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# The Impact of COVID-19 Disruptions on Hotel Supply Chain Resilience and Robustness: The Role of Risk Alleviation Practices

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***ABSTRACT***

The COVID-19 pandemic has severely disrupted hotel supply chains and emphasized the need for more resilient and robust approaches to deal with such emerging situations. This study aims to provide an in-depth insight into the impacts of COVID-19 disruptions on the resilience and robustness of hotel supply chains in Egypt. Further, the study assesses the role of risk alleviation practices adopted by hotels in Egypt in resisting disruptions and restoring their operations. A web-based survey was directed to 112 five- and four-star hotels operating in Egypt. The study model contained six latent variables, which are: COVID-19 disruption impacts; risk alleviation practices (i.e., proactive, reactive, and recovery); resilience; and robustness. The study applied the Partial Least Squares Structural Equation Modeling (PLS-SEM) regression approach to test the model. The results indicated that hotel supply chains in Egypt were severely affected by the COVID-19 disruptions. Specifically, the results showed the direct impact of COVID-19 on the risk alleviation practices that hotels in Egypt have adopted to revive the performance of their supply chains to what they were before the epidemic. However, the results did not confirm any influence of the COVID-19 disruptions on the resilience of hotel supply chains. In addition, the results indicated that all risk alleviation practices directly influenced supply chain resilience. On the other hand, only proactive and recovery practices directly impacted the robustness of the supply chain. Overall, these findings can help hotels enhance their readiness to deal with such disruptions in the future.

## Introduction

The COVID-19 pandemic has dramatically disrupted the global supply chains (Ivanov & Dolgui, 2020). The massive expanse of this pandemic has affected international business and commerce and resulted in an estimated loss of trillions of dollars in GDP for many countries (McKibben & Fernando, 2020). In particular, the pandemic has devastatingly affected the tourism and hotel industry (Nicola *et al.*, 2020). The

number of international tourist arrivals decreased by 44 and 80% in 2020 and 2021 (ICAO, 2020). This decline has been reflected in the hotel industry, where hotel occupancy rates around the world have fallen to unprecedented levels, resulting in the mass closing of nearly 76% of hotels in Europe (OECD, 2020). For example, the occupancy rate of the Marriott Group in North America and Europe retreated to less than 25% and in China to less than 15% in March 2020. Hilton Worldwide closed 150 hotels and 33,000 rooms in 2020 (Maake, 2020). Occupancy rates in German hotels plunged sharply by 36%. The pandemic has caused a partial collapse of the hotel industry in Italy after hotel occupancy rates plummeted to 6% (Hospitalitynet, 2020). Likewise, hotel revenues declined by at least 50% (European Parliament, 2020), which caused liquidity problems for all operators due to the ambiguity prompted by the epidemic in their businesses (González-Torres *et al.,* 2021). Successive and mutating waves of COVID-19 infections are expected in the upcoming years, with enduring disruptions in international supply chains (Scala & Lindsay, 2021). Consequently, experts predict that the hotel sector might take at least six years to recover and return to prior exemplary levels (Belhadi *et al.,* 2021).

Most governments around the world have adopted strict precautionary measures to tackle the outbreak of this epidemic (Kumar & Managi, 2020). Notably, these measures have led to the imposition of tighter border restrictions that have led to the complete closure of borders, causing dramatic impacts on customer spending, purchases, and agitation in international trade and global supply chains (Belhadi *et al.,* 2021). Reports indicate that approximately 75% of international hotel supply chains experienced disruptions due to unpreparedness for such challenges. (Fernandes, 2020). Service supply chains, especially hotels, have been subjected to a deeper jolt compared to manufacturing supply chains (Mittal & Sinha, 2021). This influence is due to the sensitivity of the hotel sector and its susceptibility to any risks in the external environment, be it natural calamities, political or economic trials, global disputes, terrorism, or pandemic outbursts (González-Torres *et al.,* 2021).

Egypt was not immune to this scenario. With the consecutive increase in cases of COVID-19, global tourism rates to Egypt have fallen violently (The Egyptian Center for Economic Studies, 2020). The pandemic caused the complete closure of the tourism and hotel sectors in Egypt, which has eventually resulted in financial losses estimated at $1 billion per month (CGTN, 2020). The situation remains precarious as restrictions on travel continue across the world for an indefinite period. An additional decline in tourism receipts is expected in Egypt over the upcoming months, and this decline may continue until the end of 2021 and possibly beyond. Specifically, with the cancellation of more than 70% of hotel bookings (Egyptian Center for Economic Studies, 2020), hotels in Egypt were forced to dramatically reduce their activities or fully suspend them in some cases (Salem *et al.,* 2021). The eventual result was a sharp decline in the market value of the hotel companies' shares on the Egyptian Stock Exchange (Breisinger *et al.,* 2021).

This scenario highlights vulnerabilities and potential areas that need improvement in hotel supply chains. It also revealed the unpreparedness of hotels to deal with such severe disruptions (Veselovská, 2020). It can be argued that the COVID-19 disruptions

have put the resilience and robustness of hotel supply chains to the test (Ivanov and Dolgui, 2020). Recently, El-Baz & Ruel (2021) urged researchers to conduct further investigation to examine how supply chains cope with COVID-19 disruptions. While supply chain robustness refers to the continuity of operating as planned during disruptions (Simchi-Levi *et al.,* 2018), resilience is related to its ability to restore performance after internalizing the impacts of these disruptions (Hosseini *et al.,* 2019). Therefore, hotels need to determine the extent to which their supply chains are likely to be disrupted by the COVID-19 outbreak, including suppliers and inventory levels. While most hotels focus primarily on the immediate stabilization of their supply chains, there is an urgent need to ensure such endurance in the long term. This calls for hotels to assess how their supply chains might deploy risk alleviation practices to cope with COVID-19 disruptions (Mittal & Sinha, 2021). However, to date, there is no data-based evidence to guide hotel supply chains to assess the resilience and robustness of hotel supply chains in the context of such a disruption (COVID-19), perhaps due to the relative recentness of this phenomenon; thus, its protracted consequences are not obvious (Yoo & Managi, 2020). Given the fact that COVID-19 has severely disrupted global supply chains and affected all of their operations (Araz *et al.,* 2020; Ivanov, 2020), an in-depth study of the repercussions of the COVID-19 pandemic is of paramount importance for the hotel industry to develop strategies to deal with similar crises and risks in the future (Nakamura & Managi, 2020).

Therefore, the main objectives of this study are to gain more insight into the impacts of disruptions caused by the COVID-19 pandemic on hotel supply chains in Egypt and to assess the role of risk alleviation practices adopted by hotels in Egypt in reducing the effects of the disruptions. The insights obtained and lessons learned are expected to assist hotels in Egypt to manage such types of disruptions by addressing three key research questions:

1. Do COVID-19 disruptions influence risk alleviation practices, resilience, and robustness of hotel supply chains in Egypt?
2. Do risk alleviation practices impact the resilience and robustness of hotel supply chains in Egypt?
3. Have risk alleviation practices reduced the impacts of COVID-19 disruptions on the resilience and robustness of hotel supply chains in Egypt?

Overall, the contribution of the current study is twofold: First, the study proposed an epistemological framework for the concepts of resilience and robustness of supply chains in hotel settings. The proposed framework included a specific definition of the concepts of resilience and robustness of supply chains and their integrated phases and perspectives. Furthermore, the framework included a classification of risk alleviation practices. Second, the study empirically validated how hotel supply chains in Egypt reacted to COVID-19 disruptions.

## Theoretical framework

### Disruption impacts of COVID-19 outbreak on hotel supply chain

The impacts of disruptions caused by COVID-19 have transformed the global markets and deadened many enterprises (Ivanov, 2020). During the first wave of this epidemic in March 2020, international supply chains encountered critical predicaments due to

unexpected curtailments of certain products when simultaneous stipulations on shipping and production were imposed (Mazareanu, 2020). Several scholars discussed the impacts of the COVID-19 pandemic on the hotel supply chains (e.g., Gursoy & Chi, 2020; Qiu *et al.*, 2020; Jiang & Wen, 2020). The studies emphasized the abrupt decline in hotel revenues as a result of the attempts made by most governments in the world to control the spread of COVID-19 infections by the decisive implementation of preventive and precautionary measures, sterilization, quarantines, partial or complete border closures, and the imposition of restrictions on shipments. Without a doubt, these constraints harmed global supply chain management and had a significant multifaceted impact on hotel supply chain operations (Ivanov & Dolgui, 2020). The rationale for this lies in the fact that the hotel industry, like other industries, is primarily dependent on a network of local and global suppliers. Fernandez (2020) stated that about 75% of global supply chains were severely disrupted by COVID-19.

The situation was even bleaker in the hotel industry. In a recent Fortune (2020) survey, the COVID-19 pandemic caused disruptions to the supply chains of 94% of hotel operators. Unlike previous pandemics, the COVID-19 disruptions affected all joints (stakeholders) and points (bonds) in the supply chain (Gunessee & Subramanian, 2020). Hence, the flow of the hotel supply chain has come to a halt due to long lead times due to delays in air and sea freight services. For example, the demand for essential items such as sterilizers, aerators, and preserved and canned foods has increased (Paul & Chowdhury, 2020). Because of these multidimensional effects on supply chains, some major hotel companies, such as Marriott International, had to lay off thousands of employees as an immediate response to the crisis. The circumstances prompted some other companies, such as Hilton Worldwide, to lend $1.75 billion as a precautionary measure to maintain their market presence (Nicola *et al.*, 2020).

Several studies have evaluated the performance of hotel supply chains during this pandemic. For example, Queiroz et al. (2020) proposed that hotels should identify critical points in their supply chains and allow for sufficient slack to manage potential bottlenecks and pitfalls that might occur. This includes having a buffer stock to hedge against uncertainty. Indeed, the crisis has raised the question for hotels that follow the just-in-time inventory strategy about the robustness of this strategy during crises. The strategy has failed to contain the effects of the current pandemic on the industry (Fernandez, 2020). On the other hand, Queiroz et al. (2020) proposed a framework for managing supply chains during the COVID-19 pandemic. The proposed framework is focused on sustainability. Sustainability primarily relates to supply chain localization, consumer behavioral changes, and the enhancement of confidence in local sources of supply. In addition, they emphasized digitizing the supply chain by applying techniques such as data analytics, decision support systems, and digital cloud to improve the management of supply chain operations. Similarly, Farooq et al. (2021) stated that the lessons learned from Covid-19 lie in three main aspects. The first entails the sustainability of processes and operations. The second is the comprehensive transformation of operational processes towards digitally supported systems. The third is to raise the level of overall reliability between the ends of the supply chain.

**Supply chain resilience (SCRes) and robustness**

The concepts of resilience and robustness have been extensively discussed in the SC literature at the time of the current crisis of the COVID-19 pandemic (Rajesh, 2020). The concept of resilience stems from various disciplines such as environmental and ecological vulnerability, psychology of failure restoration, engineering, and risk management (Agarwal & Seth, 2021). The term "SCRes" relates to the ability of a supply chain to revive its normal functioning after grasping the effects of risks, threats, and vulnerabilities (Hosseini *et al.,* 2019). Resilience is looming as a theory after it emerged in materials science to describe the physical ability to revert to standard form after any deformation (Alfarsi *et al.,* 2019). Interestingly, there is no single definition of the term resilience. However, there are two common aspects in most previous attempts to define resilience. First, resilience entails severe risks or hindrances, which are then supplanted by the effort to adapt to these risks (Winwood *et al.,* 2013). Among the various definitions of SCRes, Ponomarov & Holcomb's definition stands out as the most comprehensive one. They defined SCRes as "*the ability of an adaptive supply chain to deal with, respond to and recover from unexpected events and disruptions by maintaining continuity of processes at the coveted level of interdependence and control over structure and function*" (Ponomarov & Holcomb, 2009, P. 131). Several studies were subsequently conducted to analyze the concept of resilience, the most important of which are summarized in Table 1.

**Table 1**

Definitions of supply chain resilience

| Author (s) | Definition | Perspective |
|---|---|---|
| Ponomarov & Holocomb (2009) | The preparedness for unanticipated issues, react to and retrieve from them. | Anticipatory and responsive |
| Ponis & Koronis (2012) | The possibility of returning to the original status or better in terms of accuracy and effectiveness. | Responsive |
| Fiksel et al. (2015) | The ability to persist, readjust, and progress in the face of intense change. | Responsive |
| Brandon-Jones et al. (2014), Liu et al. (2018) | Ability to recognize bottlenecks and inherent risks, which enables to employ adequate standards before SC is disconnected. | Anticipatory |
| Ali et al. (2017), Pettit et al. (2019) | Actively respond to agitations and retrieve control after unexpected episodes through a reactive strategy. | Responsive |
| Sangari & Dashtpeyma (2019) | The ability to remain responsive to unplanned deviations. | Responsive |
| Parast et al. (2019) | A defensive ability (before agitation) and rehabilitation capacity (after agitation). | Anticipatory and responsive |
| Aslam et al. (2020) | The ability to recover aftershocks. | Responsive |
| Kumar & Anbanandam (2020) | The ability to plan, react, and retrieve from sudden disruptions. | Anticipatory and responsive |

For this study, the following definition of SCRes is adopted:

> *The supply chain's readiness for unexpected risks (avoidance), responsiveness (containment), and recovery (stabilization) to return to its initial status or improve to a new state to enhance customer satisfaction, increase market share, and improve financial performance* (Hohenstein *et al.,* 2015, p. 108).

Likewise, several studies have considered supply chain robustness as a competitive advantage in an unpredictable environment (Chowdhury & Quaddus, 2016; Graveline & Gremont, 2017; Ivanov *et al.,* 2017; Hosseini *et al.,* 2019). For example, Yao & Fabbe-Costes (2018) argued that robustness assists the company to achieve a better competitive position and gain an advantage over competitors by developing its adaptability to prepare for and react to unexpected situations and disruptions and recuperate from them. Among the various definitions of the robustness concept, the one formulated by Tang (2006, p. 36) stands out as the most prominent. He defined robustness as "*a preventive strategy that will enable a firm to deal efficiently with frequent inconstancies in the business environment as well as help to sustain operational plans during major disruptions*". In simplified terms, robustness refers to the firm's proactive ability to maintain and operate its action plans under severances (El Baz & Ruel, 2021). The principal distinction between the two notions is that robustness illustrates the strength of the supply chain to deal with disruptions while maintaining operational processes as planned, while resilience describes the capability to retrieve to the original state after internalizing the effects of disruptions (Simchi-Levi *et al.,* 2018; Hosseini *et al.,* 2019).

**Risk alleviation practices**

Generally, supply chain risks can be grouped into two types: operational and severance risks. Operational risks include limited-impact disruptions that occur during conventional operating conditions such as lead times and fluctuations in demand. The severance risks (high impact) include exceptional or non-traditional events such as the outbreak of epidemics and entail the almost complete disruption of operations due to duration, extreme ambiguity, and cascading effects (El-Baz & Ruel, 2021). Scholars strived to identify practices that can improve supply chain resilience and robustness, such as risk alleviation practices (Scala & Lindsay, 2021). While some studies considered alleviation practices as proactive activities that are implemented preventively before risks and disruptions (Ponomarov & Holocomb, 2009; Brandon-Jones *et al.,* 2014; Liu *et al.,* 2018; Piprani *et al.,* 2020), other studies delineated them as reactive and/or recovery activities following disruptions for recovery (Ali *et al.,* 2017; Pettit *et al.,* 2019).

Specifically, proactive practices are built on robustness activities or prior prediction of potential risks and disruptions to "absorb shocks" and minimize the negative influences on the supply chain (Chowdhury & Quaddus, 2016). Examples of proactive practices include environmental scanning, sourcing diversification, local sourcing, automation, alternative transportation and distribution networks, increased visibility, and strategic inventory of core products (El-Baz & Ruel, 2021; Paul *et al.,* 2021).

On the other hand, reactive practices enhance the organization's ability to conform and adapt to unexpected situations and respond quickly during disruption (Petit *et al.,*

2013). Examples of reactive practices are expanding agility, collaboration with supply chain partners, and redundancy (having a buffer stock to face sudden situations) (Soni *et al.*, 2014; Torabi *et al.*, 2015; Kamalahmadi & Parast, 2016).

Recovery practices refer to the procedures that ensure the rehabilitation of the supply chain after disruptions (Sheffi, 2005; Craighead *et al.*, 2007). Examples of recovery practices include contingency planning, which can curb the negative influences of supply chain agitations (Blackhurst *et al.*, 2005), strong financial positions (Petit *et al.*, 2010), integrating shared values, standards, and trust (Johnson *et al.*, 2013). A summary of risk alleviation practices in the hotel supply chains is presented in Table 2.

**Table 2**
Risk alleviation practices in the hotel supply chains

| Dimensions | Practices | Sources |
|---|---|---|
| **Proactive practices** | | |
| Environmental scanning | Scan and evaluate situations; understand SC susceptibility; early-warning systems. | Christopher & Peck (2004); Saenz & Revilla (2014). |
| Improved perceptibility | Integrated process optimization; develop IT inclinations; measured performance; shared database and information. | Brusset & Teller (2017); Govindan et al. (2017). |
| Digital connectivity | SC interface (network) design; using digital connectivity (e.g., Internet of things, blockchain, and digital twin technology). | Ambulkar et al. (2015); Liu & Lee (2018). |
| SC risk management | Risk management awareness; risk management support; risk management procedures; risk practices (drills). | Liu et al. (2017); de Oliveira et al. (2017). |
| **Reactive practices** | | |
| Expanding flexibleness | Suppliers engagement; supply base flexibility; processes flexibility; production flexibility; pricing flexibility; transportation flexibility. | Jin et al. (2014); Manders et al. (2016). |
| Stocks redundancy | Reserve capacity; strategic safety stock. | Pettit et al. (2013) |
| Collaboration | Decision synchronization; SC intelligence; collaborative communication. | Yan & Dooley (2013); Gunasekaran et al. (2015). |
| Agility | Visibility; reactivity; acceleration. | Cabral et al. (2012). |
| **Recovery practices** | | |
| Contingency planning | emergency prerogatives, reconfiguration of resources; reconfigure SC plans, recovery, or rehabilitation plans. | Olcott & Oliver (2014); Ambulkar et al. (2015). |
| Market position | Economic strength; demand share; strategic alliances; customer interaction. | Pettit et al. (2010); Fiksel et al. (2015). |
| Building social capital | Relational norms and values; trust; inter-organizational ties. | Golgeci & Kuivalainen (2019). |
| Post disruption management | Analyzing opportunities; converting to a learning company; learning and practice; augmenting innovativeness. | Golgeci & Ponomarov (2015); Oliva et al. (2019). |

Several researchers have pointed out the relationship between risk alleviation practices and the robustness and resilience of supply chains (Chowdhury & Quaddus, 2017; El-Baz & Ruel, 2021). To enhance supply chain resilience and robustness, firms must embrace unified approaches to reduce vulnerabilities in supply chains. Firms can practice proactive activities to improve responses to inherent risks even before they occur (Azadegan *et al.,* 2013). Thus, these firms can better withstand the impacts of disruptions according to pre-prepared scenarios, resulting in a faster recovery (Ivanov & Sokolov, 2013). In general, in emerging disruptions such as the COVID-19 pandemic, the resilience of supply chains and the deployment of resources and capacities through risk alleviation practices help to deal with the effects of disruption and maintain the resilience and robustness of supply chains (El-Baz & Ruel, 2021).

## Methodology

### The study model and hypotheses development

Consistent with prior research (Brusset & Teller, 2017; Govindan *et al.*, 2017; Liu & Lee, 2018; Golgeci & Kuivalainen, 2019; Oliva *et al.,* 2019), this study grouped manifold risk alleviation practices that might affect SC resilience and robustness into three categories: proactive, reactive, and recovery. Based on this view, the proposed model for this study is shown in Figure (1).

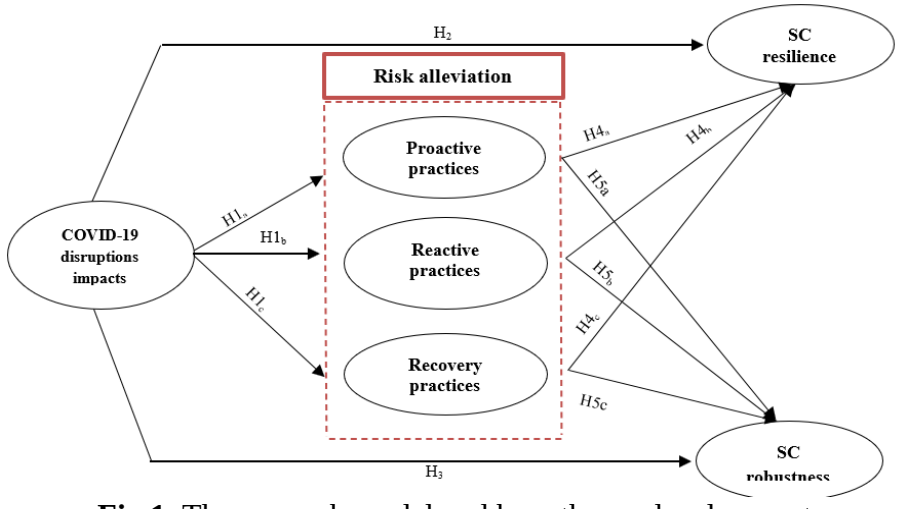


**Fig.1.** The research model and hypotheses development

Based on the foregoing review, the hypotheses for the current study can be formulated as follows:

**$H_1$.** COVID-19 disruptions directly influence SC risk alleviation practices i.e., proactive ($H_1$a), reactive ($H_1$b), and recovery ($H_1$c).

**$H_2$.** COVID-19 disruptions directly influence the resilience of the hotel SC.

**$H_3$.** COVID-19 disruptions directly influence the robustness of the hotel SC.

**$H_4$.** SC resilience is positively emphasized by proactive practices ($H_4$a), reactive practices ($H_4$b), and recovery practices ($H_4$c).

**$H_5$.** SC robustness is positively emphasized by proactive practices ($H_5$a), reactive practices ($H_5$b), and recovery practices ($H_5$c).

**The instrument and data collection methods**

The instrument was a web-based survey administered to five and four-star hotels in Egypt. This technique was ideal in light of the exceptional circumstances imposed by the COVID-19 outbreak. In the pilot phase, an email containing a hyperlink to the questionnaire was sent to a sample of five and four-star hotels located in Greater Cairo and Sharm El Sheikh. Two weeks later, 24 hotels responded, but four of them were omitted for incomplete responses. The study scales were formulated after being revised and validated in prior studies (Oliva *et al.,* 2019; Ivanov & Dolgui, 2020; El Baz & Ruel, 2021; Scala & Lindsay, 2021). In this sense, respondents were asked to identify the extent of Covid-19 disruptions impacts on their SC performance based on three predefined metrics: the overall effectiveness in managing and operating the SC, suppliers' ability to deliver on time (delivery reliability), and procurement costs. Risk-reduction practices were assessed based on three dimensions (i.e., proactive, reactive, and recovery). The proactive risk alleviation practices were evaluated by seven indicators adapted from (Govindan *et al.,* 2017; Liu & Lee, 2018). The practices included environmental scanning, early warning systems, information technology applications, performance measurements, databases, and shared information, the use of digital technology, and risk management practices. Drawing on prior studies (Jin *et al.,* 2014; Manders *et al.,* 2016), reactive practices were measured based on six indicators related to SC flexibility, suppliers' engagement, the analysis of risks' impacts, stock redundancy, collaboration, and the evaluation of SC agility. Recovery practices were composed of seven items that measured the respondents' recovery strategies, including recovery plans, strategic alliances, relational ties, analyzing opportunities, converting to a learning company, and augmenting innovativeness. SC resilience was assessed using four constructs that measured the ability of the hotel SC to manage sudden disruptions, easily handle production problems, quickly respond to changes, and overcome delays. SC robustness was assessed using four constructs to measure the ability of the SC to retain the same enduring status following a system failure. All indicators were rated on a five-point Likert scale, ranging from (1) strongly disagree to (5) strongly agree. The second part of the survey identified the profile of the respondents' hotels.

**Population and sampling procedures**

The target population for this study included five- and four-star hotels operated in ten major tourist regions: Cairo, Giza, Alexandria, El Alamein, Sharm El Sheikh, El Gouna, Marsa Alam, Dahab, Hurghada, and Ras Sidr during 2019/2020. These areas were chosen because they have a high concentration of four-and five-star hotels in Egypt. An online survey was directed to 171 four-star hotels and 106 five-star hotels listed in the Egyptian Hotel Guide for the year 2020. The survey targeted the decision-makers in the investigated hotels. An electronic invitation was sent to these hotels with a clarification of the purpose of the study, a description of the terms used, and a commitment to the confidentiality of responses. A weekly email was sent to these hotels for follow-up. From September 1 to December 31, 2021, 112 complete responses were obtained from 72 four-star hotels and 40 five-star hotels.

**Data processing and analysis**

The study model has been tested using the Partial Least Squares Structural Equation Modeling (PLS-SEM) regression approach. This approach was employed because it aims to determine the extent to which a complex theoretical model, as in the case of the current study, matches the field data. The PLS-SEM represents interpretations of a series of deemed cause and effect relationships between variables. PLS-SEM tests the validity of the model through a set of statistical methods, in particular, path analysis, regression analysis, and confirmatory factor analysis. For analysis, WarpPLS version 7.0 was applied (Hair *et al.*, 2020; Kock, 2020).

**Results**

Using the approach of Werner et al. (2007), the study attempted to determine the statistical differences between five-star and four-star hotels and found no significant differences in terms of the number of hotel suppliers, annual revenue, and property ownership ($t$ = 0.740; p = 0.423; $t$ = 0.754; p = 0.368; and $t$ = 0.123; p = 0.843, respectively). Thus, non-response bias is not a predicament for this study. The demographic profile of the respondents is presented in Table (3).

**Table 3**

Demographic profile of the respondents (N = 112)

| ***Attribute*** | Five-star hotels ($n$= 40) | | Four-star hotels ($n$ = 72) | |
|---|---|---|---|---|
| | **Freq.** | **%** | **Freq.** | **%** |
| **Form of property ownership** | | | | |
| Chain/group affiliation | 26 | 65 | 38 | 53 |
| Independently owned/operated | 8 | 20 | 20 | 28 |
| privately owned/leased operation | 6 | 15 | 14 | 19 |
| **Annual revenue (NT) last year (EGP Million)** | | | | |
| Less than 100 million | 0 | 0 | 5 | 7 |
| From 100 to less than 300 million | 10 | 25 | 42 | 58 |
| More than 300 million | 30 | 75 | 25 | 35 |
| **The number of hotel suppliers** | | | | |
| < 20 suppliers | 0 | 0 | 22 | 30 |
| From 20 to 50 suppliers | 14 | 35 | 35 | 49 |
| > 50 suppliers | 26 | 65 | 15 | 21 |

**Structural model assessment**

The item loadings and the composite reliabilities (CR) were examined to measure the internal consistency in the study model, using the alpha coefficient (Cronbach's alpha). In addition, the average extracted variance (AVE) and discriminative validity tests were included to assess study attributes (Table 4).

**Table 4**
Item loadings, Cronbach's Alpha, Composite Reliability, and AVE

| *Construct/Item* | *Item Loadings* | α | *CR* | *AVE* |
|---|---|---|---|---|
| **SC Disruption Impacts (SCDI):** | | | | |
| $SCDI_1$: The overall effectiveness of SC operations | 0.905 | 0.970 | 0.883 | 0.701 |
| $SCDI_2$: Supplier's ability to deliver (delivery reliability) | 0.802 | | | |
| $ScDI_3$: Purchasing costs | 0.750 | | | |
| **Proactive practices (PRP)** | | | | |
| $PRP_1$: Scrutinizing historical situations | 0.872 | 0.818 | 0.981 | 0.835 |
| $PRP_2$: Scanning the environment to identify possible threats | 0.926 | | | |
| $PRP_3$: Tracking and evaluating the urgency of SC risks | 0.899 | | | |
| $PRP_4$: Analyzing the possible impact of SC risks | 0.907 | | | |
| $PRP_5$: Using the early warning system | 0.930 | | | |
| $PRP_6$: Using risk mapping and simulation models | 0.818 | | | |
| $PRP_7$: Creating trust and long-term relationships | 0.774 | | | |
| **Reactive practices (REP)** | | | | |
| $REP_1$: Demonstrating possible flexible reactive strategies | 0.814 | 0.763 | 0.869 | 0.846 |
| $REP_2$: Having strategic safety stock | 0.902 | | | |
| $REP_3$: Risk management collaboration with suppliers | 0.916 | | | |
| $REP_4$: Having multiple suppliers | 0.816 | | | |
| $REP_5$: Removing intervening stocks | 0.804 | | | |
| $REP_6$: Reducing non-value adding activities | 0.683 | | | |
| **Recovery practices (RP)** | | | | |
| $RP_1$: Prompt recovering from disruption effects | 0.744 | 0.769 | 0.975 | 0.792 |
| RP2: Absorbing the massive upheaval | 0.823 | | | |
| $RP_3$: Reducing the impact of losses by managing risks | 0.809 | | | |
| $RP_4$: Recovering from the turmoil with minimal costs | 0.727 | | | |
| $RP_5$: Interpreting what ran well in the reactive management | 0.836 | | | |
| $RP_6$: Analyzing practices that could have been done better | 0.944 | | | |
| $RP_7$: Incorporating analysis into future risk management | 0.892 | | | |
| **SC Resilience (Resil)** | | | | |
| $Resil_1$: Ability to manage sudden SC disruption | 0.843 | 0.711 | 0.965 | 0.786 |
| $Resil_2$: Ability to handle production problems easily | 0.826 | | | |
| $Resil_3$: Ability to respond to changes quickly | 0.743 | | | |
| $Resil_4$: Ability to overcome material delays | 0.826 | | | |
| **SC Robustness (Robust)** | | | | |
| $Robust_1$: Retaining same enduring status following a failure | 0.787 | 0.801 | 0.908 | 0.785 |
| $Robust_2$: SC granting time to find a reasonable reaction | 0.636 | | | |
| $Robust_3$: SC works well over likely extensive situations | 0.711 | | | |
| $Robust_4$: SC conveys its ends despite unusual destruction | 0.871 | | | |

The *Cronbach's alphas* and composite reliability (CR) demonstrated a high degree of internal consistency for the entirety of the traits (Aichouni *et al.*, 2014). The CR and *Cronbach's alpha* values exceeded the accepted threshold of 0.60 (Hair *et al.*, 2020). Further, the average variance extracted of all items exceeded the minimum

0.5 thresholds for convergent validity (Hair *et al.*, 2020). In addition, the discriminant validity was checked by the Fornel-Lacker criterion (Hamid & Sami, 2017). Table (5) shows that the square root of AVE for each construct is higher than the correlation with other latent variables, and this indicates satisfactory convergence and discriminant validity for all constructs in the model.

**Table 5**

The square root of **AVE** for each construct

| | ***SCDI*** | ***PRP*** | ***REP*** | ***RP*** | ***Resil*** | ***Robust*** |
|---|---|---|---|---|---|---|
| ***SCDI*** | **(0.701)** | | | | | |
| ***PRP*** | 0.607 | **(0.835)** | | | | |
| ***REP*** | 0.712 | 0.716 | **(0.846)** | | | |
| ***RP*** | 0.764 | 0.688 | 0.711 | **(0.792)** | | |
| ***Resil*** | 0.653 | 0.740 | 0.608 | 0.754 | **(0.786)** | |
| ***Robust*** | 0.741 | 0.732 | 0.665 | 0.672 | 0.715 | **(0.785)** |

**Model analysis and hypotheses testing**

From the previous results, it is clear that the construction of the study model is reliable and valid. The next step in PLS-SEM is to assess the structural model using the path coefficients (β), the p values, $R^2$, and Stone-Geisser's $Q^2$ values. Before embarking on this assessment, it was important to examine the collinearity level in the constructivist model because the coefficients of the independent variables may be biased due to the presence of a high level of collinearity among the expected latent variables, so there is a need to examine this relationship. According to the PLS-SEM method, the collinearity problem arises when the tolerance values are 0.20 or less and the variance inflation (VIF) values are 5 or higher (Hair *et al.*, 2021). Table (6) indicates that there are no collinearity problems, as the tolerance values are above the threshold of 0.2, while all the VIF values are below the permissible threshold limit of 5.

**Table 6**

Assessment of collinearity

| Latent variables | Supply chain resilience | | | Latent variables | Supply chain robustness | |
|---|---|---|---|---|---|---|
| | *Tolerance* | *VIF* | | | *Tolerance* | *VIF* |
| ***SCDI*** | 0.629 | 1.588 | | ***SCDI*** | 0.632 | 1.582 |
| ***PRP*** | 0.316 | 3.158 | | ***PRP*** | 0.390 | 2.556 |
| ***REP*** | 0.235 | 4.243 | | ***REP*** | 0.335 | 2.983 |
| ***RP*** | 0.227 | 1.987 | | ***RP*** | 0.346 | 1.865 |

**Direct relationship results**

The study measured the direct relationship between variables using (β) coefficients. Accordingly, the recommended values for measuring the strength of the association between variables are 0.02, 0.15, and 0.35 (i.e., little, medium, or significant, respectively) (Kock, 2020).The results in Figure (2) show a significant direct relationship between COVID-19 disruptions impacts and proactive practices, recovery practices, and SC robustness with $\beta = 0.35$, $\beta = 0.37$ and $\beta = 0.46$ respectively.

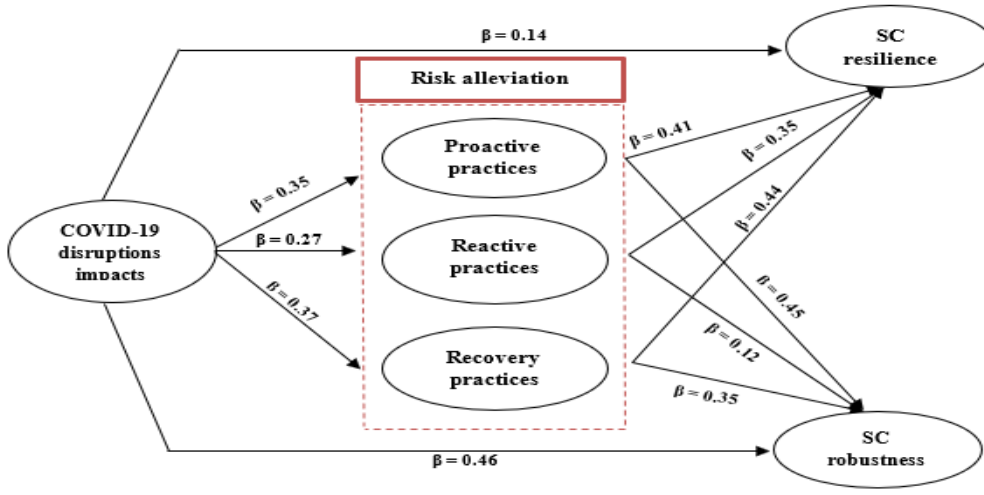


**Fig.2**. Hypotheses results and beta coefficients

Therefore, $H1_a$, $H1_c$, and H3 are accepted. $H1_b$ is also accepted, although disruption impacts had a lower impact on reactive practices (β = 0.27). These results show the direct impact of the disruptions caused by the Coronavirus on the risk alleviation practices that hotels in Egypt have adopted to revive the performance of their supply chains to what they were before the epidemic. On the other hand, there was no significant impact of disruptions on the resilience of hotel supply chains in Egypt (β = 0.14). Thus, H2 was rejected. The findings also show that all risk mitigation practices have a significant impact on supply chain resilience (β = 0.41, β = 0.35, and β = 0.44, respectively), indicating that $H4_a$, $H4_b$, and $H4_c$ were supported. Proactive and recovery practices had a direct influence on supply chain robustness (β = 0.45 and β = 0.35, respectively), so $H5_a$ and $H5_c$ were supported. Thus, $H5_b$ was rejected.

**Indirect relationship (mediation) results**

On the other hand, this study adopted the approach of (El-Baz & Ruel, 2021) to characterize the indirect relationships (mediation) between the study variables (Table 7). According to this approach, three types of mediation can be distinguished: (1) integrative mediation indicating that direct and indirect effects are complementary to each other and of equal significance and direction; (2) competitive mediation signifying that direct and indirect influences are of equal significance but are in opposing directions; (3) indirect mediation: in which the indirect influence is more important than the direct influence.

**Table 7**

The mediation relationships between constructs

| **Constructs** | **$R^2$** | **$Q^{2*}$** |
|---|---|---|
| COVID-19 disruptions impacts | - | - |
| Proactive risk alleviation practices | 0.37 | 0.30 |
| Reactive risk alleviation practices | 0.35 | 0.42 |
| *Recovery* risk alleviation practices | 0.55 | 0.46 |
| SC resilience | 0.35 | 0.19 |
| SC robustness | 0.22 | 0.12 |

**values higher than zero is sufficient to accept the model's predictive validity (Kock, 2020)*

The results revealed an indirect relationship between the impacts of COVID-19 disruptions and proactive risk alleviation practices (integrative mediation) and supply chain resilience (indirect mediation). Likewise, the results showed an indirect relationship between risk alleviation practices and supply chain resilience (integrative mediation) and supply chain robustness (integrative indirect mediation).

**Discussion and implications**

The repercussions of the COVID-19 have subjected global supply chains to the maximum test. After being a source of competitive advantage for many businesses, including hotels, the global shock from the COVID-19 epidemic has revealed the fragility of global supply chains. Therefore, this study attempted to explore the impact of the COVID-19 pandemic on the resilience and robustness of hotel SC in Egypt. The study also attempted to shed light on the role of risk alleviation practices that hotels in Egypt have adopted in absorbing disruptions and maintaining the resilience and robustness of supply chains. The results indicated that COVID-19 had a direct impact on the risk alleviation practices pursued by hotels in Egypt, in particular on proactive and recovery measures. This may be due to the unexpected spread of the scope of disruptions at the global scale in a way that hotels were not able to predict in advance. In addition, the magnitude of impact is expanding and will most likely continue to affect the hotel supply chain in the future.

The results also indicated that the effects of the COVID-19 disruption have mainly impacted the robustness of the supply chain, which means developing a negative short-term impact. Surprisingly, the resilience of SC was not been affected by the same disruptions. The explanation for this may lie in hotels' confidence in their ability to sustain SC operations and recover after disruptions. To explain this difference in the context of Covid-19, it can be argued that the resilience and robustness of hotel SC primarily depend on disparate combinations of resources. These resources include physical, human, and organizational capital resources (El-Baz & Ruel, 2021). In the context of severe disruptions such as COVID-19, hotels must adequately realign their limited resources by reconfiguring and rearranging them according to the exigency scenario. Reconfiguring these resources can enhance the enforcement and effectiveness of supply chains in challenging scenarios (Queiroz *et al.*, 2021). As stipulated by Ivanov (2020) and Ivanov & Dolgui (2020), the robustness of hotel SC can be enhanced without fundamental adjustments or processes, while resilience requires specific adjustments.

The findings concluded that risk alleviation practices have a direct impact on supply chain resilience, which supports the findings of DuHadway et al. (2019) on recovery practices required to enhance SC resilience. On the other hand, only proactive risk alleviation and recovery practices have a direct impact on the robustness of the SC. These results differ from previous literature on risk mitigation practices (Kern *et al.*, 2012; Wieland & Wallenburg, 2012; Ambulkar *et al.*, 2015). Accordingly, hotels should improve risk alleviation practices by continuously developing their data and information processing capabilities. Disruptions, in general, pose a challenge to supply chains due to uncertainty and ambiguity resulting from the amount of

information that needs to be processed and interpreted (Wu *et al.*, 2013). Thus, real-time information processing is one of the cornerstones for developing risk alleviation practices (DuHadway *et al.*, 2019). In this optic, hotels should direct more investment in data modeling simulations to prepare for all scenarios. The more hotels improve their ability to process data and information (i.e., improve quality and flow), the more they can deal with future risks (Wu *et al.*, 2013). The findings confirm that hotels that strategically invest in digital transformation and automation can effectively monitor their SC and collect and analyze data in real-time (Queiroz *et al.*, 2021). This is consistent with the findings of Sinha et al. (2020), who stated that integrating digital technology can make SC more integrated, regulated, and transparent. In the same vein, the results of the study conducted by Remko (2020) concluded that advanced technologies enable advanced levels of perceptibility to predict future risks. Accordingly, hotels should focus on building supply chain resilience by incorporating digital technologies such as blockchain, artificial intelligence, big data analytics, IoT, cloud services, and robotics can help in enhancing their ability to manage risks and disruptions.

One of the intriguing findings of this study is that scanning the environment to identify possible threats and using the early warning system are effective prevention practices. This can be explained by the fact that early detection may be the best way to achieve protection against potential risks. Hotels need to accurately anticipate risks and then formulate appropriate measures to ensure the flow of their supply chains. Undoubtedly, the pace of the hotel's response to the challenges facing supply chains is as significant as having the capabilities to mitigate the impact of these challenges, especially with the complexity of today's business environment. However, the COVID-19 pandemic has provided compelling evidence that some crises cannot be predicted or avoided. If the disruption does occur, hotels must realize that the effectiveness of their alleviation and reactive efforts are mainly dependent on having risk management collaboration with suppliers. Effective risk handling requires a long-term collaborative relationship to restructure the SC whenever needed. Accordingly, hotels should focus on some practices such as joint planning, real-time information exchange, and synchronizing to enhance the collaborative relationships with their partners to mitigate any anticipated risks. Therefore, the more hotels engage in collaborative activities with SC partners, the higher the levels to anticipate potential risk sources, which ultimately leads to a more resilient SC. Hotels should note that resilient employees represent the starting point to reach mutual collaboration with suppliers because it is the activities and synergies among the organization's employees that foster the emergence of the company's resilience. The rationale for this is that employees who are trained and qualified with the requisite abilities know when it is relevant to act toward supporting efforts to maintain the resiliency of the supply chain during a disruption (Durach *et al.*, 2018).

**Practical implications**

The findings of this study may encourage Egyptian hotels to virtually adopt risk mitigation practices or, at the very least, develop existing ones, due to the expected benefits on the resilience and robustness of supply chains. The findings guide hotels

regarding the typical conditions for risk alleviation practices to enhance their outcomes. In this sense, the priority of hotels should be to constantly update their risk identification measures as they influence other risk mitigation practices. Keeping in mind the expected technological and economic transformations after COVID-19, hotels should move towards developing their risk mitigation practices in order to improve the resilience and robustness of their supply chains. It is more imperative for hotels in Egypt to make more direct and indirect investments towards automation systems and data exchange, such as in the Internet of Things (IoT) and cloud computing, which can contribute to mitigating future risks by taking important long-term roles in response to future COVID-19 mutations. It is more imperative for hotels in Egypt to make more direct and indirect investments towards automation systems and data exchange, such as in the Internet of Things (IoT), blockchain, and cloud computing, which can contribute to mitigating future risks by taking important long-term roles in response to future COVID-19 mutations. This digital technology can help hotels in Egypt respond quickly to crises as supply chain management needs accurate and timely data during and after crises.

However, it must be noted that not all hotels have the resources and capabilities to do so. Thus, the current crisis raises the question of the feasibility of relying on local supply systems instead of global ones. The crisis has proven, with conclusive evidence, that the resilience and robustness of local systems outweigh global systems in the light of global crises (Nandi *et al.,* 2021). Indeed, risk mitigation practices are frequently regarded as an effective tool when dealing with repeated and low-impact events (El Baz & Ruel, 2021), but they may not be as effective when dealing with impulsive events such as epidemic outbreaks. The disruptions caused by the COVID-19 virus highlighted the need for collaboration among all parts of the supply chain in sharing data, resources, and capabilities. Accordingly, hotels in Egypt must prepare for what may unfold.

**Limitations and further research directions**

The current study has several limitations that pave the way for further research in the future. First, the study sample was limited to the supply chains of four and five-star hotels in Egypt. Future studies may combine other hotel categories. Second, the current study's data were gathered through an online survey conducted over a specific time. Thus, conducting structured surveys at different times may provide insight into the development of the resilience and robustness of supply chains. Third, due to the recentness of the subject of this study, there is a limitation in the available literature to compare the results in a more in-depth manner. Future research might investigate the effects of resilience and robustness on the operational and financial performance of hotel supply chains.

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# أثر اِضْطرابات فيْروس كُورونَا المسْتجدّ على مُرونة وقوَّة سلاسل التَّوْريد الفنْدقيَّة: دوْر مُمارسات التَّخْفيف مِن المخاطر

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**معلومات المقالة**

**الكلمات المفتاحية**
اِضْطرابات كُوفيد 19؛ مُرونة سلسة التَّوْريد؛ قُوَّة سلسة التَّوْريد؛ مُمارسات التَّخْفيف مِن المخاطر؛ الفنادق؛ مِصْر.

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**المجلد 22، العدد 1، (يونيو 2022)، ص 132-152.**

**الملخص**

كشفتْ جائحة كُورونَا عن العدِيد مِن الإشْكاليَّات فِي سلاسل التَّوْريد العالميَّة ومن ضِمْنهَا سلاسل التَّوْريد الفنْدقيَّة. لِذلك حظيتْ مفاهِيم مِثْل مُرونة وقوَّة سلاسل التَّوْريد بِاهْتمام مُتزايد، نظرًا لِأهمِّيَّتهمَا فِي اِسْتعادة أداء سلاسل التَّوْريد بعْد الاضْطرابات الَّتي صاحبتْ تفشِّي الوبَاء. بِناء على ذلك، تهْدف هذه الدِّراسة إِلى تَوفِير نظْرة مُتعمِّقة حوْل تَأثِير اِضْطرابات فيْروس كُورونَا المسْتجدّ على مُرونة وقوَّة سلاسل التَّوْريد الفنْدقيَّة فِي مِصْر. عِلاوة على ذلك، تهْدف الدِّراسة إِلى تَقِيم دوْر مُمارسات التَّخْفيف مِن المخاطر (الإجْراءات الاسْتباقيَّة، الإجْراءات التَّفاعليَّة، إِجْراءات التَّعافي) الَّتي تبنَّتْهَا الفنادق فِي مِصْر خِلال الأزْمة فِي التَّخْفيف مِن تداعيات هذه الاضْطرابات. ولتحْقيق أَهدَاف الدِّراسة، تمَّ تَوجِيه اِسْتبْيان عبْر الإنْترْنت لِعدد 112 فُنْدقًا مِن فِئة الخمْس والْأرْبع نُجوم فِي مِصْر. اِعتمَد نموذج الدِّراسة على سِتّ مُتغيِّرات رئِيسِيَّة هِي: تأْثيرات اِضْطرابات فيْروس كُورونَا المسْتجدّ وممارسات التَّخْفيف مِن المخاطر ومرونة سِلْسلة التَّوْريد وقوَّة سِلْسلة التَّوْريد. تمَّ اِختِبار النَّموذج بِاسْتخْدام نهْج الانْحدار لِنمْذَجة المعادلات الهيْكليَّة لِلْمربَّعات الصُّغْرى. أشارتْ النَّتائج إِلى التَّأْثير المباشر لِلاضْطرابات الَّتي سبَّبهَا فيْروس كُورونَا على مُمارسات التَّخْفيف مِن المخاطر الَّتي اِنْتهجتْهَا الفنادق فِي مِصْر لِاسْتعادة أداء سلاسل التَّوْريد الخاصَّة بِهَا إِلى مَا كانتْ عليْه قبْل الوبَاء. مِن ناحية أُخْرى، لَم يُلاحظ أيُّ تَأثِير مُباشر لِلاضْطرابات على مُرونة سلاسل التَّوْريد الفنْدقيَّة. أَظهَرت النَّتائج أيْضًا أنَّ جميع مُمارسات التَّخْفيف مِن المخاطر كان لَهَا تَأثِير مُباشر على مُرونة سِلْسلة التَّوْريد. أمَّا قُوَّة سِلْسلة التَّوْريد، فقد أثَّر عليْهَا الممارسات الاسْتباقيَّة والتَّعافي تَأثِير مُباشر. بِشكْل عامّ، مِن المتوقَّع أن تُساعد هذه الدِّراسة الفنادق فِي مِصْر على تَطوِير مُرونة وقوَّة سلاسل التَّوْريد الخاصَّة بِهم لِلتَّعامل مع مِثْل هذه السِّينارْيوهات فِي المسْتقْبل.