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Agility Prevalence Across Industry Type: A Proposed Model

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Abstract

In a turbulent market environment, firm agility is one of the key factors influencing an organization's performance in adapting to a changing market environment. The value of agility in the improvement of firms' internal and external performance has been evaluated differently across diverse industries. This study investigates how the focus of firms' agility is distributed across different industries. This study proposes that differences exist in the prevalence of agility across industries, as well as in the relationship between agility and the industry-life cycle. An understanding of the differences of value in agility across industries may reaffirm why consideration of the industrial element in business research is important. Thus, this perspective allows researchers and practitioners to understand the difference in agility across different industries and reaffirm the importance of agility in overall business processes.

Keywords: agility, industry type, industry-life cycle, capability, data analytics, adaptability

1. Introduction

Agility refers to a firm's ability to sense opportunities in the marketplace and manage the resources required to seize such opportunities. Hypercompetition, increasing globalization, and rapid changes in customer preferences often cause a firm to realize the need for improvements in agility (Van Oosterhout et al., 2006). The global pandemic and healthcare crisis significantly affected the balance of supply and demand in both upstream and downstream disruptions. These disruptions caused difficulty in forecasting demand planning and managing supply chain resources (Nikolopoulos et al., 2021). For the post-pandemic era, Khan et al. (2022) suggest that companies do not need to reinvent new capacities, but instead must interconnect and digitize their supply chain data analytics in order to produce greater profits. Adaptability in a dynamic business environment, along with a proactive manner to approach market and customer needs, are necessary (Shariff and Zhang, 2000; Dahmardeh and Banihashemi, 2010; Roberts and Grover, 2012). Thus, agility is one of the necessary factors to create value and obtain a

Vol. 7, No.09; 2023

ISSN: 2456-7760

competitive advantage (Aitken et al., 2002; Ganguly et al., 2009; Al-Romeedy, 2019; Wu et al., 2017; Stylos et al., 2021). A recent study by Schleper et al. (2021) points out that for the retail industry to fight against external environment disruptions/shocks, firms must develop an agile supply chain via real-time flexible systems using real-time data to manage a fluctuating capacity.

Although many industries are closely related to each other, each industry has its own characteristics and unique perspective. Specifically, the level of intensity in market change is different across industries. As an example, market change in the IT industry would be more intensive than in the food industry. Even within the same industry, such levels vary across different products and services. The interest in such differences has led to extensive research on industrial differences from various viewpoints. As such, industry type is often considered as one of the major variables explaining the relationship among other variables.

This study explores how the perspectives in firms' agility tend to vary across different industries. Although scholars and practitioners generally agree that agility is one of the critical factors affecting firm performance and value, research on the comparison of the value of agility across industries is scarce. Though all industries may consider agility as a key resource, the value of agility investments may be perceived differently across industry types. For example, some industries (e.g. food and retail) invest in ERP technology to better anticipate customer needs and optimize inventory levels. Automotive, logistics, or IT industries can become more supply chain agile by investing in cloud-based/advanced data analytics to better predict demand and streamline supply chain processes while reducing lead times. An understanding of the differences of value in agility across industries may reaffirm why consideration of the industrial element in business research is important. Thus, this perspective allows researchers and practitioners to understand the difference in agility across different industries and reaffirm the importance of agility in overall business processes.

2. Literature Review and Proposition

2.1 The concept of "Agile" defined

As a result of increased interest in the concept of agility, agility is defined in slightly different ways. Overby et al. (2006) defined enterprise agility as "*the ability of the firm to sense environmental change and respond readily*". Van Oosterhout et al. (2006) defined agility as "*a way to cope with external and internal changes, which are unpredictable or uncertain*". In a separate study, Sharifi and Zhang (2010) listed two main concepts of agile manufacturing as "*Responding to changes*" and "*Taking advantages of agilities through strategic utilization of material and manufacturing methods and tools*". Yusuf et al. (2014) defined agility as "*the successful adoption of competitive bases (speed, flexibility, innovation proactivity, quality, and profitability) through the integration of reconfigurable resources and best practices in a knowledge-rich environment to provide customer-driven product and services in an uncertain market setting*".

Although scholars have defined agility in various ways, the common view is that agility is the capacity to sense business environmental changes and to respond effectively in order to maintain or improve competitiveness. For agility to be improved, a company needs to be market-oriented

Vol. 7, No.09; 2023

ISSN: 2456-7760

and able to absorb/develop technologies which enhance the effectiveness and efficiency of processes via learning, while continuing to be strategically flexible.

2.2 Agile Practices

In the study of business-related disciplines, the consideration of industry type involves various factors such as intra/inter-organizational structure, as well as required employee skills. Chatman and Jehn (1994) investigated the relationship between industrial characteristics and organizational culture, whereas Boter and Holmquist (1996) assessed the internationalization process of small companies. Their research emphasized the necessity to understand the relationships among industries, the company's condition, and the people who are involved. Meanwhile, Rajagopalan and Datta (1996) examined the relationships between CEO characteristics and industry conditions.

The effect of agility on firm performance tends to differ across industries. Numerous studies have been conducted within a variety of industrial settings: airlines (Al-Romeedy, 2019), manufacturing (Yauch, 2017), service (Stylos et al., 2021), software and IT (Wendler, 2016), hospitality (Kale et al., 2019), oil and gas (Yusuf et al., 2014), fashion (Chan et al., 2017), and cement (Dastylar et al., 2020). Researchers have found an array of perspectives on the relationship between industry and agility. Identifying the differences between leanness and agility, Narasimhan et al. (2006) found that the overall prevalence of agility tends to differ across industry types. More recently, the uncertainty of the pandemic period caused multiple industries to utilize more agile production methods, thereby ensuring that critical equipment and materials could be provided via stable delivery logistics. Under a social sustainability model, industries should be concerned with saving lives or slowing the spread of positive cases in the "hot spot" areas by promoting flexible manufacturing technologies, such as adding robotics to local production capabilities (Sarkis, 2020). Thus, the potential transformations from lean toward agile supply chains might be more “green” than lean within an uncertain environment.

With an overall increasing interest in agility, scholars have studied various perspectives including the measurement of agility, as well as the effect of agility on the intra/inter-organizational level by using various empirical and analytical methods. Among the studies which have measured the level of agility, Shariff and Zhang (1999) discussed the methodology development efforts to achieve agility in manufacturing companies. Likewise, Zhang and Shariff (2000) presented a conceptual model and methodology for the implementation of agility. Afterwards, Ganguly et al. (2009) proposed the techniques to assess enterprise agility, whereas Yauch (2011) constructed a quantitative metric for agility performance by using a case study and survey data in the manufacturing industry. A separate study by Shin et al. (2015) produced a conceptual model for investigating the relationship among firms' strategic agility, operational performance, and financial performance of Korean small and medium enterprises. Their study found that strategic agility positively influences the improvement of operational performance and customer retention, while financial performance was not affected. Examining the influence of Big Data in the service industry, Gunasekaran et al. (2018) provided a framework on how Big Data and business analytics can assist agile manufacturing practices. They determined that Big Data and business analytics can enable agile manufacturing to better achieve business performance objectives and compete in turbulent market environments. More recently, Stylos et

Vol. 7, No.09; 2023

ISSN: 2456-7760

al. (2021) found that the use of Big Data helps organizations to build agility, especially within dynamic industries, along with more accurate prediction of customers' behavior.

As examples of various effects of agility at the intra-organizational level, Aitken et al. (2002) described the process for transforming a traditional enterprise into a lean, agile manufacturing enterprise. Thereafter, Sherehiy et al. (2007) identified the characteristics of agile manufacturing as follows: flexibility, responsiveness, speed, culture of change, integration, low complexity, customized products with high quality, and mobilization of core competencies. Additionally, Bottani (2010) investigated the profile of agile companies and the tools to achieve agility in order to produce a taxonomy of attributes for agility progress. Meanwhile, Dahmardeh and Banihashemi (2010) argued that agile manufacturing is a recent paradigm which can fundamentally improve performance by responding to business environmental changes. Similarly, in a study of JIT, operational performance, and firm performance of U.S. manufacturers, Inman et al. (2011) found a direct relationship between agile manufacturing and a firm's operational performance.

Agile manufacturing emphasizes the competitive metrics of being first to market in a manner that surpasses customer expectations. Thus, technology integration with the enterprise-wide sharing of supply chain information is the primary enabler of agile manufacturing processes (Gunasekaran et al., 2018). As an example, in the early- to mid-stage of the pandemic period, many areas faced shortages of numerous products, including medical support systems. Tonday et al. (2021) found that agile manufacturing techniques can be applied to manufacturing and service processes in order to accommodate changes in demand. Furthermore, various elements and dimensions contribute to supply chain agility, such as speed, cost, and efficiency. Other essential components of an agile supply chain include flexibility, process improvement, automation technology, market sensitivity, and collaboration.

2.3 Agility in Firm Capabilities

Proposing that a firm's agility is comprised of two distinct capabilities (i.e., sensing-capability and responding-capability), related to market demand Robert and Grove (2012) revealed that firm performance is higher when these two capabilities are aligned and when the value of each capability is high. Results of their study indicate that sensing-capability has a higher effect on firm performance, whereas responding-capability plays a mediating role between market sensing capability and firm performance. Studying the effects of IT capabilities on firm performance, Liu et al. (2013) found that absorptive capacity mediates the relationship between IT capabilities and supply chain agility; likewise, supply chain agility plays a critical role in the improvement of firm performance. In a separate study, Chen et al. (2014) described the business agility process as mediating the relationship between IT capability and firm performance.

In a study of the software and IT service industry, Wendler (2016) identified six organizational agility factors (workforce, technology, management of change, collaboration & cooperation, agility values, and flexible structures), along with three dimensions of organizational agility (prerequisites for agility, people for agility, and structure to enhance agility). Also, Hazen et al. (2017) noted that enterprise/architecture-based capabilities impact business processes, whereas IT systems enhance agility and improve firm performance. Clauss et al. (2019) showed that a

Vol. 7, No.09; 2023

ISSN: 2456-7760

firm's agility is associated with innovative development of the business model; moreover, the degree of environmental turbulence strengthens the relationship. Their study also found that innovation in a business model plays an intermediary role between a firm's agility and its performance; furthermore, strategic sensitivity, leadership unity, and resource fluidity allow the business model to be innovative (Clauss et al., 2019). Al-Romeedy (2019) stated that agility positively affects innovation, service quality, delivery reliability, process flexibility, and cost leadership in the airline industry. Felipe et al. (2020) determined that IS capabilities positively affect a firm's performance through organizational agility. More recently, a study by Yildiz and Aykanat (2021) discussed the positive effects of a firm's strategic agility on firm performance and organizational innovation. Likewise, in a study of the resource-based view, Nurjaman et al. (2021) proposed a framework showing the relationship between a firm's strategic agility and performance in asset growth and increases in the number of employees. Finally, Kale et al. (2019) found that a firm's agility positively mediates the influence of absorptive capacity on firm performance in the hospitality industry.

2.4 Agility in the Supply Chain

Agility at the inter-organizational level influences the process among supply chain partners. Specifically, Shaw et al. (2005) assessed various ways to improve supply chain agility in capital-intensive, conservative industries where the capabilities of individual processing assets are valued. Likewise, Vickery et al. (2010) found that agility plays a mediating role in the use of supply chain IT and supply chain organizational initiatives to improve firm performance. Information system integration positively influences the improvement of network agility and the network agility has a moderating effect on the positive relationship between the mixed channel strategy and a firm’s financial performance (Chen & Chiang, 2011). Also, Yang and Liu (2012) explored whether firms' network structure enhances their agility, as well as performance. In a study of the oil and gas industry, Yusuf et al. (2014) identified the attributes of supply chain agility and assessed the relationship between such attributes and firm performance. In another study, Fayezi and Zomorrodi (2015) argued for the importance of relationship integration with business partners in the development of supply chain agility and flexibility. Likewise, Wu et al. (2017) showed that collaboration and information integration with supply chain partners significantly influence overall supply chain agility.

Based on the resource-based view within the fashion industry, Chan et al. (2017) found that flexibility in a firm's strategy is positively associated with supply chain agility; likewise, supply chain agility has a mediating effect on the firm's strategic and manufacturing flexibilities. In a recent study by Butt (2021), interviews were conducted to explore the countermeasures implemented by the buying and distributing firms to combat supply chain disruptions via agile production and manufacturing functions. The interviewees revealed that their firms prepared very refined production schedules based on the availability of inventory and variability in demand. Notably, the firms emphasized that they were not dependent on component parts which entailed the risk of stock outages. Additionally, in order to alleviate the effects of plant shutdowns due to pandemic-related regulations, firms need to engage in innovative agile production by re-routing production to other locations within their networks. Other agile practices to manage possible supply shortages include modularized production units to assemble

Vol. 7, No.09; 2023

ISSN: 2456-7760

goods across different sites. Overall, stock-out material risks can be avoided by streamlining the firms' supply chain with visibility throughout their extended supplier networks via new digital approaches to identify critical supply shortage points. In sum, the capability to make swift decisions is a critical aspect of supply chain agility. Thus, the first proposition is:

Proposition 1: Supply chain capability has a positive impact on supply chain agility.

2.5 Agility in Data Analytics

In order to assess the inherent advantages of agility, scholars have used analytic research approaches. Tsinopoulos and McCarthy (2000) developed a method to understand the emergence of new manufacturing processes as organizations transit to be agile. Tsourveloudis & Valavanis (2002) proposed a framework to determine and measure agility by using fuzzy logic. Lin et al. (2006) and Tseng & Lin (2011) developed a fuzzy agility index to measure agility levels and identify potential obstacles to the improvement of agility. Yu and Heng (2006) introduced a model to measure agility by using analytic hierarchy processes and Bayesian belief networks. Other researchers (Erande and Verma, 2008) presented a tool to measure comprehensive agility by capturing agility enablers, while Hasan et al. (2012) introduced a decision model which can be used to improve production layout within the agile manufacturing environment. Thereafter, Aravind et al. (2013) developed a conceptual model using graph theory to identify agile manufacturing elements, as well as compute dependencies among the agile enablers. Galankashi et al. (2016) proposed a model based on the fuzzy analytic hierarchy process approach to assess suppliers' levels of agile manufacturing. Also, one recent study by Dastyar et al. (2020) identified supply chain agility factors in the cement industry by using a fuzzy analytic network process. In sum, the supply chain must remain flexible, especially within highly unpredictable environments. However, a flexible supply chain requires advanced data analytics capabilities in order to quickly process information and gain the meaningful insights necessary to respond quickly and decisively. Thus, the second proposition is:

Proposition 2: Supply chain data analytics have a positive impact on supply chain agility.

2.6 Agility in the Adaptability of Product Life Cycles

Van Oosterhout et al. (2006) proposed six key factors for agility, including Social/Legal, Business network, Competitive environment, Customer needs, Technology, and Internal demand; notably, their study revealed that the requirement of these factors differs across industry types. Janssen and Van der Voort (2020) found that government policies tend to interfere with the organization's agility and adaptation abilities in environmental uncertainty. When policymakers are less bureaucratic and provide quicker responses to the public regarding updated regulations, organizations will display agility in response to changing needs, reflected in the desire of consumers. Zhang (2011) suggested that selection in agility strategies should be quick, responsive, and proactive, as based on the markets' nature and competition, characteristics of products considering life cycle, and firm's market position. Prange and Henning (2019) argued that regardless of the differences in industry type, agility is required for all industries. They introduced three different agility patterns with different levels of change: Resilience for industry demanding stability, Versatility for industry requiring regulated processes, and Transformation for industry requiring disruptive change.

Vol. 7, No.09; 2023

ISSN: 2456-7760

The industry's life cycle represents the intensity level of industrial competition and the diversity of customer preferences. The industry life cycle is closely related to the market's demand characteristics and technical changes (Agarwal and Gort, 2002). As an example, in the mobile phone industry, the strategic focus of manufacturers evolved into the innovation of both product and process, rather than classical change from product innovation to process innovation. Such innovation leads customers to demand more replacement purchases (Giachetti and Marchi, 2010). Falling behind in the adaption to such changes within the product life cycle may eventually cause a company to become less competitive. Ivanov (2020) examined the underlying supply chain elements in agility, resilience, and sustainability of a viable supply chain during a time of environmental disruption. When firms can dynamically react and adapt to positive changes in an agile manner, the firms tend to be resilient in absorbing negative situations and recover more efficiently after short-term or long-term disruptions. Such adaptions to the agile supply chain can be adjusted by capacity utilization or modifying allocations to various demands during global disruptions. Hence, the third and fourth propositions of this study are as follows:

Proposition 3: Supply chain adaptability has a positive impact on supply chain agility.

Proposition 4: The industry type moderates the relationship between supply chain capability and supply chain agility.

Furthermore, the consideration of the industry type needs to be added to the relationship between supply chain agility with supply chain capability and supply chain data analytics. Thus, the final propositions of this study are as follows:

Proposition 5: The industry type moderates the relationship between supply chain data analytics and supply chain agility.

Proposition 6: The industry type moderates the relationship between supply chain adaptability and supply chain agility.

Based on the above literature review and propositions for this study, the following Research Model is proposed. See Figure 1.

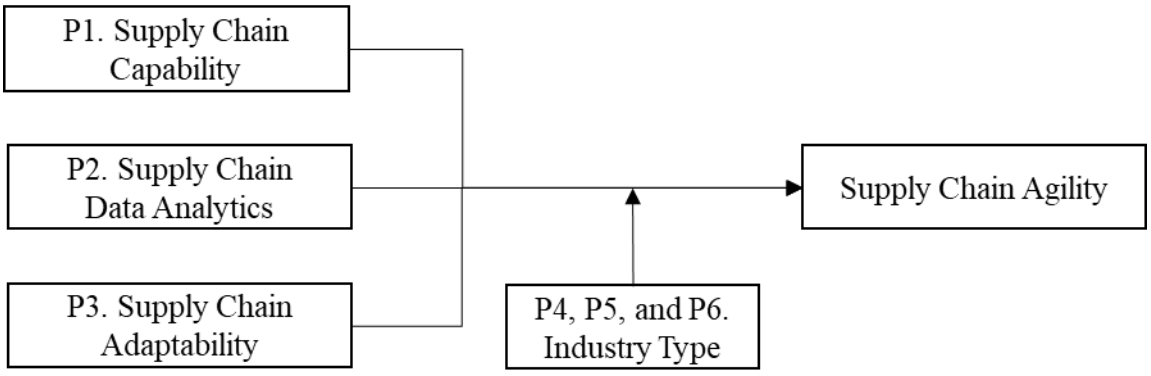

Fig. 1: Research Model

Several studies have provided fundamental measurement scales for supply chain capability (Sangari and Razmi, 2015), data analytics (Shafiq et al., 2019), adaptability (Sheel and Nath,

Vol. 7, No.09; 2023

ISSN: 2456-7760

2019), and agility (Altay et al., 2018) which can be applied to the research model presented above.

3. Managerial Implication

The propositions of this study offer significant implications for supply chain managers. In order to improve performance during disruptive times, firms should concentrate on risk management strategies which utilize intelligent information systems and data analytics solutions. The deployment of agility and adaptability of supply chain risk management can facilitate a system response that effectively addresses disruptions, strengthens mitigation capacities, and ensures supply chain continuity.

Practitioners can benefit from these propositions by developing dynamic capabilities within their organizations' supply chain, making risks more manageable, and reducing the impact of potential hazards (e.g., the COVID-19 pandemic) on the supply chain. The COVID-19 pandemic forced businesses to become more agile in their operations. The pandemic revealed major vulnerabilities in certain parts of supply chains, whereas other areas have remained largely unaffected. Companies with adequate resources and strategies have been able to maintain their supply chains in an agile manner. The level of agility in supply chains during crisis situations is largely determined by a company's management strategies. Businesses can draw from past experiences and apply the lessons learned to their current circumstances, as well as predict future disruptions. Therefore, it is important to build organizational knowledge and develop additional organizational capabilities. For example, organizations may face both supply and demand unpredictability due to a disruption. To address this scenario, managers may accumulate safety stock near marketplaces and improve distribution capabilities to offset supply unpredictability. Additionally, managers may choose the appropriate strategic measures to increase performance, based on the specific needs and circumstances of their organizations.

Other managerial applications involve the use of analytics capabilities to quickly gather and analyze various data sources, thereby resulting in faster solutions. This can assist managers in utilizing resources more effectively, adjusting production, product mix or quantity, and accurately rerouting shipments from different locations. To reduce lead times and eliminate waste, service organizations should strive to optimize their activities and improve supply chain processes via agile practices, particularly in crisis situations such as the COVID-19 pandemic. While previous studies have shown that supply chain analytics can improve overall corporate performance (Khan et al., 2022; Stylos et al., 2021), the positive impact on disruption performance has been largely overlooked.

4. Limitations and Suggestions for Future Studies

Certain limitations of this paper should be acknowledged, including the propositions approach and the lack of data collection. Nevertheless, these limitations offer possibilities for future research within various industries, in order to provide a more fully developed theorical model and the necessary measurement scales.

Researchers may wish to examine whether being agile is an individual-specific characteristic by investigating the role of unobservable managerial characteristics, such as risk aversion,

Vol. 7, No.09; 2023

ISSN: 2456-7760

managerial ability/skills, and managerial agility. Future researchers could collect primary data by interviewing experts with a historical overview of key developments and events shaping the agile field. Other research methods that could be used to investigate the agile concept include surveys, observations, and textual analyses. Further studies will help to advance the agility concept and provide a more comprehensive picture of its emergence, evolution, and impact.

In conclusion, supply agility has become a critical component of managing supply chains, especially during emergency situations such as the COVID-19 pandemic. One of the most important aspects of supply agility is the capacity to make swift decisions based on available data and resources. Decisiveness is crucial during emergencies, where time is of the essence, and quick decisions are required. The ability to make rapid decisions and implement changes is essential to achieving an agile supply chain during crises such as global pandemics, as well as in the post-pandemic era.

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