA of the completed model the value of reliability can

be found by calculating Cronbach's alpha. Cronbach’s alpha should be above 0.7. The top row of Table 6.40 shows the Cronbach’s alpha of the extracted 10 constructs, which are all greater than 0.7. Therefore, the completed model obtains good reliability.

To summarize, all the measurement scales used in this study were subjected to reliability and validity tests. The next section will discuss confirmatory factor analysis (CFA).

6.2.6 Measurement model analysis and results (CFA)

The objective of conducting a CFA is to further identify convergent validity and discriminant validity of a measurement model (Hair et al., 2016). In the first stage of CFA, all the items from EFA were loaded into IBM AMOS Version 25 to check the model fit measures. The initial measurement model based EFA was not a good model fit compared with the threshold of model fit measure in Table 6.44. We further checked the modification indices to identify high correlated items. Items of LOI5, SIO3, SCO3, SIO6, CRF1, SIO4, SIO5, and ODC5 were deleted due to this issue. After dropping those items, the model fit was achieved. Table 6.43 shows items that were left for the rest of the analysis.

Table 6.43 Factor loadings, construct mean and standard deviation from CFA

Constructs	Codes	Loadings
Emerging Rival Challenges (ERC)	ERC1	.762
	ERC2	.792
	ERC3	.883
	ERC4	.842
	ERC5	.780
Market Culture Shifts (MCS)	MCS1	.734
	MCS 2	.819
	MCS 3	.654
	MCS4	.706
	MCS5	.731
Level of Internationalization (LOI)	LOI1	.911
	LOI 2	.954
	LOI 3	.956
	LOI 4	.726
	LOI 6	.757
Level of Localization (LOL)	LOL 1	.788
	LOL 2	.843
	LOL 3	.815
	LOL 4	.799
	LOL5	.778
Cross-Functional Synergies (CFS)	CFS1	.849
	CFS2	.733
	CFS3	.628
Organizational Digital Collaboration (ODC)	ODC3	.841
	ODC4	.912
	ODC6	.846
Core Relationship Focust (CRF)	CRF1	.466
	CRF3	.542
	CRF4	.884
	CRF5	.931
Competitive Benchmarking Outcomes	CBO1	.846
	CBO2	.790
	CBO4	.750
	CBO5	.800
	CBO6	.846
Socio-Tech Innovation Outcomes (SIO)	SIO1	.822
	SIO2	.825
	SIO7	.694

Supply Chain Outcomes (SCO)	SCO1	.731
	SCO2	.730
	SCO4	.862
	SCO6	.889
	SCO7	.650

6.2.6.1 Model fit indices for assessment

Figure 6-1 presents the updated measurement model and Table 6.45 shows the associated model fit measures. As the results suggest, CMIN was 1303.127, DF was 774, CMIN/DF was 1.684, CFI was 0.944, SRMR was 0.054, RMSEA was 0.046 and PClose was 0.915. all these measures are considered excellent according to the literature (Hair et al., 2016; Hu & Bentler, 1999; Sharma et al., 2020; Weill & Olson, 1989).

Table 6.44 Model fit indices threshold

CMIN/DF	<3 good; <5 sometimes acceptable	(Browne, Cudeck, Bollen, & Long, 1993; Byrne, 2009)
GFI	>0.90 is good; >0.80 permissible	(Hair et al., 2006)
RMR	<0.05 is good, <0.08 is permissible	(Browne et al., 1993; Byrne, 2009)
CFI	>0.90 is good; >0.80 permissible	(Hair et al., 2006)
NFI	>0.90 is good; >0.80 permissible	(Hair et al., 2006)
RMSEA	<0.8 is good; >0.1 is poor	(Browne et al., 1993; Hair et al., 2006). Hu and Bentler say anything below 0.6 is good.
AGFI	>0.90 is good; >0.80 permissible	(Hair et al., 2006)
PClose	Less than 0.05 is Excellent. Between 0.01 and 0.05 is acceptable.	Hu and Bentler 1999
TLI	0.95 or higher	Hu and Bentler 1999
SRMR	<0.06 is Excellent, >0.06 and >0.08 is acceptable	Hu and Bentler 1999

Table 6.45 Model fit measures

Measure	Estimate	Threshold	Interpretation
CMIN	1303.127	--	--
DF	774.000	--	--
CMIN/DF	1.684	Between 1 and 3	Excellent
CFI	0.944	>0.95	Acceptable
SRMR	0.054	<0.08	Excellent
RMSEA	0.046	<0.06	Excellent
Pclose	0.915	>0.05	Excellent

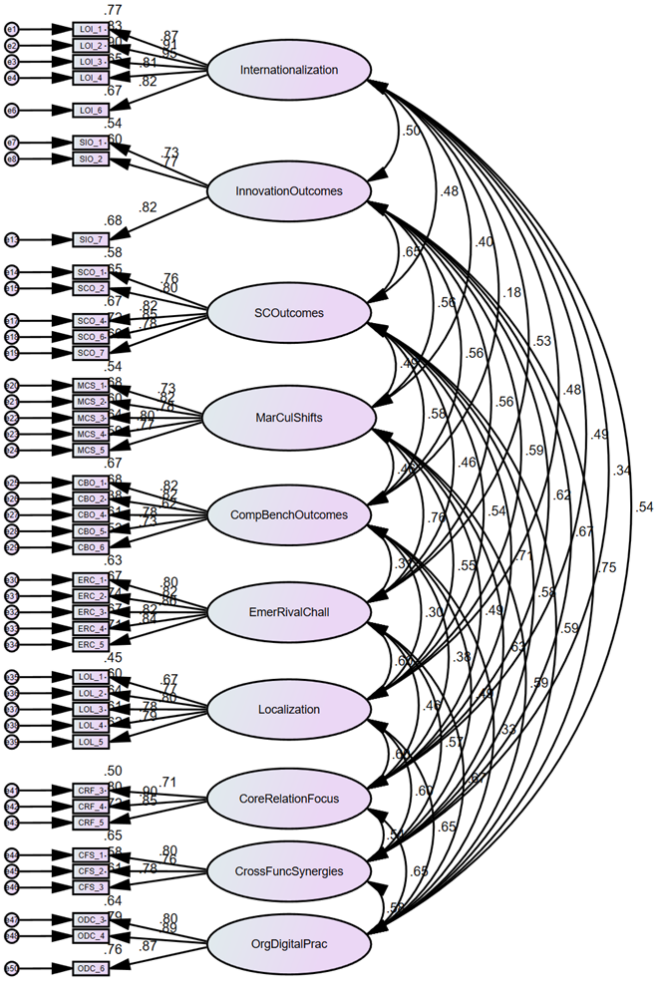

Figure 6–1 Measurement model

6.2.6.2 Convergent validity

The convergent validity represents the alignment between the measurement items and constructs (Hair et al., 2016). The convergent validity was assessed first by looking at the item loadings (Anderson & Gerbing, 1988). The item loading was sufficiently higher. Next, when assessing the fit indices, namely χ^2, SRMR, CFI, SRMSEA and PClose, they were found to be excellent or above acceptable level (Hair et al., 2016; P. Hong et al., 2012; Hu & Bentler, 1999).

6.2.6.3 Discriminant validity

When distinct groups of measurement items represent a construct, discriminant validity is

used to access unconventionality and distinctiveness. To test discriminant validity, the square root of AVE value is compared to the correlation value between the constructs (Fornell & Larcker, 1981). Greater values indicated the adequate discriminant validity on diagonal (square root of AVE) than off-diagonal correlations coefficients. The bold diagonal values in Table 6.46 are square root of AVE to compare with the off-diagonal correlation coefficient between latent variables. We can see the values on the diagonal are all greater than the rest of factors correlations.

6.2.6.4 Composite reliability

The internal consistency of the constructs is determined by Composite Reliability (CR) (Hair et al., 2016). It reflects the ability of the construct to generate the same outcomes in repeated statistical tests. Cronbach's alpha is a measure of composite reliability. In Table 6.40, Cronbach's alpha is represented. Composite Reliability (CR) for the constructs ranges higher than the 0.7 level suggesting strong reliability.

Table 6.46 Correlation matrix and validity measures

	CR*	AVE**	M[b]	SD[c]	LOI	SIO	SCO	MCS	CBO	ERC	LOL	CRF	CFS	ODC
Level of Internationalization	0.942	0.766	2.810	1.260	**0.875[a]**									
Socio-Tech Innovation Outcomes	0.821	0.605	3.209	0.697	0.503***	**0.778**								
Supply Chain Outcomes	0.900	0.643	3.421	0.749	0.478***	0.646***	**0.802**							
Market Culture Shifts	0.886	0.610	3.608	0.656	0.395***	0.561***	0.495***	**0.781**						
Competitive Benchmarking Outcomes	0.869	0.573	3.949	0.667	0.180**	0.558***	0.576***	0.460***	**0.757**					
Emerging Rival Challenges	0.916	0.685	3.402	0.771	0.529***	0.556***	0.464***	0.761***	0.309***	**0.827**				
Level of Localization	0.875	0.585	2.740	0.689	0.484***	0.588***	0.545***	0.548***	0.303***	0.602***	**0.765**			
Core Relationship Focus	0.860	0.675	3.557	0.979	0.492***	0.616***	0.708***	0.494***	0.383***	0.463***	0.601***	**0.821**		
Cross-functional Synergies	0.825	0.612	3.931	0.793	0.336***	0.671***	0.580***	0.633***	0.489***	0.566***	0.605***	0.536***	**0.782**	
Organizational Digital Collaboration	0.890	0.730	3.179	0.977	0.544***	0.752***	0.589***	0.590***	0.332***	0.670***	0.655***	0.646***	0.582***	**0.854**

∗ Composite reliability (CR) for the constructs range higher than the 0.70 level suggest strong reliability.

∗∗Convergent validity is assessed using the average variance extracted (AVE). AVE measures of 0.5 or more are considered to demonstrate adequate convergent validity

a Discriminant validity: indicated by greater values on diagonal (square root of AVE) than off-diagonal correlations coefficients.

b Mean of the construct

c Standard deviation of the construct

6.2.7 Multicollinearity

In order to proceed with the analysis, multicollinearity must be checked. The statistical interpretation made from the data may not be reliable if multicollinearity is present in the data. Multicollinearity can be detected with the help of variance inflation factor (VIF). To calculate the VIF, we first computed each construct in the measurement model into one observed variable. Then SPSS has been used for the analysis of VIF (Podsakoff et al., 2003). Table 6.47 denotes VIF related to the hypothesized relationship in the research model. The relationship with VIF of less than 5 is considered to be free from significant multicollinearity issues. Thus, we don't have any multicollinearity issues in this dissertation.

Table 6.47 Multicollinearity assessment

Hypothesized relationship	VIF
ERC➔CFS	3.822
MCS➔CFS	3.131
LOL➔CFS	1.937
LOI➔CFS	1.570
ERC➔ODC	3.822
MCS➔ODC	3.131
LOL➔ODC	1.937
LOI➔ODC	1.570
ERC➔CRF	3.822
MCS➔CRF	3.131
LOL➔CRF	1.937
LOI➔CRF	1.570
CRS➔CBO	2.376
ODC➔CBO	1.889
CRF➔CBO	2.150
CRS➔SIO	2.376
ODC➔SIO	1.889
CRF➔SIO	2.150
CRS➔SCO	2.376
ODC➔SCO	1.889
CRF➔SCO	2.150

6.2.8 Common Method Biads

Common method bias (CMB) happens when the instrument causes variations in responses.

Since this study use self-reported survey method to test the hypothesis. Hence, CMB needs to be analysed and, if the results are significant, needs to be controlled. For this study, the common method bias issue was considered from the development stage of the questionnaire. The questionnaire was designed in such a way that survey questions were clear and concise. Moreover, constructs involving independent and dependent variables were given separately in different sections in the questionnaire (P. Hong et al., 2012; Murat Ar & Baki, 2011; Shin et al., 2000; Venkatesh & Bala, 2008). From the instrument design and development stages, we were trying to control the common method bias issue. To further test and control common method bias issues, we conducted another three methods:

1. Harmans (1961) single factor test.
2. Common latent factor test
3. Use of a marker variable

6.2.8.1 Harman's (1961) single factor test

Harman (1961) proposed that to test for the presence of common method bias, we should run EFA in SPS by constraining current items into 1 factor. If the total variance explained by using Harman's single factor is less than 50%, then we could conclude that common method bias does not present in the study. We plug in all the items from Table 6.43 into SPSS. In the "extraction" section, we constrain the number of factors to "1" and did not rotate the solution. The total variance produced was 37.267% (Podsakoff et al., 2003, 2012).

6.2.8.2 Common latent factor test

The common latent factor test of detecting CMB is done in in AMOS by introducing a common latent factor. Then regression lines are added to every observed item. We first to run the model with an unconstrained common fatten factor and record the χ^2 and degree of freedom. Then, we constrain the path coefficient of each regression line to be 0 and run the analysis again.

Figure 6-2 shows constrained model as drawn in AMOS. The results provide us χ^2 and degree of freedom. Finally, we compare both model's χ^2 and degree of freedom and check if the difference is significant. Table 6.49 shows the χ^2 difference test of the two models. The χ^2 test for the zero constrained model was significant, which means that the model has been detected with CMB. To further control the CMB, in the next section we involved a marker variable in the path model analysis (Gaskin and Lim, 2017).

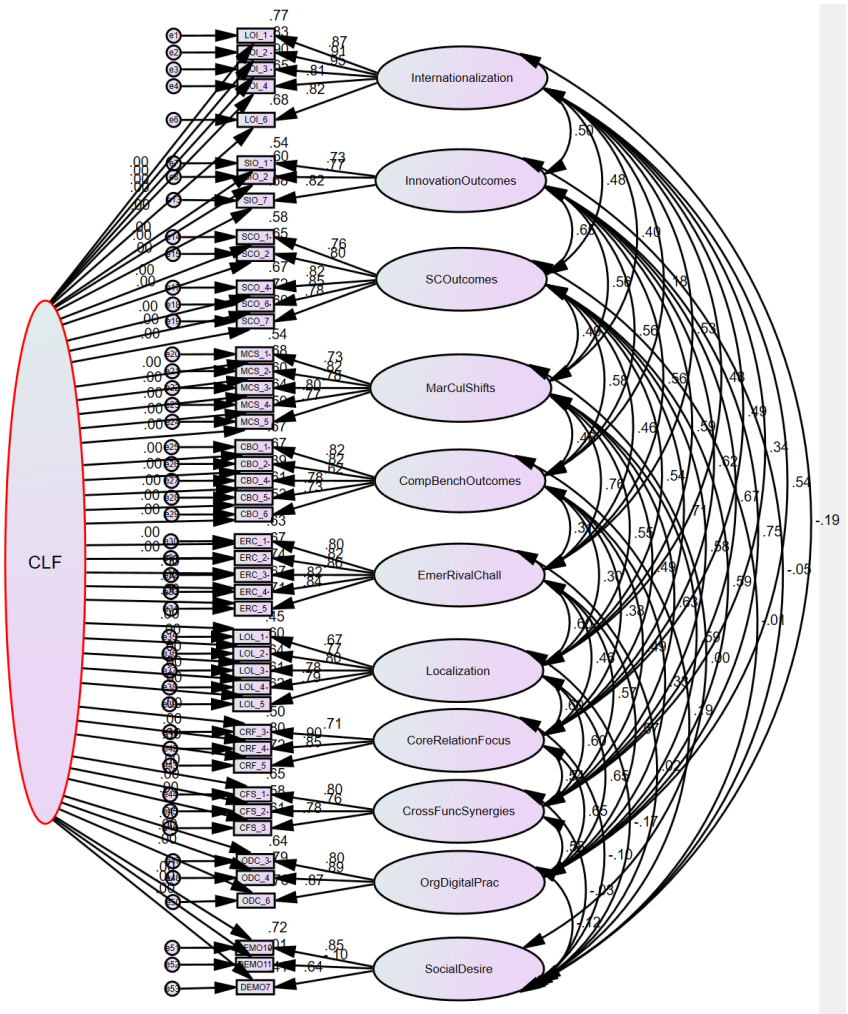

Figure 6–2 Measurement model with common latent factor and path coefficient constrained to 0

Table 6.48 χ^2 test of unconstrained and constrained common latent factor method

	χ^2	Degree of freedom	Delta	p-value

Unconstrained Model	1279.7	845	$\chi^2 = 222$	0.000
Zero Constrained Model	1501.7	890	DF=45	

6.2.8.3 Marker variable

The marker variable technique is the most reliable method to identify common method bias (Malhotra et al., 2006). We need a latent variable in our survey that is theoretically uncorrelated with any other latent variable in the system for this method. We used three demographic items (DEMO6, DEMO7, DEMO10) to form this marker latent variable. Since we detected CMB from the common latent factor section, we included this marker latent variable in our path analysis.

Chapter 7

7 Hypothesis Testing and Results

In this chapter, the proposed model is tested using structural equation modeling (SEM). This technique uses series of multiple regression equations to explain the relationship between multiple variables. IBM AMOS version 25 was used to evaluate the structural/path model. SEM is conducted in two stages (Anderson & Gerbing, 1988). The first stage of SEM, the measurement model, was discussed in the previous chapter. The second stage, the path model, was discussed in this chapter.

7.1 Results of the initial hypothesized structural model

Since there are five constructs (ILC, DTI, BLP, DIP and ENO) that are deleted due to cross-loading and higher correlation issues in the previous section. We have 10 constructs that are valid for the path model analysis. Thus, some of the hypotheses cannot be tested in this section. Figure 7-1 shows the hypothesized model in which the red color constructs need to eliminate due to the poor factor loadings. After deleting prementioned constructs, we further test a revised model with ERC, MCS, LOI, LOL, CFS, ODC, CRF, CBO, SIO, and SCO (see Figure7-2).

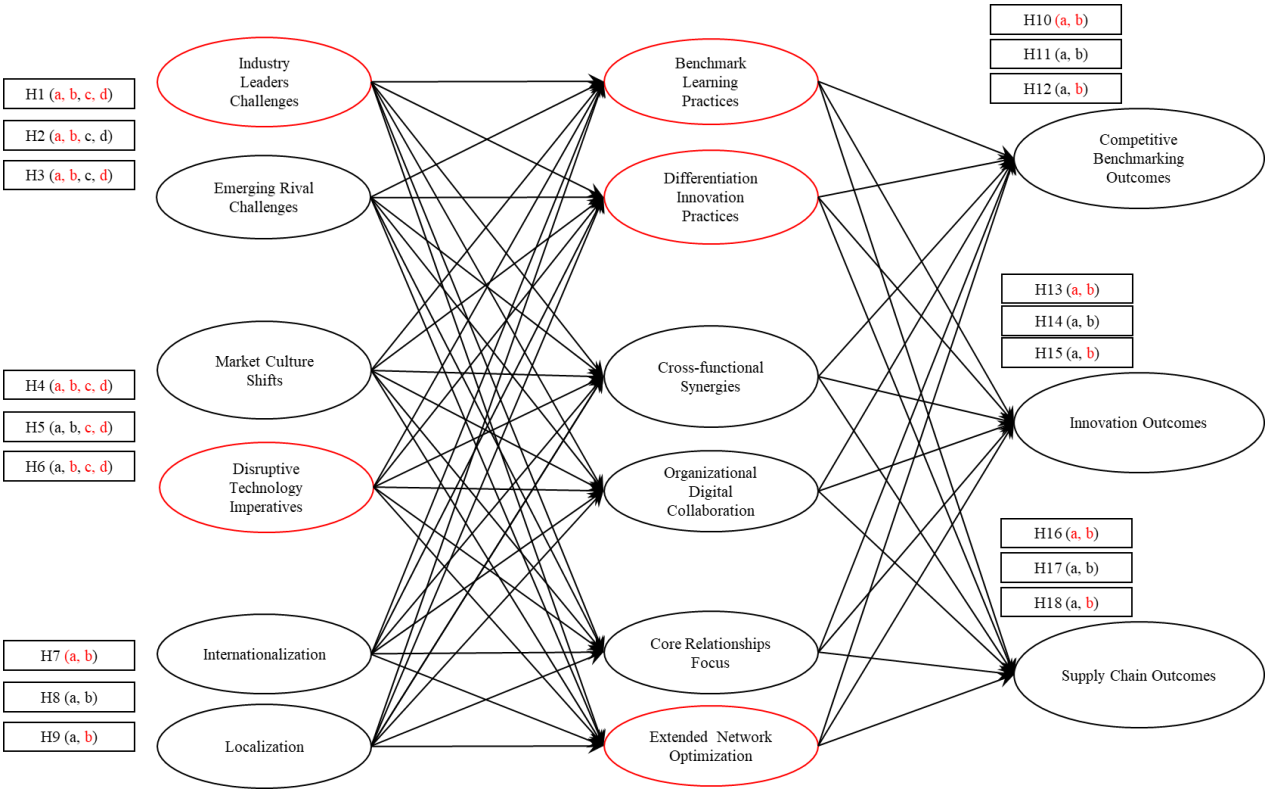

Figure 7–1 Proposed model with hypothesis that cannot be tested (red color)

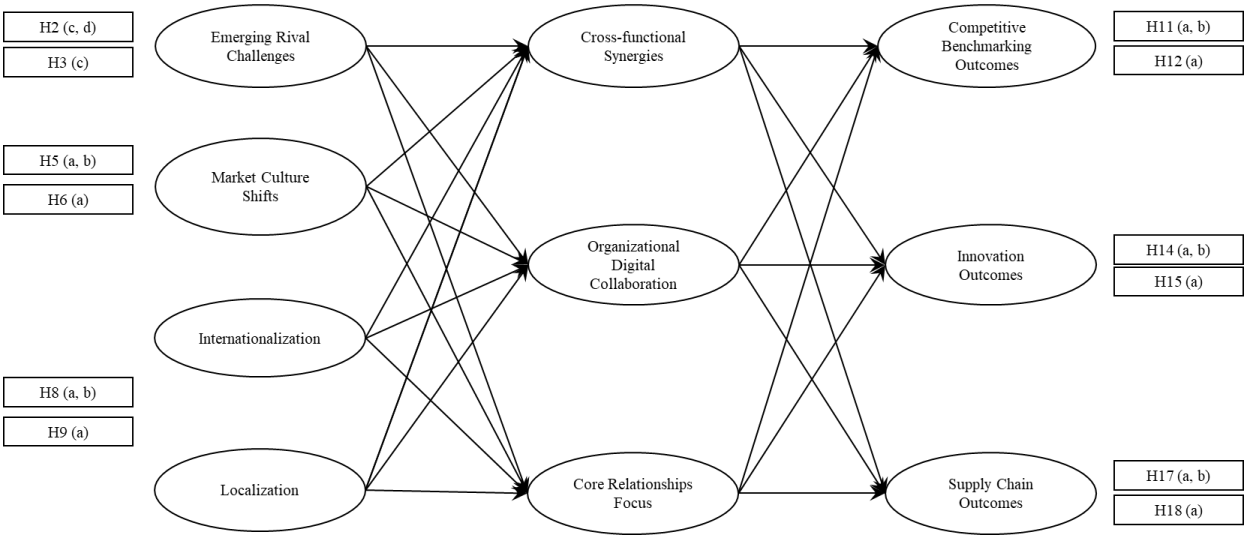

Figure 7–2 Revised model

Path model analysis was further tested by using the revised model shown in Figure 7-2. The overall model fit was first examined as part of assessing the path model. Table 7.2 shows model

fit indices with CMIN of 1553.633, Degree of freedom of 905, CMIN/DF of 1.71, CFI of 0.933, SRMR of 0.067, RMSEA of 0.047, and PClose of 0.85 which indicate a very good model fit (Hu & Bentler, 1999). Next, the individual relationship between the variables (except the deleted five constructs) as specified by the research hypothesis section were examined.

Table 7.1 Path model fit indices of the revised model

Measure	Estimate	Threshold	Interpretation
CMIN	1553.633	--	--
DF	905.000	--	--
CMIN/DF	1.717	Between 1 and 3	Excellent
CFI	0.933	>0.95	Acceptable
SRMR	0.067	<0.08	Excellent
RMSEA	0.047	<0.06	Excellent
PClose	0.850	>0.05	Excellent

There are 18 sets of proposed hypotheses with 48 hypotheses in total. After deleting 5 invalid constructs, 30 hypotheses were not supported. The rest of 18 hypotheses in the path model were tested using AMOS. The results of the individual hypotheses were determined based on standardized regression coefficient value, critical ratio (t-value) and significant value (p-value). Table 7.3 identifies the relationship results and associated path coefficients and significant levels. Figure 7-3 shows the path model in AMOS. Figure 7-4 summarizes the results of revised model.

Table 7.2 Results of revised path model

Hypothesis	Predictor	Outcome	Regression Coefficient and Significant level	t-value	Supported or Not Supported
H2c	EmerRivalChall	CrossFuncSynergies	-.002	0.020	Not supported
H2d	EmerRivalChall	OrgDigitalPrac	.279 **	3.191	Supported
H3c	EmerRivalChall	CoreRelationFocus	-.143	-1.449	Not supported
H5a	MarCulShifts	CrossFuncSynergies	.446 ***	4.754	Supported
H5b	MarCulShifts	OrgDigitalPrac	.109	1.405	Not supported
H6a	MarCulShifts	CoreRelationFocus	.275 **	3.076	Supported
H8a	Internationalization	CrossFuncSynergies	-.002	-0.025	Not supported
H8b	Internationalization	OrgDigitalPrac	.198 ***	3.587	Supported
H9a	Internationalization	CoreRelationFocus	.273 ***	4.342	Supported
H10a	Localization	CrossFuncSynergies	.380 ***	4.896	Supported
H10b	Localization	OrgDigitalPrac	.334 ***	4.946	Supported
H10c	Localization	CoreRelationFocus	.415 ***	5.365	Supported
H11a	CrossFuncSynergies	CompBenchOutcomes	.461 ***	5.456	Supported
H11b	CrossFuncSynergies	InnovationOutcomes	.350 ***	5.573	Supported
H12a	CrossFuncSynergies	SCOutcomes	.250 ***	4.170	Supported
H14a	OrgDigitalPrac	CompBenchOutcomes	-.120	-0.830	Not supported
H14b	OrgDigitalPrac	InnovationOutcomes	.472 ***	6.289	Supported
H15a	OrgDigitalPrac	SCOutcomes	.144 *	2.100	Supported
H17a	CoreRelationFocus	CompBenchOutcomes	.259 *	2.572	Supported
H17b	CoreRelationFocus	InnovationOutcomes	.155 *	2.342	Supported
H18a	CoreRelationFocus	SCOutcomes	.505 ***	7.048	Supported

*** $p < 0.001$
** $p < 0.010$
* $p < 0.050$

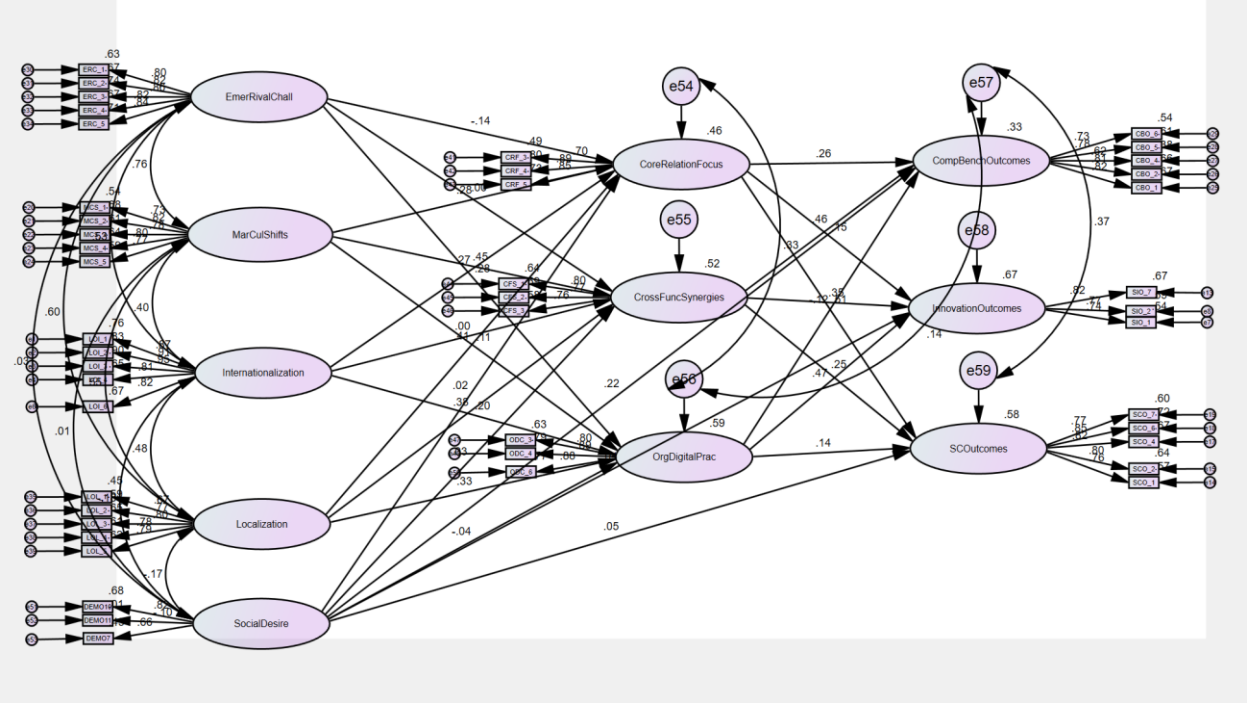

Figure 7–3 Research model in AMOS

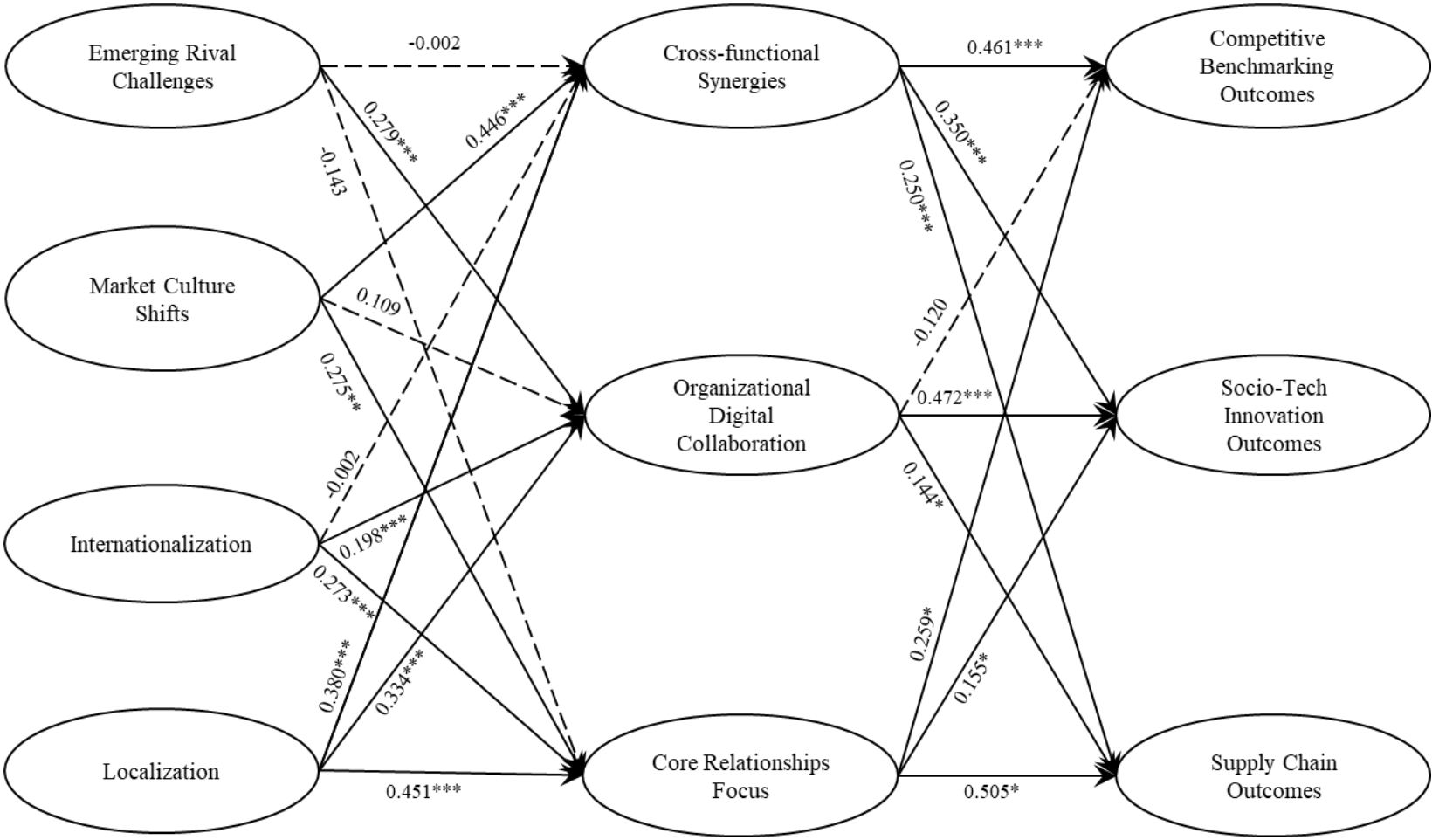

Figure 7–4 Results of the revised model

*** p < 0.001
** p < 0.010
* p < 0.050

7.2 Alternative model

In the hypothesis development section, this research proposed 18 sets of hypotheses with 15 constructs. Even we deleted five constructs (i.e., Industry Leader Challenges, Disruptive Technology Imperatives, Benchmark Learning Practices, Differentiation Innovation Practices, and Extended Network Optimization) due to the poor factor loading, we still believe that those constructs theoretically contribute to the proposed risk responsive framework. Thus, we analyzed those five constructs separately with the Competitive Benchmarking Outcomes to see the performance of those constructs.

7.2.1 Results of the alternative model

This study first performed the EFA to validate the alternative model with constructs of ILC, DTI, BLP, DIP, ENO, and CBO. We run the factor loading analysis by putting all of those constructs together. Maximum likelihood extraction based on eigenvalues greater than 1 and Promax rotation were implemented. However, due to the poor factor loadings and low communalities of the items of BLP, we have to delete this construct for the rest of the analysis. Table 7.4 presents the pattern matrix of factor loadings and the Cronbach's α of the alternative model. Five constructs are loaded separately with CICT greater than 0.5 shows good discriminant validity and convergent validity of the alternative model. In addition, Cronbach's α of these five constructs are higher than 0.7 indicates accepted construct reliability. We also tested the correlation among those five constructs, and Table 7.6 further supports the discriminant validity of the construct by having scores less than 0.7. KMO of the alternative model is 0.896, and the total variance explained was 63.735%. The communalities of the alternative model are shown in Table 7.5.

Table 7.3 Factor loading and Cronbach's α

Factors Cronbach's α	ENO 0.849	ILC 0.864	CBO 0.845	DIP 0.835	DTI 0.798
ILC_1		.950			
ILC_2		.772			
ILC_4		.693			
DTI_1					.711
DTI_2					.685
DTI_4					.677
DIP_3				.727	
DIP_4				.856	
DIP_5				.539	
ENO_1	.758				
ENO_2	.738				
ENO_3	.777				
ENO_6	.789				
CBO_1			.838		
CBO_2			.855		
CBO_5			.712		
Extraction Method: Maximum Likelihood. Rotation Method: Promax with Kaiser Normalization.					

Table 7.4 Communalities of the alternative model

	Initial	Extraction
ILC_1	.645	.816
ILC_2	.626	.677
ILC_4	.554	.588
DTI_1	.468	.556
DTI_2	.538	.634
DTI_4	.464	.547
DIP_3	.545	.628
DIP_4	.567	.716
DIP_5	.580	.620
ENO_1	.470	.539
ENO_2	.522	.597
ENO_3	.593	.692
ENO_6	.518	.583
CBO_1	.574	.662
CBO_2	.614	.756
CBO_5	.502	.586
Extraction Method: Maximum Likelihood.		

Table 7.5 Constructs correlation matrix of alternative model

Factor	ENO	ILC	CBO	DIP	DTI
ENO	1.000	.505	.208	.483	.542
ILC	.505	1.000	.301	.580	.675
CBO3	.208	.301	1.000	.571	.491
DIP	.483	.580	.571	1.000	.658
DTI	.542	.675	.491	.658	1.000
Extraction Method: Maximum Likelihood. Rotation Method: Promax with Kaiser Normalization.					

Then, this research conducted tests of the measurement of the alternative model. The model fit indices are excellent with CMIN of 149.7, DF of 84, CMIN/DF of 1.593, CFI of 0.979, SRMR of 0.046, RMSEA of 0.043, and PClose of 0.803 (see Table 7.7). Figure 7-5 presents the measurement model in the AMOS with standardized values. We also tested the convergent and discriminant validity of the alternative measurement model When distinct groups of measurement

items represent a construct, discriminant validity is used to access unconventionality and distinctiveness. To test discriminant validity, the square root of AVE value were compare to the correlation value between the constructs.(Fornell & Larcker, 1981). Greater values indicated the adequate discriminant validity on diagonal (square root of AVE) than off-digonal correlations coefficients. The bold diagonal value in Table 7.8 represents the square root of AVE to compare with the off-diagonal correlation coefficient between latent variables. We can see the value on the diagonal is all greater than the rest of factors correlations. The internal consistency of the constructs is determined by Composite Reliability (CR) (Hair et al., 2016). It reflects the ability of the construct to generate the same outcomes in repeated statistical tests. Cronbach's alpha is a measure of composite reliability. In Table 7.8, Cronbach's alpha is represented by CR. Composite Reliability (CR) for the constructs ranges higher than the 0.7 level suggesting strong reliability.

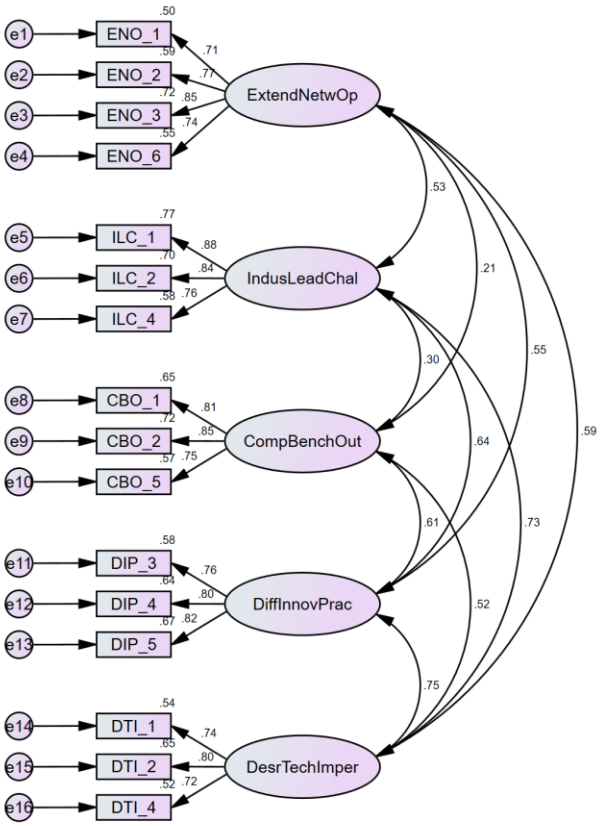

Figure 7–5 Measurement model of the alternative model

Table 7.6 Measurement model fit indices of the alternative model

Measure	Estimate	Threshold	Interpretation
CMIN	149.700	--	--
DF	94.000	--	--
CMIN/DF	1.593	Between 1 and 3	Excellent
CFI	0.979	>0.95	Excellent
SRMR	0.036	<0.08	Excellent
RMSEA	0.043	<0.06	Excellent
PClose	0.803	>0.05	Excellent

Table 7.7 Correlation matrix and validity of alternative model

	CR*	AVE**	M[b]	SD[c]	ENO	ILC	CBO	DIP	DTI
Extended Network Optimization	0.852	0.591	2.585	0.784	**0.769**[a]				
Industry Leader Challenges	0.867	0.685	3.721	0.779	0.530***	**0.828**			
Competitive Benchmarking Outcomes	0.846	0.648	3.720	0.653	0.210**	0.296***	**0.805**		
Differentiation Innovation Practices	0.836	0.630	3.497	0.678	0.550***	0.636***	0.612***	**0.794**	
Disruptive Technology Imperatives	0.798	0.570	3.707	0.733	0.586***	0.733***	0.516***	0.753***	**0.755**

∗ Composite reliability (CR) for the constructs range higher than the 0.70 level suggest strong reliability.

∗∗Convergent validity is assessed using the average variance extracted (AVE). AVE measures of 0.5 or more are considered to demonsatrate adequate convergent validity

a Discriminant validity: indicated by greater values on diagonal (square root of AVE) than off-diagonal correlations coefficients.

b Mean of the construct

c Standard deviation of the construct

The next step of validating the alternative model is the path/structural model analysis. We obtained the initial theoretical relationships among those constructs in the path model which shows in Figure 7-6. ILC and DTP are the drivers, DIP and ENO are the practices, and the CBO is the outcomes. Model fit measure of alternative path model shows in Table 7.9 which indicated with excellent fit. The path analysis results of the alternative model can be found in both Table 7.11 and Figure 7-7. We only see one non-significant relationship in the alternative model which from ILC to DIP. In the next section, we combined both revised model and alternative model results together to discuss the results of hypotheses testing.

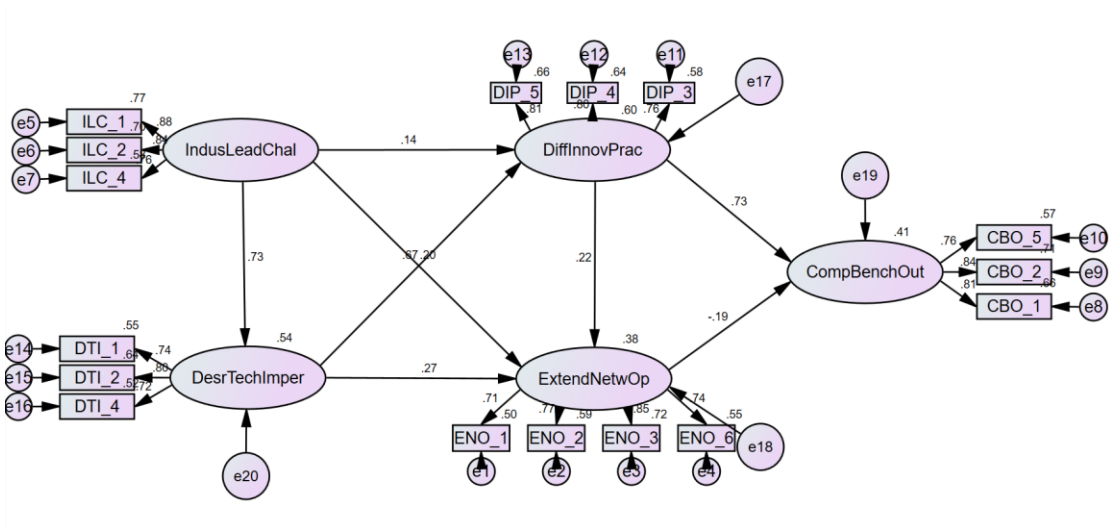

Figure 7–6

Table 7.8 Model fit of the alternative path model

Measure	Estimate	Threshold	Interpretation
CMIN	158.402	--	--
DF	96.000	--	--
CMIN/DF	1.650	Between 1 and 3	Excellent
CFI	0.977	>0.95	Excellent
SRMR	0.039	<0.08	Excellent
RMSEA	0.045	<0.06	Excellent
PClose	0.726	>0.05	Excellent

Table 7.9 Results of the alternative model

Hypothesis	Predictor	Outcome	Regression Coefficient and Significant level	t-value	Supported or Not Supported
N/A	IndusLeadChal	DesrTechImper	.732 ***	10.770	N/A
H1b	IndusLeadChal	DiffInnovPrac	.139	1.574	Not supported
H4d	DesrTechImper	DiffInnovPrac	.665 ***	6.469	Supported
H3d	IndusLeadChal	ExtendNetwOp	.196 *	2.100	Supported
H6d	DesrTechImper	ExtendNetwOp	.270 *	2.045	Supported
N/A	DiffInnovPrac	ExtendNetwOp	.221 *	2.062	Supported
H10b	DiffInnovPrac	CompBenchOut	.727 ***	8.487	Supported
H12b	ExtendNetwOp	CompBenchOut	-.190 **	2.579	Not Supported

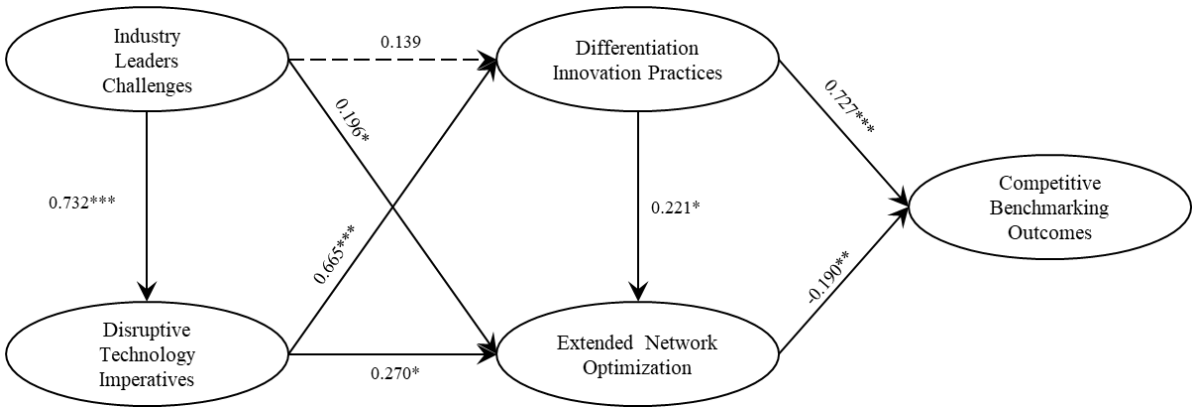

Figure 7–7 Results of the alternative model

7.3 Discussion of Hypotheses testing results

Combining the revised model and alternative model, the analysis results are discussed based on the 18 sets of hypotheses proposed in Chapter 4. We first examined the direct relationships among three contextual drivers (i.e., Dynamic Market Drivers, Scio-Technological Drivers, and Globalization Balancing Drivers) and three structural practices (i.e., Risk Responsive Practices, Process Innovation Practices, and Network Resilience Practices). Then we tested the direct relationships among contextual practices (i.e., Risk Responsive Practices, Process Innovation Practices, and Network Resilience Practices) and performance outcomes (e.g., Competitive Benchmarking Outcomes, Scio-Tech Innovation Outcomes, and Supply Chain Outcomes).

Not all the proposed relationships are supported as desired. For the relationships which are not supported, this study explains the rationale behind those relationships. Table 7.11 shows the summary of supported and not supported hypotheses. In the following section, proposed hypotheses and their results are illustrated in detail

7.3.1 Discussion of hypothesis results

H1a: The better recognition of Industry Leaders Challenges the better formulation and

implementation of Benchmarking Learning practices. *(Not supported)*

H1b: The better recognition of Industry Leaders Challenges the better formulation and implementation of Differentiation Innovation Practices. *(Not supported)*

H1c: The better recognition of Emerging Rival Challenges the better formulation and implementation of Benchmarking Learning Practices. *(Not supported)*

H1d: The better recognition of Emerging Rivals Challenges the better formulation and implementation of Differentiation Innovation Practices. *(Not supported)*

H2a: The better recognition of Industry Leaders Challenges the better formulation and implementation of Cross-functional Synergies. (Not supported)

H2b: The better recognition of Industry Leaders Challenges the better formulation and implementation of Organizational Digital Collaboration. (Not supported)

H2c: The better recognition of Emerging Rival Challenges the better formulation and implementation of Cross-functional Synergies. (Not supported)

H2d: The better recognition of Emerging Rival Challenges the better formulation and implementation of Organizational Digital Collaboration. (Supported)

H3a: The better recognition of Industry Leaders Challenges the better formulation and implementation of Core Relationships Focus practices. (Not supported)

H3b: The better recognition of Industry Leaders Challenges the better formulation and implementation of Extended Network Optimization practices. (Supported)

H3c: The better recognition of Emerging Rival Challenges the better formulation and implementation of Core Relationships Focus practices. (Not supported)

H3d: The better recognition of Emerging Rival Challenges the better formulation and implementation of Extended Network Optimization practices. (Not supported)

The rationale behind hypothesis 1 to 3 from the risk management framework that investigate the exacerbating sources of risk pressure after a major disruption event occurred, especially from the external sources. We theorized that the external pressures of industry leader challengers and emerging rival challenges are the main sources and drivers to seek and implement risk responsive practices. However, the measurement analysis based on the collected data didn't show a good factor loading of Industry Leader Challenges, Disruptive Technology Imperatives, Benchmark Learning Practices, Differentiation Innovation Practices, and Extended Network Optimization. Hypothesis that consist of those constructs cannot be further tested in structural analysis. Even we conducted a test of the alternative model, we were still not able to test on some of those hypotheses. The regression coefficient and significant level of N/A in Table 7.11 identities hypothesis with this issue. Instead of focusing on external pressures, firms tend to pay more attention to the opportunities by improving internal capabilities. This is the major reason that the constructs of Industry Leader Challenges and Benchmark Learning Practices are not loaded well. In the meantime, the dramatic changes due to the disruption event would increase the complexity in both internal and external environment, extend existing network is not an easy strategy to implement. This explains the poor factor loading of Extended Network Optimization. Thus, it results that two hypotheses (i.e., H2d and H3b) are supported in the first set of analysis.

Table 7.10 Results of Hypothesis 1 to 3

Hypothesis	Predictor	Outcome	Regression Coefficient and Significant level	Supported or Not Supported
H1a	IndusLeadChal	BenchmLearnPrac	N/A	Not supported
H1b	IndusLeadChal	DiffInnovPrac	.139	Not supported
H1c	EmerRival	BenchmLearnPrac	N/A	Not supported
H1d	EmerRival	DiffInnoPra	N/A	Not supported
H2a	IndusLeadChal	CrossFuncSynergiesc	N/A	Not supported
H2b	IndusLeadChal	OrgDigitalPrac	N/A	Not supported
H2c	EmerRivalChall	CrossFuncSynergies	-.002	Not supported
H2d	EmerRivalChall	OrgDigitalPrac	.279 **	Supported
H3a	IndusLeadChal	CoreRelationFocus	N/A	Not supported
H3b	IndusLeadChal	ExtendNetworkOp	.196 *	Supported
H3c	EmerRivalChall	CoreRelationFocus	-.143	Not supported
H3d	EmerRivalChall	ExtendNetwOp	N/A	Not supported

H4a: The better recognition of Market Culture Shifts the better formulation and implementation of Benchmarking Learning Practices. *(Not Supported)*

H4b: The better recognition of Market Culture Shifts the better formulation and implementation of Differentiation Innovation Practices. *(Not Supported)*

H4c: The better recognition of Disruptive Technology Imperatives the better formulation and implementation of Benchmarking Learning Practices. *(Not Supported)*

H4d: The better recognition of Disruptive Technology Imperatives the better formulation and implementation of Differentiation Innovation Practices. *(Supported)*

H5a: The better recognition of Market Culture Shifts the better formulation and implementation of Cross-functional synergies. *(Supported)*

H5b: The better recognition of Market Culture Shifts the better formulation and

implementation of Organizational Digital Collaboration. *(Not Supported)*

H5c: The better recognition of Disruptive Technology Imperatives the better formulation and implementation of Cross-functional synergies. *(Not Supported)*

H5d: The better recognition of Disruptive Technology Imperatives the better formulation and implementation of Organizational Digital Collaboration. *(Not Supported)*

H6a: The better recognition of Market Culture Shifts the better formulation and implementation of Core Relationship Focus. *(Supported)*

H6b: The better recognition of Market Culture Shifts the better formulation and implementation of Extended Network Optimization. *(Not Supported)*

H6c: The better recognition of Disruptive Technology Imperatives the better formulation and implementation of Core Relationship Focus. *(Not Supported)*

H6d: The better recognition of Disruptive Technology Imperatives the better formulation and implementation of Extended Network Optimization. *(Supported)*

The second sets of hypotheses include hypotheses 4,5 and 6. The theoretical support of these hypotheses derived from Socio-technological Theory, which argues that the interation between social and technical aspects within a firm would impact on the formulation and imnplementation of effective practices. We proposed that the market cultural shifts after certain major disruption events are the social drivers for the organizational changes, while the increasing needs of disruptive technologies are the technical driver. Since the Benchmark Learning Practices and Differentiation Innovation practice cannot be tested due to the poor factor loading, the regression coefficient and significant level cannot be identified in some of the hypotheses. Table 7.12 summarized the results of this set of hypotheses and four hypotheses (i.e., H4d, H5a, H6a, and H6d) are supported..

Table 7.11 Results of Hypothesis 4-6

Hypothesis	Predictor	Outcome	Regression Coefficient and Significant level	Supported or Not Supported
H4a	MarCulShifts	BenchmLearnPrac	N/A	Not supported
H4b	MarCulShifts	DiffInnovPra	N/A	Not supported
H4c	DesrTechImper	BenchmLearnPrac	N/A	Not supported
H4d	DesrTechImper	DiffInnovPrac	.665 ***	Supported
H5a	MarCulShifts	CrossFuncSynergies	.446 ***	Supported
H5b	MarCulShifts	OrgDigitalPrac	.109	Not supported
H5c	DesrTechImper	CrossFuncSynergies	N/A	Not supported
H5d	DesrTechImper	OrgDigitalPrac	N/A	Not supported
H6a	MarCulShifts	CoreRelationFocus	.275 **	Supported
H6b	MarCulShifts	ExtendNetwOp	N/A	Not supported
H6c	DesrTechImper	CrossFuncSynergies	N/A	Not supported
H6d	DesrTechImper	ExtendNetwOp	.270 *	Supported

H7a: The better recognition of Globalization Balancing Driver the better formulation and implementation of Benchmarking Learning Practices. *(Not Supported)*

H7b: The better recognition of Globalization Balancing Driver the better formulation and implementation of Differentiation Innovation practices. *(Not Supported)*

H8a: The better recognition of Globalization Balancing Driver the better formulation and implementation of Cross-functional Synergies Practices. *(Not Supported)*

H8b: The better recognition of Globalization Balancing Driver the better formulation and implementation of Organizational Digital Collaboration practices. *(Supported)*

H9a: The better recognition of Globalization Balancing Driver the better formulation and implementation of Core Relationship Focus Practices. *(Supported)*

H9b: The better recognition of Globalization Balancing Driver the better formulation and implementation of Extended Network Optimization Practices. *(Supported)*

In this set of questions, we investigated the interdependence between globalization and

markets which falls into the scope of Network Theory. We theorized that the multidimensional network and the dynamic relationship in the networks influenced the allocation of limited resources to determine the application of strategic and operational practices in different scenarios. The balance of globalization was tested from two dimensions, which are the level of internationalization and localization. Exclude the poor factor loadings constructs of Benchmark Learning Practices, Differentiation Innovation Practices, and Extended Network Optimizations, it results in 2 hypotheses are supported when both Internationalization and localization are significant impact on structural practices.

Table 7.12 Results of hypothesis 7-9

Hypothesis	Predictor	Outcome	Regression Coefficient and Significant level	Supported or Not Supported
H7a	Internationalization	BenchmLearnPrac	N/A	Not supported
H7b	Internationalization	DiffInnovPra	N/A	Not supported
H8a	Internationalization	CrossFuncSynergies	-.002	Not supported
H8b	Internationalization	OrgDigitalPrac	.198 ***	Supported
H9a	Internationalization	CoreRelationFocus	.273 ***	Supported
H9b	Internationalization	ExtendNetwOp	N/A	Not supported
H8a	Localization	CrossFuncSynergies	.380 ***	Supported
H9b	Localization	OrgDigitalPrac	.334 ***	Supported
H9a	Localization	CoreRelationFocus	.415 ***	Supported
H9b	Localization	ExtendNetwOp	N/A	Not supported

H10a: The better implementation of Benchmark Learning Practices the better chance to achieve Competitive Benchmarking Outcomes. *(Not Supported)*

H10b: The better implementation of Differentiation Innovation Practices the better chance to achieve Competitive Benchmarking Outcomes. *(Supported)*

H11a: The better implementation of Benchmark Learning Practices the better chance to achieve Process Innovation Outcomes. *(Not Supported)*

H11b: The better implementation of Differentiation Innovation Practices the better chance

to achieve Process Innovation Outcomes. *(Not Supported)*

H12a: The better implementation of Benchmark Learning Practices the better chance to achieve Supply Chain Outcomes. *(Not Supported)*

H12b: The better implementation of Differentiation Innovation Practices the better chance to achieve Supply Chain Outcomes. *(Not Supported)*

In this set of hypothesis, we anlyzed the direct relationships among Risk Responsive Practices and Performance Outcomes. CBO were measured by the major business outcomes which consist of both operational and financial aspects. SIO measures the innovation outcomes by considering the interaction of social and technical perspectives. Supply chain level performances are measured by SCO. Due to the poor factoring loadings, we didn't involve Benchmark Learning Practices and Differentiation Innovation Practices in the alternative model, but we tested the direct effect of DIP and CBO. As a result, we only have one supported hypothesis (i.e., H10b) supported in this set of analyses. Table 7.14 shows the regression coefficient and significant level of the result.

Table 7.13 Results of hypothesis 10-12

Hypothesis	Predictor	Outcome	Regression Coefficient and Significant level	Supported or Not Supported
H10a	BencmLearnPrac	CompBenchOut	N/A	Not supported
H10b	DiffInnovPrac	CompBenchOut	.727 ***	Supported
H11a	BencmLearnPrac	InnovationOut	N/A	Not supported
H11b	DiffInnovPrac	InnovationOut	N/A	Not supported
H12a	BencmLearnPrac	SCOutcomes	N/A	Not supported
H12b	DiffInnovPrac	SCOutcomes	N/A	Not supported

H13a: The better implementation of Cross-functional Synergies Practices the better chance to achieve Competitive Benchmarking Outcomes.

H13b: The better implementation of Organizational Digital Collaboration Practices the better chance to achieve Competitive Benchmarking Outcomes.

H14a: The better implementation of Cross-functional Synergies Practices the better chance to achieve Process Innovation Outcomes.

H14b: The better implementation of Organizational Digital Collaboration Practices the better chance to achieve Process Innovation Outcomes.

H15a: The better implementation of Cross-functional Synergies Practices the better chance to achieve Supply Chain Outcomes.

H15b: The better implementation of Organizational Digital Collaboration Practices the better chance to achieve Supply Chain Outcomes.

In this set of hypotheses, we analyzed the direct relationships among Process Innovation Practices and Performance Outcomes. CBO was measured by the major business outcomes which consist of both operational and financial aspects. SIO measures the innovation outcomes by considering the integration of social and technical perspectives. Supply chain level performances are measured by SCO. Table 7.15 presents the summary of the results associated with H13 to H15. There are five out of six hypotheses (i.e., H13a, H14a, H14b, H15a, and H15b) are supported in this group of analysis.

Table 7.14 Results of hypothesis 13-15

Hypothesis	Predictor	Outcome	Regression Coefficient and Significant level	Supported or Not Supported
H13a	CrossFuncSynergies	CompBenchOutcomes	.461 ***	Supported
H13b	OrgDigitalPrac	CompBenchOutcomes	-.120	Not supported
H14a	CrossFuncSynergies	InnovationOutcomes	.350 ***	Supported
H14b	OrgDigitalPrac	InnovationOutcomes	.472 ***	Supported
H15a	CrossFuncSynergies	SCOutcomes	.250 ***	Supported
H15b	OrgDigitalPrac	SCOutcomes	.144 *	Supported

In this set of hypotheses, we analyzed the direct relationships among Network Resilience Practices and Performance Outcomes. CBO was measured by the major business outcomes which

consist of both operational and financial aspects. SIO measures the innovation outcomes by considering the integration of social and technical perspectives. Supply chain level performance are measured by SCO. The direct relationship of ENO and SIO, and ENO and SCO didn't test in both the revised model and alternative model, so we don't have regression coefficients and significant levels of hypothesis in these two relationships. In the proposed hypothesis H17b, we argued that ENP is positively impacted on CBO. However, the results show that the relationship is negatively related. One possible explanation of the results is in the high level of complexity environment after the major disruption events; firms might not be capable in expand and strengthen the relationships with their lower-tier partners.

Table 7.16 presents the summary of the results associated with H16 to H18. There are three out of six hypotheses (i.e., H16a, H17a, and H18a) are supported in this group of analyses.

Table 7.15 Results of hypothesis 16-18

Hypothesis	Predictor	Outcome	Regression Coefficient and Significant level	Supported or Not Supported
H16a	CoreRelationFocus	CompBenchOutcomes	.259 *	Supported
H16b	ExtendNetwOp	CompBenchOut	-.190 **	Not Supported
H17a	CoreRelationFocus	InnovationOutcomes	.155 *	Supported
H17b	ExtendNetwOp	InnovationOutcomes	NA	Not Supported
H18a	CoreRelationFocus	SCOutcomes	.505 ***	Supported
H18b	ExtendNetwOp	SCOutcomes	NA	Not Supported

Chapter 8

8 Implications, Limitations and Future Research

This chapter discussed the theoretical implications, managerial implications, limitations, and future research direction.

8.1 Theoretical Implications

This dissertation generates four major theoretical implications. First, we integrated dynamic theory, contingency theory, and risk management framework in this research (Bechor et al., 2010; Donaldson, 2006; Enrriquez-De-La-O, 2015; Gordon et al., 2009; Nonaka, 1994; Porter, 1991; Shimizu et al., 2012; Singh & Hong, 2020; Wang et al., 2017) and generalized a dynamic risk response framework in the context of major disruptions. We empirically confirmed that external dynamic market pressure, internal socio-technological integration, and macro-level trends are the three crucial factors to pay attention to when businesses face major disruption events (Hong et al., 2015; Shimizu et al., 2013; Youn et al., 2013). Second, we rigorously designed the original instrument through literature review, q-sorts, pilot study and large-scale survey (Singh & Hong, 2020; Hong et al., 2019). Third, we have applied multiple methods to investigate and test the research model that follows a unique three-phase structure. The process involved text mining, field interview-based case studies, and large-scale survey. Therefore, the research model was formulated and tested by both qualitative and quantitative methods. Fourth, this dissertation also expanded and enriched risk management literature (Christopher & Peck, 2004; Park & Hong, 2011; Pettit et al., 2010; Shimizu et al., 2013; Wang et al., 2017). We found that companies pay more attention in business continuity planning rather than competitive success planning in a dynamic and complex

changing environment, especially in the early phase of major disruption events. The main model provides meaningful insights about how companies should respond to the major disruptions in the early phase, and the alternative model offers directions for contingent planning in the later phase.

8.2 Managerial implications

Five managerial implications will be discussed in this section. First, building on text mining, case study, and literature review, we developed a research model that generalizes a dynamic risk response framework and empirically tests it through a large-scale survey. The results suggested major disruption events are very likely to trigger dynamic and changing environments in the business world. Managers should identify priorities for dealing with those events that are different from the strategies most businesses have implemented in normal times (Knemeyer et al., 2009; Roh et al., 2014). Business continuity is more important than business success at the beginning phase. The results also show that proactive internal socio-technical collaboration is more critical than reactive response to external pressures. In addition, the way companies position themselves in the global market impact differently in responding to disruption events.

Second, this paper proposes a strategic sensing mechanism to realize the drivers for companies to pay attention to in a turbulence situation. Our research model suggested that the major external pressures in and after major disruptions are coming from Industry Leaders Challenges and Emerging Rival Challenges (Hong et al., 2012; Peng Wong & Yew Wong, 2008; Vorhies & Morgan, 2005). Even the results from the main model show that the external pressures are not the priority for business continuity planning. They are still crucial for firms to foresee the upcoming threats after the disruption. The way industry leaders respond to the disruption is very likely to become the benchmark of the industry. Recognizing the movement of industry leaders would help companies to build competitive advantages in a timely fashion. In addition, keeping

eyes open to new entrances also provides companies with a better view of further trends. Observing market culture shifts and disruptive technology imperative are the important internal socio-technical drivers. Our study argues that the way companies position themselves in the global market will impact differently in responding to the disruption events. A higher level of internationalization helps companies to develop contingency plans, but it also increases the difficulty of handling complexities. A higher level of localization helps companies to control uncertainties, but opportunities would be limited to certain region. Therefore, the last set of drivers we propose is the Globalization Balancing Driver. Companies should find a balance point of the level of globalization according to their situation. Either extreme focus on the level of localization or internationalization would not be beneficial in major disruption events.

Third, we identified a tactical responding mechanism to translate pressure into effective practices (Dobrzykowski et al., 2015; Singh & Hong, 2020; Yang et al., 2011). Benchmark Learning Practices and Differentiation practices are crucial to respond to external dynamic market pressure. Cross-functional Synergies and Organizational Digital Collaboration are important aspects to enable socio-technical collaboration in a company. We also argue that integrating Core Relationships Focus and Extended Network Optimization are the key to formulating resilient network practices.

Fourth, the original developed comprehensive measure mechanism also could help managers to evaluate their performance outcomes in three dimensions (Gunasekaran et al., 2014; Hong et al., 2018; Youn et al., 2013). The first dimension is Competitive Benchmarking Outcomes which captures both operational and financial performances. The second dimension is Socio-Tech Innovation Outcomes which measure the innovation performances. And the third dimension is Supply Chain Outcomes which evaluates the network level performances.

Fifth, the findings from text mining provide practitioners clear views of current and future trends of the market. Those trends and topics enable managers to evaluate their positions better and make adjustments if necessary. In addition, the field interview-based case studies have further investigated those trends and topics derived from text mining in different companies from various industries which extended the depth of this research.

8.3 Limitations and future research

After discussing implications, we also observed several limitations of this dissertation. The first limitation is the data collection range of the text mining method. It is from December 2019 to October 2020, which couldn't capture the market trend changes after October 2020. Further research could involve a wider time range of data collection. Time series analysis also can add value in revealing different trends in different phases of major disruptions.

The second limitation would be the sample size of the large-scale survey. We have analyzed 319 completed responses that include 220 respondents from the U.S. and 90 from the European countries. Future research can collect more data from European countries and conduct multi-group analysis.

Third, we have interviewed three subjects from the High-tech, Energy, and automobile industry in the second method of field interview-based case study. The findings highlight interesting and inspiring aspects of how those firms respond to the COVID19 pandemic disruptions. However, collecting more information from other industries (e.g., food, health care, capital equipment, government, etc.) would provide a richer view of how diverse companies respond to the pandemic at large. Therefore, future research could investigate more in different industries and develop ground theories.

Fourth, a confirmatory text analysis using different data sources (i.e., academic journal

articles) would be another opportunity to explore multiple views of the dynamic risk response research model.

Fifth, we collected seven demographic items (i.e., industry type, job position, firm size by the number of employees, firm size by annual sales, target markets, the impact of the pandemic on operations, acceleration of digital transformation) in data collection process. However, we didn't do extensive analysis other than descriptive analysis of those demographic items. Multiple-group analysis and moderating effects could be done by using those demographic items in future research.

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Appendix A – Interivew Manuscripts

Interview with Jason Hood- CTO of Stratascale

1. Could you please tell us your position and responsibility?

I worked for a company called Stratasclae which is part of SHI. SHI is an 11.5 billion dollar provider of technology. We are the largest privately held woman and minority owned business in the United States. The owner of our organization started the organization and still owns it in Korean and has been heavily involved in the Asian community.

My job as Chief Technology Officer and focused on how do we onboard new technologies, what are the new partnerships we should look at, how do we dip into the venture capitalist communities and understand what's happening in the market. As you can see that a lot of innovations are happening in that space and eventually purchased by some of the bigger companies like the Cisco and the Microsoft. My job responsibilities consist of what are the innovative technologies out there, who are the providers of that, and how do we actually build some offering around that space.

2. What are the three major challenges your organization has experienced because of the Covid-19?

Let's look back at the SHI part of the business. They are really a technology provider selling things like PCs and servers and network equipment. So there is a huge component of our business that related to supply chain management. We have large warehouses that will not only store the product, but also configure and build it into a workable model that we can ship to our clients. In order to hold enough materials and inventory for production to reduce the lead time, we experience our first challenges of labor shortage. We were strugling with making sure

we were bringing in people safely, how many people we could have in and what did that do to the length of time to deliver products to our clients.

We are a business built around sales, so we have a number of salespeople who are out selling to clients and in their buildings, but it was stopped by the pandemic. Then, the second challenge is related the drastic change of selling model, which has shifted from face to face oriented to highly driven by virtual tools.

The third challenge is kind unique, because we opened a brand new headquarter in Austin, Texas that house a couple of thousands of people. We had announced the opening for early April of 2020, and never moved into that facility. The waste of such nice new office space in this case is very challenging financially and emotionally.

3. How did your organization respond to those challenges?

Regarding the supply chain challenge of inventory management, we did buy ahead strategy. We fore see the chip shortage and respond quickly to buy ahead the capacity that we need. We made this strategy work by communicating with our partners to make inventory decision to service our clients better. Risk management was a major part of our business in responding disruptions.

To respond the second challenges of worker shortage, our organization used different tools that allow us to bring people in safely. such as automated temperature check system and Sonde. Sonde is an application to detect symptoms by using a voice analytics technic. We also applied rotated schedule for office employees and provide PPEs and social distancing for shop floor workers.

The third challenge regarding the new facility was addressed in the following ways. Localize meetings in that space with limited capacities to encourage people to keep up with the passion. By implementing the rotated schedule, employees be able to communicate with the business leaders and the CEO.

4. What is your target market? Domestic or in a global base?

We primarily served domestic market. But we do have a growing international organization, mostly through Europe and Asia right now.

5. Would you share the main difference between pre- and post- Covid-19 in terms of opportunities?

We actually built in the COVID time. Our owner recognize the opportunities that brought by COVID especially the transformation of digitalization. As part of that our owner believes the need for digital experience in an increasing trend. For example, the phenomena of ordering groceries online and picking up at the curbside, requires more user friendly and fast responses website design. Business cannot afford to lose customer because slow credit card processing time. So the digital experience has become a key peive of business in recognition that we've changed the brain for that challenge. The other opportunity is we no longer seek for talent locally, instead we can bring talent from a global base on board.

6. How did your firm implement the work-from-hone policy?

We actually had a work-from-home policy prior to COVID. It just didn't cover everybody which is more opportunistic. There are several things in our HWF policy. First, we don't babysite people. We don't track keystrokes or mouse movements and no requirement of camera on. We are trying to blend in work-life together. As long as employees can complete their work on time, we offer them a very flexible working environment. We also provide work equipments, such as PCs and printers to our employee to enable effective WFH policy.

7. What online communication platform do you use for work?

We subscribe to the Microsoft Teams for the internal communication.

Yeah. So really, we use, we subscribe to the Microsoft platform and moved into the teams environments, both on phones and on PCs. We do that internally and externally. Like, it comes with a great set of tools. Like I said, we mentioned whiteboarding. You know, it comes with

teams rooms, it's really a SharePoint back end that allows us to share documentation quickly. It also allows us to integrate into our CRM system, which has been key so we can take data out of the the chats and move those into CRM, if somebody shares a file with us, or if we've got, you know, something that we've put in there, that applies to a certain customer. So that's been really great as well. You know, we do we do not subscribe to the dial in capabilities because there is a cost to provide a phone number to dial into teams. And so we have limited the use of that if there are people that need that for Specific sales position and they have people that are more comfortable dialing, you know, we do provide that on an as needed basis. But but primarily people have used teams.

8. Since social distancing is required in the most of workplace, what did you firm implemented (e.g., rotated schedule)?

We have moved many people to a permanent work at home position which actually has speed things up. As I mentioned previous, Sonde app is anther way to facilitate social distanding. It has been a key part of us coming back to the workplace safely. We also respect our people’s choice of taking vaccine. We have done the rotation schedule, allowed more permanent work at home environment, and checked temperatures regulary.

9. How did your company implement cross-functional problem-solving collaboration during the pandemic?

We figured out how to collaborate, how to bring people together, how not to annoy people, by constantly setting up meetings and filling up calendars. That was something that early on, we had to figure out. You know what, before you had Hallway Conversations, or had a conversations in the cafeteria, you lost that capability. So it turned into just back to back meetings for eight, nine hours, right, even through people's lunches. So we had to figure out how to make that work best in our organization. And we started again, doing a couple of things. I think teams was a key part of that. We talked about teams early on here. And the use of the

team's rooms became a key collaboration feature that that used, the ability to share documentation, edit documentation together, was it was a key part of that. You know, we set up like I said, the whiteboarding. We've really started to use the tool sets that are available to us, especially through teams. We've done some unique things like the whiteboards in people's offices that they can stand in front of them in use. And so we're always bringing people together solve a client's problem, an internal problem or something else. And that's where those tool sets really, you know, change what used to be gather people into a conference room, it's gathered people into a Team's team.

10. Are there any changes regarding the way of communicating with suppliers and customers between pre-and post-COVID-19?

Like automotive guys, we do a lot of VDI in our supply chain. That was one thing really beneficial for to improve our capability of not only the predictions, but even the use of things, such as inbound and outbound flows and capture the increasing use of the website of our clients. There are automation processes that we could put in place to enable user self service and even expanded it beyond. So inside sales, could spend time with people that really needed help and allow people who are willing to do things more on their own capabilities.

Predictive Analytics became important of our supplier side. And I mentioned that early on that we were really trying to think about, what are the things we needed? Where should we go get them? How do we sourced them, and begin to plan for that delivery to clients in kind of seeing that coming? This is another important aspect that we need to dedicate more after the pandemic.

We also realize the importance of using video fatigue to assist clients, but there are some challenges to keep peoples attention for a long time, especially in front of a screen.

11. What are your offshoring strategies? How are your strategies changing over time (e.g., reshoring)? Why did your company make the changes?

We have a multi levels of offshoring strategies. As you know we get into more of the service world and less on the hardware side. Our business continuity plan keeps multiple sourcing strategy to deal with sudden changes.

12. What level of R&D or innovation of your firm compare with your competitors?

We are reall built around innovation, that's really where we have strived to change. We have hired researchers in our company who have been at university and big research companies to help us build capabilities to understand what's happening in certain markets, and even beyond. We also allow people to get into our R&D lab to lay their hands on things. I truly think our level of innovation has increased as we have started to build partnership up and we were founded during the time period of COVID. To facilitate innovation, we have get out and try things policy. Learning processes are the key aspects of innovation.

13. What types of data does your company collect and keep in the record (e.g., employee's working performance, machine-generated production data, etc.)?

We do not track employee motion, we do not track, you know, employees, at their keyboard at their mouse, you know, in those types of things, we really trust that our employees are doing the things that are important. So we don't track or collect any of those kinds of things. We do run an organization by management by objective. So quarterly, we're building goals for people we're tracking to those goals, they tend to build on top of each other, and they aligned to the business goals. So we build that not only top down bottom up alignment to those goals, and really manage people through MBO. That's really the key part of what we do. So we don't collect data on employees we don't collect when they talk, you know, when they start work, when they end work. You know, when they're at their PC, I could I could disappear from here and answer emails from my phone for four hours, and nobody would care. And that's just the truth. That's the kind of environment that we've built for our employees.

Wgot the client success managers who are out talking to clients and ensuring that what

they have is working and tracking that with them. And so we could collect data through that client success relationship, that really focuses for the most part around the delivery of technology.

14. How could that analysis help your firm in decision-making (e.g., predict demand, future trend, risk, etc.)

We do think that data is a very key part of what we do everything from market analytics, how we try to predict what's happening through our innovation lab space, what are the technologies we think that people are going to want from our warehouses. We were looking at automating silver inside sales work. So if you look at process visualization, process automation, one of the things COVID has taught us is we have a lot of processes that we did by hand. Automation allowed us to speed things up, that's allowed us to be more accurate in what we do, and recognize where we might have anomalies that we've got to address and alert somebody to that. And so we've pretty quickly started to automate a lot of our internal processes which free workforces to focus on relationship management, such as customer satisfaction management, rather than regular repetitive work.

15. What do you think about the digital transformation for business after the COVID-19?

We have seen a lot of companies now are really looking at building up their own innovation center. That’s because they are changing digital experiences for their customer. They are trying to improve the ability to use data to build competitive advantages. Amazon started a shopping experience that customer pick things up and walk out the store, the scanner could automatically capture those things. Those changes has accelerated the digital transformation.

Interview with Yuepeng Deng- Head of Performance Prediction Analytics of First Solar, Inc.

1. Could you please tell us your position and responsibility?

I am Head of Performance Prediction Analytics. Basically what I do is analyzing the solar

panel performance through advanced analytics and trying to figure out how the enery yield and production looks like in the outdoor large utility scale power plants. And then we can determine whether the product is meeting expectation, or not meeting, or even actually exceeds expectations. Based on that we can feedback to the R&D team and they can continoue to optimize the processes to improve the product performance. That is mainly what I do.

2. What are the three major challenges your organization has experienced because of the Covid-19? How did your organization responde to those challenges?

When the COVID just started last march, a little over a year ago, it was pretty challenging. The first challenge was labor shortage. One reason would be people were concerned about the safety issue, the other fact is if one people got tested positive, the people who had direct contact with that person in the production plan need to be quarantined. So we had to cut the the number of production workers down at the begining. But our company handed it very well and pick up within a few weeks by carefully implementing social distancing. And the workforce actually restored very quickly. Since first solar was deemed as essential business by the government, we didn't experience completely shut down during the pandemic.

The second challenge we have experience was the supply shortage. A lot of suppliers of First Solar are from China. And at the early stage of COVID, China took pretty strong action on quarantine and shuting down business. Due to that, we had to shut down one production line in Malaysia, but not in the US. The accompany actually really responded to that very well and got a different suppliers in a very short period of time. It lead to approximately 1 week of production loss, but it was very limited.

3. What is your target market? Domestic or in a global base?

Dr. Ahrens: Are these products meant mostly for the retail market like homes? Or are they meant for industrial or commercial facilities?

The biggest market for us is in the utility scale, like gigantic power plants in the desert.

We also sell solar panel to Facebook data centers and Google data centers.

4. Did your company make adjustments to your products or services to respond the COVID related challenges?

No, because we oly have one product which is the solar panel. The service that we provide is the maintence or we call it energy service was also not impacted. We actually sold our energy service business on March 31 this year.

5. Would you share the main difference between pre- and post- Covid-19 in terms of challenges and opportunities?

I observed that more people preferred to stay unemployed rather than working, because of the benefits provided by the government.

6. How did your firm implement the work-from-hone policy?

Our leadership team actually responded to the pandemic very well and quick. I believe it was March last year, our CEO has sent out emails to the entire company on this work-from-home policy. Basically, the policy applied to whoever can WFH should work from home. And if people have to go to the office and go to the floor to get things done, people have to make sure to discuss with managers to get permission and approval to do that. After June last year, the company has started rotated schedule among office workers to allow them came back to office gradually. For the shop floor workers, they have to follow a very strict social distancing policy.

7. What online communication platform do you use for work?

We use Cisco Jabber as major communication platform. We were so used to it before the pandemic and that is our major internal communication platform for many years. When the pandemic took place, it became even more helpful because we can have the instant message, phone call and other functions. We also have the Mircrosoft Teams as another supporting platform.

8. How did your company implement cross-functional problem-solving collaboration during the pandemic?

Honestly, that really didn't changed too much about how we communicate in the type of collaboration or how we collaborate. I have done or have been involve in a lot of problem solving projects which is held by WebEx meetings before the pandemic. Sometime those meeting held in person, but we have done virtually meetings quite frequently before the COVID.

9. Are there any changes regarding the way of communicating with suppliers and customers between pre-and post-COVID-19?

Yes, I think there were a lot of changes, because when it comes down to suppliers auditing. Due to the pandemic, we cannot go to suppliers' facilities to do the auditing which was very challenging. But our supply chai folks actually use different vitual communication tools to complement this problem. Even it si very difficult and different than before, we still be able to get what we need. One thing that I learned through the pandemic was human beings are very adapted to changes.

The way that we commuinicated with our customers is very similar. Our customers had to use their preferred virtual communication tools to audit our plant before they make the big order.

10. What are your offshoring strategies? How are your strategies changing over time (e.g., reshoring)? Why did your company make the changes?

A lot of our raw materials are coming from Asia,. Solar panels have two pieces of glass. One actually comes from local, so we do have suppliers in the area. But in terms of the raw material volum from our local suppliers is very limited compare with our international suppliers. We do not really take actions to localize our raw materials.

11. What level of R&D or innovation of your firm compare with your competitors?

The world started to use solar in many different countries, like the US, Europe, Australia,

China and other countries. But when it comes down to solar panel production, it really comes from either First Solar and Crystal Silicon Companies in China, So our competitors are primary from China, Korea, and Japan. We have been do R&D and innovation of solar for a long time. Our competitors, they pretty much share the same set of innovation, technology and knowledge of know-how. I will say the level of R&D and Innovation of First Solar is phenomenal. Based on the public information, the earnings release, our R&D cost per year is probably little over 100 million dollar on average. Our competitors spend very little on R&D because they don't have to do that, they just share information with each other.

12. What types of data does your company collect and keep in the record (e.g., employee's working performance, machine-generated production data, etc.)?

It is fascinating experience that to put my hands on our production data. It really excited me back to 10 years ago when I was the first person who join the production data analytics in First Solar. Every single solar panel coming out from the production line has its unique ID, it tracks the lifelong performance of each panel. If I want to see what happened with any given solar panel, I can access current and all the historical process data from our system.

We use data very heavily. SAP is the our enterprise system, and Oracle is part of the database. We also have other databases.

13. How could that analysis help your firm in decision-making (e.g., predict demand, future trend, risk, etc.)

Data analysis is almost 90% of our decision making process. For instance, our pricing strategy highly rely on how to configurate different level of solar panel in terms of voltage.

To improve our product performance, we have lab testing and field testing to bring in new technologies and innovations. We also have a long term lab testing called accelerate lab testing. It basically simulates what the product will look like after 20 ro 40 years later. In this way, we can predict or estimate our performance based on our data.

14. What do you think about the digital transformation for business after the COVID-19?

We are data driven company and using data is part of our company culture. Almost every meeting that I participate is data review meeting. I will say the use of data will become the future for business. Digital transformation would be the next wave of the business world.

Interview with Danille Long- Purchasing Manager of Magna International

1. Could you please tell us your position and responsibility?

I am the purchasing manager at Magna Nordplus my responsibilities and tail managing the $400 million supply chain spend, ensuring supply continuity and sourcing and quoting new new projects for our company.

2. What are the three major challenges your organization has experienced because of the Covid-19? How did your organization responde to those challenges?

Most recently have been supplier insolvency. You know, we found that if any suppliers were kind of on the financial distress. The mandated shutdowns and the additional constraints placed on businesses overall has pushed a few folks over the edge. So that's been a really big challenge for our group. In addition to that logistics constraints have been increased over the past few months. It's due to a multitude of reasons. The first one would be the port congestions for products coming from overseas. Second, lack of driver of availability or truck availability for domestic transport, and on top of that costs for transportation have just gone through the roof. So lots of increasing costs, lots of pressure from our team to keep costs down. So that's been another big challenge. The third one would be material constraints. There has been issues getting personal protective equipment, resin and chemicals materials over recent months. It was largely stemming from COVID, but then exacerbated by recent disruptions,of the big winter storm that hit Texas Back in February. The fourth one would be the labor shortage. We have seen a lot of labor constraints that are tiered suppliers, more so at the beginning of restart phase. When everyone started going back to manufacturing, there's a lot of folks who were

very skeptical were very concerned about their health and the well being of their families. So they didn't want to go and work in public spaces. So that made it very difficult to get people support your production line. It has led up a little bit in in the past few months, I would say, but the issue is present for sure.

3. How did your organization responde to those challenges?

I would say with the the material constraints, we had to work really hard to develop contingency plans and identify alternative supply options. For some products that's more challenging than others. A lot of the items we deal with are engineered and tooled specifically for one vehicle for one customer. Those sort of items were definitely more of a challenge. In that regard, it wasn't so much focusing on finding new suppliers to produce the parts but more so finding ways to help those suppliers to be able to produce the parts. A lot of times they were running into constraints with their raw material supply or their ability to get various sub-components that they need. That’s where our purchasing team had to step in quite a bit and try to lend a helping hand to our supply partners. With logistics constraints, we do have two or three really close three PL partners that we've worked with for a long time. We've also had to develop a few additional partners so that we had a few more options. The long term partnerships that the three PL 's have helped us mitigate a little bit of the cost pressures, but not nearly as much of it as we would like to costs just in general for transport are going through the roof right. In terms of supplier insolvency, it has been particularly challenging. For our group, it's been a lot of phone calls and conversations with supply partners to get temperature checks on how their financials are doing. We've had an increased number of financial audit requests that we filter out through our corporate office. Iit is more difficult now that we're not doing face to face visits with suppliers or on site visits. So it's a little bit more challenging to identify financial red flags when you're not there at their facility, and you can't see what's going on. We have to pay more attention on major concerns like missed shipments or major staffing turnovers, or

other fundamental challenges. In addition, we definitely focus more so on building safety stock and buffer inventorie in recent months, just because there has been so much uncertainty and so many factors that are impacting suppliers ability to produce and deliver product. Overall, we have increased the amount of inventory that we're carrying for those high risk parts, it has been a little bit of a challenge to try to get and maintain those inventory levels. Because we have always historically worked on a just-in-time environment, and our suppliers have always done the same.

4. Have you observed any opportunities from the COVID-19?

The biggest opportunity for us is to focus more heavily on information systems. Speaking just to my company, pre-COVID we weren't very focused on maintaining good databases or good information. And there was a lot of things we did that weren't necessarily efficient. Most of our communications were had via Outlook email, or in face to face conferences. But after the COVID, almost everything we're doing has been through Microsoft Teams with file sharing. We have gotten a lot better at maintaining information and put a great emphasis on getting good folks in our IT group to help make sure ERP systems are capturing the information they need to capture so that everyone in our organization can use information and access it quickly.

5. What is your target market? Domestic or in a global base?

Magna overal is a global entity and definitely plays in a global market. Our specific division which is a branch of the exteriores group, we focus largely in the US, almost all of our customers are based in southern Michigan. We work with General Motors, Ford, Chrysler, and Honda who's down in Ohio, we do have one or two customers that we ship to, General Motors in Korea, and some Chrysler customers in Taiwan. But I would say probably 90% to 95% of the products, we ship out our doors shipped to domestic customers.

6. How did your firm implement the work-from-hone policy?

It went in some stages. When things started to get a little bit questionable around early to

mid March of last year, only few different companies were shutting down.Our company started doing rotational shifts, where only have half the team on site, then the other half working from home. Then shortly thereafter, there was the the actual government mandated shutdown. So when that occurred, a lot of the folks in our salaried groups ended up working remotely, and even some of them were laid off temporarily. Without our manufacturing line running, we didn't really have work for a lot of the hourly folks who worked on the assembly line. I would say probably after the six to eight weeks shutdown, we were able to open back up and brought people back in stages. We first brought our manufacturing groups back on for those who worked on the assembly line that were in support roles tied directly to production. For example the molding group, paint group. Then other support groups, like purchasing, sales and accounting groups, have continued either working remotely or doing rotational shifts. Probably, around October timeframe, we got about everyone back on site. So now we have almost our entire staff working back in the in the facility.

7. What online communication platform do you use for work?

We use Cisco Jabber as major communication platform. We were so used to it before the pandemic and that is our major internal communication platform for many years. When the pandemic took place, it became even more helpful because we can have the instant message, phone call and other functions. We also have the Mircrosoft Teams as another supporting platform.

8. Are there any changes regarding the way of communicating with suppliers and customers between pre-and post-COVID-19?

Very much Microsoft Teams. Depends on the customer, some of them have leaned more towards like zoom, some have leaned have stuck with WebEx. But when we were in charge, we tried to stick with Microsoft Teams when we can.

9. What are your offshoring strategies? How are your strategies changing over time (e.g.,

reshoring)? Why did your company make the changes?

There are a lot of the products we deal with fall into two categories. We have customer directed item, where the customer directs who you should buy from and what the price should be. In this case, we don’t have control with where the supplier is located. For the items in the second category, which is Nordplus controlled items, we can make our own purchasing decisions. We've always kind of leaned towards localizing our supply base. It gave us quite a few benefits, such as freight savings, quick response to changes in demand. I would say going forward, we're definitely going to continue our focus on keeping things close to home wherever we can. It helps avoid some of the constraints that you have when you're working on the global market.

10. What level of R&D and innovation of your firm are currently at compare with your competitors?

I would say we're on par or a little bit ahead of a lot of our competitors in this market.In our division, we have a little bit of a niche market. There's only two or three companies in the game, who can really do what we do. Norplus have a lot of technical capable employees working in our molding and our paint groups. We also have emphasis on new development technologies. Especially we are always looking at new ways to incorporate plastic in cars, instead of using steel or aluminum. We started branching into plastic liftgates for Honda programs and a few other customers. We also have a strong engineering staff here, we have been very lucky to work with some OEM customers who are very focused on innovation. For example, GM being one of our largest customers who has recent shifted towards electrification and autonomous vehicles. So, we've had a lot of involvement in the development of some upcoming platforms that are utilizing that technology.

11. What types of data does your company collect and keep in the record (e.g., employee’s working performance, machine-generated production data, etc.)?

We collect different types of data. We use a lot of scanners out on our production line. We capture the movement of parts through one cell into the next cell, anytime a scan transaction occurs, that data is collected and archived in our ERP system. We also collect data on supplier performances which we can show in a dashboard with our supply partners track their performance, address any issues that micht come up.

12. How could data analysis help your firm in decision-making (e.g., predict demand, future trend, risk, etc.) and do you have a vision that utilizing data will become more popular in the future?

I would say absolutely. From my experience, disruptions popping up at every branch of the supply chain. Not only our customers been requesting more detail from us, but also our leadership group need to be able to access more information than we ever have. So I would say COVID is really shed light on some some gaps in our data collection, data management processes, and I'm sure it's done the same for a lot of other companies. I know we've made a lot of great strides in the last 12 months in this regards, but we still have a long ways to go. But I think that with all of the lessons that everyone's learned from all of these crazy, embracing data and strong information systems is an absolute necessity.

13. What do you think about the digital transformation for business after the COVID-19?

That is definitely a trend in the future I will say.

Appendix B- Survey Instrument

Dear Participant,

Since the outbreak of the COVID19 pandemic, the business world has experienced dramatic changes. To survive from this global crisis, this survey has been designed to explore and identify the drivers that accelerate the market changes, the strategic and operational practices that will enhance the performance outcomes for successful firm performance in a turbulent and complex environment.

Your participation is an important contribution to this research. The information you provide is vital to improving decision-making in disruptive and turbulent environments from a network perspective. I have provided a space in the questionnaire to indicate if you would like to receive an executive summary of the results. This executive summary may help firms like yours be more effective in the post-COVID world, and it will allow you to see how your company compares to the industry in general.

Please give your opinions with respect to various issues, strategies, and outcomes by completing the enclosed questionnaire. There is no right or wrong answer. So please provide the best estimate to answer all questions. It should take you approximately 20 minutes to complete. If you have any questions about this research, feel free to contact me (Elsie Deng, at 419-921-2484 or xiyuedeng1991@gmail.com or my adviser, Dr. Paul Hong, at 419-530-2054 or paul.hong@utoledo.edu). We truly appreciate your completion of this questionnaire.

Section A: Dynamic Market Drivers. : This is the extent to which Firms experience competitive disruptions that demand their responses from two major leading groups: (1) industry leader challenges (i.e., drastic actions of leading incumbent groups that stir up the existing norms and standards of best practice firms in the upper level of industry hierarchy—top-down process); (2) emerging rival challenges (i.e., innovative actions of rising star groups that generate the attention of small and medium-sized business in the grass-root level—bottom-up process)

Note: All scales are 1=Strongly Disagree, 2=Disagree, 3. Neither agree nor disagree, 4. Agree, 5. Strongly Agree

Table 0.1 Dynamic Market Drivers

Codes	**Industry Leaders Challenges:** This is about competitive and aggressive intent, initiatives and actions of major firms that hold the outstanding market share position with the reputation of excellence. To what extent you agree or disagree with the following statements:					
ILC1	Our firm knows about the new strategic aim/direction of the industry-leading firms.	1	2	3	4	5
ILC2	Our firm recognizes the publicized new significant initiatives of the industry-leading firms.	1	2	3	4	5
ILC3	Our firm notes the market growth investment initiative of industry-leading firms.	1	2	3	4	5
ILC4	Our firm is aware of the new products/services introduction of the industry-leading firms	1	2	3	4	5
ILC5	Our firm collects news about the partnership alliance of the industry-leading firms.	1	2	3	4	5
	Emerging Rival Challenges: This is about competitive and aggressive intent, initiatives and actions of growing firms and new entrants that hold the potentially threatening market share position with rapid growth track records.					
ERC1	Our firm knows about the new strategic aim/direction of emerging rival firms.	1	2	3	4	5
ERC2	Our firm recognizes the publicized new major initiatives of emerging rival firms.	1	2	3	4	5
ERC3	Our firm notes the market growth investment initiative of emerging rival firms.	1	2	3	4	5
ERC4	Our firm is aware of the new products/services introduction of emerging rival firms.	1	2	3	4	5
ERC5	Our firm learns about the news about the partnership alliance of emerging rival firms.	1	2	3	4	5

Section B: Socio-Technological Drivers: This is the extent to which socio-technological drivers are measured in terms of (1) market culture shifts (i.e., Gradual or sudden changes of mindsets, norms, and values that affect buying and selling patterns in the broad segments of the ecosystems) and (2) disruptive technology imperatives (i.e., radical applications of innovative knowledge, procedures and tools with enormous relevance and broad appeal).

Note: All scales are 1=Strongly Disagree, 2=Disagree, 3. Neither agree nor disagree, 4. Agree, 5. Strongly Agree

Table 0.2 Socio-Technological Drivers

Codes	**Market Culture Shifts:** This is about gradual or sudden changes of mindsets, norms, and values that affect buying and selling patterns in the broad segments of the ecosystems.					
SSC1	Our firm observes changing customer requirements for new products and services.	1	2	3	4	5
SSC2	Our firm recognizes the shifted market norms of new products and services.	1	2	3	4	5
SSC3	Our firm senses increasing value proposition changes of new products and services.	1	2	3	4	5
SSC4	Our firm is aware of the changing patterns of successful products and services.	1	2	3	4	5
SSC5	Our firm realizes to growing expectations of new products and services.	1	2	3	4	5
	Disruptive Technology Imperatives: This is about radical applications of innovative knowledge, procedures and tools with enormous relevance and broad appeal.					
DSC1	Our firm is aware of radical technological applications.	1	2	3	4	5
DSC2	Our firm discovers about innovation knowledge.	1	2	3	4	5
DSC3	Our firm recognizes well-defined operating procedures that facilitate by new technology.	1	2	3	4	5
DSC4	Our firm recognizes the increasing investment need for new technology.	1	2	3	4	5
DSC5	Our firm explores possible useful technological tools.	1	2	3	4	5
DSC6	Our firm searches for easy-to-use technological tools.	1	2	3	4	5

Section C: Globalization Balancing Drivers: Firms aim to develop their international influence or expand their business networks on an international scale to build competitive advantages. The degree of balancing a firm's (1) internationalization and (2) localization is crucial for long-term success. Any extreme preference of one of the two sides (internationalization and localization) strategy will dampen the ability to rise to global challenges.

Note: All scales are 1=Strongly Disagree, 2=Disagree, 3. Neither agree nor disagree, 4. Agree, 5. Strongly Agree

Table 0.3 Globalization Balancing Drivers

Codes	**Level of Internationalization:** is about the efforts and processes of discovering, designing, developing and delivering values across countries in the world to enlarge the scale and scope of business activities with larger suppliers and customers					
LOI1	Our firm initiates efforts in increasing revenue potential in global markets.	1	2	3	4	5
LOI 2	Our firm observes new business opportunities in multiple countries.	1	2	3	4	5
LOI 3	Our firm assesses global capabilities to target market segments of multiple countries.	1	2	3	4	5
LOI 4	Our firm segments target customers by income levels (upper, middle, lower) of different countries.	1	2	3	4	5
LOI 5	Our firm compares customer value requirements of different countries.	1	2	3	4	5
LOI 6	Our firm searches for suppliers from a global base.	1	2	3	4	5
	Level of Localization: is about the efforts and processes of discovering, designing, developing and delivering values within the specific country to explore and enlarge the scale and scope of business activities with local, regional and domestic suppliers and customers					
LOL 1	Our firm initiates localization efforts in increasing revenue potential in the country we operate.	1	2	3	4	5
LOL 2	Our firm plans to develop local talents.	1	2	3	4	5
LOL 3	Our firm examines local managerial capabilities.	1	2	3	4	5
LOL 4	Our firm values the innovative ideas of the local focus group for business development efforts.	1	2	3	4	5
LOL5	Our firm evaluates local customer value requirements.	1	2	3	4	5
LOL 6	Our firm prefers to work with suppliers from a specific region.	1	2	3	4	5

Section D: Risk Responsive Practices: In relation to broad risk management pressures, firms take steps to keep up with (1) the best and emerging leader practices (i.e., benchmark learning practices) and (2) develop their own unique positioning initiatives (i.e., differentiation innovation practices)

Note: All scales are 1=Strongly Disagree, 2=Disagree, 3. Neither agree nor disagree, 4. Agree, 5. Strongly Agree

Table 0.4 Risk Responsive Practices

Codes	**Benchmark Learning Practices:** is the extent of the adoption practices of current industry leaders (i.e., firms that represent the standard of excellence in the industry) in the form of innovative business model, advanced technology, cutting-edge knowledge practices, forward-thinking operational practices, and effective leadership management to sustain market position in the industry					
BLP1	Our firm learns the best practices from industry leaders.	1	2	3	4	5
BLP2	Our firm assesses disruptive advanced technologies for our firm's needs.	1	2	3	4	5
BLP3	Our firm examines the cutting-edge knowledge practices in our industry.	1	2	3	4	5
BLP4	Our firm sends middle managers for operational practices benchmarking in annual conferences.	1	2	3	4	5
BLP5	Our firm involves senior managers for benchmarking innovative leadership practices.	1	2	3	4	5
	Differentiation Innovation Practices: is the extent to developing firm context-specific and unique practices in innovative business models, advanced technology, cutting-edge knowledge practices, forward-thinking operational practices, and effective leadership management to create unique products or services that stand out from the competitors.					
DIP1	Our firm revises our business model in response to market changes to stand out from competitors.	1	2	3	4	5
DIP2	Our firm invests in specific advanced technologies to improve the uniqueness of our firm.	1	2	3	4	5
DIP3	Our firm keeps investigating new knowledge to meet customers' requirements.	1	2	3	4	5
DIP4	Our firm improves forward-thinking operational practices to stand out from competitors.	1	2	3	4	5
DIP5	Our firm develops exceptional leadership capabilities in response to competitor challenges.	1	2	3	4	5

Section E: Process Innovation Practices: The internal collaborative coordination practices of (1) behavioral competencies of diverse functions (i.e., cross-functional synergies) and (2) technological capabilities of digital infrastructure that enable systematic linkages and interactive integrations (i.e., digitalization).

Note: All scales are 1=Strongly Disagree, 2=Disagree, 3. Neither agree nor disagree, 4. Agree, 5. Strongly Agree

Table 0.5 Process Innovation Practices

Codes	**Cross-functional Synergy:** is the extent of the internal collaborative coordination of behavioral competencies of diverse functions through which people from different areas of an organization work together toward a common goal to generate outcomes greater than the sum of their separate effects.					
CFS1	Our firm communicates organization-wide policy guidelines across all functional areas.	1	2	3	4	5
CFS2	Our firm adopts common communication platforms for all functional areas.	1	2	3	4	5
CFS3	Our firm clarifies interactive rules of engagements among diverse functional areas.	1	2	3	4	5
CFS4	Our firm uses joint decision-making mechanisms (e.g., shared leadership council) that affect all functional areas.	1	2	3	4	5
CFS5	Our firm makes enterprise-wide information platforms (e.g., performance dashboards) accessible to all functions.	1	2	3	4	5
	Organizational Digital Collaboration: is the extent of systematic linkages and interactive integration of technological capabilities (e.g., enabling descriptive, predictive and prescriptive analytic tools) to support value-creation-capture processes and improve decision making quality for achieving desirable performance outcomes					
ODC1	Our firm uses virtual platforms to share common goals.	1	2	3	4	5
ODC2	Our firm installs a cloud-based software system for real-time communication.	1	2	3	4	5
ODC3	Our firm adopts interactive digital coordination (e.g., access to customer feedback/satisfaction ratings).	1	2	3	4	5
ODC4	Our firm applies descriptive analytical tools for problem assessment.	1	2	3	4	5
ODC5	Our firm implements standard predictive analytic tools for managing supply chain risks.	1	2	3	4	5
ODC6	Our firm tests digital prescriptive analytic tools for the implementation of long-term goals.	1	2	3	4	5
ODC7	Our firm develops supply chain traceability (e.g., product authentication, product origin) for effective visualization.	1	2	3	4	5

Section F: Network Resilience Practices: The external interactive collaboration within the overall ecosystem that consists of (1) Core Relationship Focus (i.e., internal functional cores within a focal form that are instrumental in relating to key customers and suppliers that involve in primary value creation processes of strategic planning, product development, sourcing and operations) and (2) Extended Network Optimization (i.e., internal functional support or enable functions within a focal firm that are instrumental in expanding customers and suppliers at large involving in secondary value creation processes of infrastructure development, logistics, performance measurement and post-sales management).

Note: All scales are 1=Strongly Disagree, 2=Disagree, 3. Neither agree nor disagree, 4. Agree, 5. Strongly Agree

Table 0.6 Network Resilience Practices

Codes	**Core Relationships Focus:** is about the internal functional cores within a focal firm (e.g., management, marketing and supply chain) that are instrumental in relating to key customers and suppliers (e.g., 1st tier) involve in primary value creation processes (e.g., strategic planning, product development, sourcing and operations).					
CRF1	Our sourcing department works well with strategic suppliers.	1	2	3	4	5
CRF2	Our marketing and sales department communicates effectively with first-tier suppliers	1	2	3	4	5
CRF3	Our supply chain department engages actively with first-tier suppliers.	1	2	3	4	5
CRF4	Our firm involves with key suppliers in the strategic planning process.	1	2	3	4	5
CRF5	Our firm involves with primary suppliers in the product development process.	1	2	3	4	5
CRF6	Our firm includes operational managers in major contract design processes with primary suppliers and customers.	1	2	3	4	5
CRF7	Our firm involves with primary customers in the product development process	1	2	3	4	5
DRF8	Our firm involves with key customers (in terms of sales value) in strategic planning process.	1	2	3	4	5
	Extended Network Optimization: is about Internal functional support/enable functions within a focal firm that are instrumental in expanding customers and suppliers (2nd and 3rd tier suppliers) at large involving in broader value creation processes (e.g., infrastructure development, logistics, performance measurements and post-sales management).					
ENO1	Our firm networks with lower tiers (2^{nd} and 3^{rd} tier) suppliers	1	2	3	4	5
ENO2	Our firm expands (supply) logistics network in a global base.	1	2	3	4	5
ENO3	Our firm implements contingent multiple-sourcing network plans.	1	2	3	4	5
ENO4	Our firm deploys a broad communication network (multi-tier relationships) in the new product development process.	1	2	3	4	5
ENO5	Our firm involves lower-tier network members in post-sales services.	1	2	3	4	5
ENO6	Our firm networks with potential customers.	1	2	3	4	5

Section G: Dynamic competitive outcomes:

This section consists of three sets of performance outcomes which are (1) Competitive Benchmarking Outcomes, (2) Socio-Tech Innovation outcomes, and (3) Supply Chain Outcomes.

Note: All scales are 1=Strongly Disagree, 2=Disagree, 3. Neither agree nor disagree, 4. Agree, 5. Strongly Agree

Table 0.7 Dynamic Competitive Outcomes

Competitive Benchmarking Outcomes: is about the Results of a firm's evaluation of their key traditional operational and financial outcomes against the competitors or the "best-in-class companies" to determine how to achieve performance levels						
CBO1	Our firm attains a high product quality reputation.	1	2	3	4	5
CBO2	Our firm achieves high delivery performance.	1	2	3	4	5
CBO3	Our firm obtains high manufacturing flexibility	1	2	3	4	5
CBO4	Our firm attains good logistics performance.	1	2	3	4	5
CBO5	Our firm excels in customer responsiveness.	1	2	3	4	5
CBO6	Our firm obtains high customer satisfaction ratings.	1	2	3	4	5
CBO7	Our firm are cost competitiveness.	1	2	3	4	5
CBO8	Our firm secures a desirable return on asset (ROA) performance.	1	2	3	4	5
CBO9	Our firm maintains a steady sales growth.	1	2	3	4	5
CBO10	Our firm achieves profitability growth targets	1	2	3	4	5
CBO11	Out firm is committed to social responsibility					
CBO12	Our firm looks after the well-being of its employees					
Socio-Tech Innovation Outcomes: is about the internal results of cross-functional collaboration and Innovative technology-driven value creation outcomes through interfaces of behavioral and technological practices.						
SIO1	Our firm obtains a high level of human-computer interactions.	1	2	3	4	5
SIO2	Our firm succeeds in the technology adoption process.	1	2	3	4	5
SIO3	Our firm attains high process innovation impacts.	1	2	3	4	5
SIO4	Our firm reports high product innovation results.	1	2	3	4	5
SIO5	Our firm excels in cross-functional problem solving through digital platforms.	1	2	3	4	5
SIO6	Our firm achieves high productivity by socio-automation collaboration.	1	2	3	4	5
SIO7	Our firm succeeds in training employees to use newly developed software.	1	2	3	4	5
Supply Chain Outcomes: is about the external results of supplier and customer network-driven outcomes plus cross-industry network outcomes.						
SCO1	Our firm attains supply chain competitiveness	1	2	3	4	5
SCO2	Our firm maintains a high level of integration with supply chain members.	1	2	3	4	5
SCO3	Our firm operates in a mature supply chain.	1	2	3	4	5
SCO4	Our firm operates in a supply chain with flexibility.	1	2	3	4	5
SCO5	Our firm excels in supply chain responsiveness.	1	2	3	4	5
SCO6	Our supply chain achieves agility in response to changes	1	2	3	4	5
SCO7	Our firm operates in a resilient supply chain can recover from disruptions quickly.					

Demographic Descriptions

This demographic information is for data integration purposes only. Please select the most appropriate one for each item.

1. Indicate the level of impacts on your company due to the COVID-19 pandemic?
☐ Low impacts on normal operations ☐ Medium impacts on normal operations ☐ High impacts on normal operations ☐ very high impact on normal operations

2. Indicate how COVID-19 has impacted your company's digital transformation? Consider how the pandemic had impacted plans the company had in place before the pandemic began.
☐ Negatively impacted ☐ No real change ☐ Accelerated by 1 to 2 years ☐ Accelerated by more than three years

3. Indicate your position: (Please specify for details).
☐ CEO/Owner ☐ VP in _____ ☐ Manager of _____ ☐ Others: _____

4. Indicate the form of ownership of your company or its parent company. Please select one.
☐ Public ownership ☐ Institutional ownership ☐ Private ownership ☐ Co-operative

5. Identify the industry that your firm belongs to:
☐ Manufacturing ☐ Financial Services ☐ Food and Hospitality (hotels/restaurants) ☐ Health Services ☐ Educational ☐ Governmental ☐Transportation ☐Hi-Tech

6. Number of employees in your company:
☐ 1-100 ☐ 100-500 ☐ 500-1000 ☐ >1000

7. Your company has been in business for:
☐ 0-2 years ☐ 2-5 years ☐ 6-10 years ☐ >10 years

8. Indicate the range of your company's annual sale (in US $). Pick one.
☐ <1 million ☐ 1-10 million ☐ 10-100 million ☐ 100-1,000 million ☐ > 1billion

9. Your firm's location in the USA/Canada.

Northeast US (MA, NY, NJ)
Northwest US (WA, OR, CA)
Midwest US (OH, MI, IN)
Central US (CO, MO, KS)
Southwest US (TX, AZ, OK)
Southeast US (FA, FL, NC, SC)
Northern Europe
Western Europe
Central Europe
Southern Europe

10. The years you have been in this organization. Select one.
☐ <2 years ☐ 2-5 years ☐ 6-10 years ☐ 10-20 years ☐ > 20 years

11. Where are the firm's products and services offered? Select one.
☐ At one site in this country ☐ At more than one site in this country
☐ At locations in a few countries in this continent ☐ Globally, at sites in various continents