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Assessment of the Impact of Supply Chain Risk Factors on Supply Chain Performance

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***Abstract*—** Exposure to significant supply chain risks results in a decline in the performance of a firm's supply network. The goal of this research is to determine the impact levels of six different types of supply chain risk factors on the performance of the supply network of hotels within the Ghanaian hospitality sector. Additionally, the article discusses the moderating effects of supply chain risk management strategies on the impacts of supply chain risks on supply chain performance. The Partial Least Squares-Structural Equation Modeling (PLS-SEM) approach was used to analyze empirical data collected through a cross-sectional survey of a purposive sample of hotels within the Ghanaian hospitality sector. Overall, **t**his study demonstrated a statistically significant negative correlation between supply chain risk and performance. Specifically, various types of supply chain risks have varying degrees of impact on supply chain performance. Although some have negative impacts, others have positive impacts due to contextual influences. The most critical risks in the sample investigated were operations and information risks. Additionally, the implementation of supply chain risk management strategies has the potential to moderate the effects of supply chain risks on performance. Few studies have examined the impact **o**f supply chain risks on the performance of supply networks, and the results from various study contexts are equivocal. This article gives practitioners, scholars, and researchers empirical information about the most severe risk variables that hurt the performance of a firm's supply chain, especially in the case of hotels in African emerging economies.

Keywords— Hospitality, Supply Chain Risks, Supply Chain Performance, Supply Chain Risk Management

I. INTRODUCTION

Managing a supply chain (SC) is becoming increasingly challenging due to the existence of different kinds of risks, which have the potential to disrupt SC activities and create significant losses to the performance of firms within the network [1],[2],[3]. Globalization and various efforts to make SCs efficient and leaner in a stable environment have led to the introduction of initiatives such as outsourcing, just-in-time, etc., all of which have increased the vulnerability of SCs to risk events [4]. Also, the fact that SCs are multidimensional makes it more likely that risks will have a big effect because the interdependence of firms means that a risk event in one member of the network will affect all the other members of the network [5].

This is particularly true for hospitability SCs, which are characterized by strong service-driven interconnectedness and high dependence on external factors, evolving increasingly in globalized markets. Notably, the cyclical nature of activities in the hotel sector tends to increase its susceptibility to risks associated with changes in business conditions, economic downturns, and health crises, among others [6]. Currently, the hospitality industry players, particularly hotels, are still grappling with the devastating effects of the COVID-19 pandemic, which has created a temporary shutdown of hotels and tourist sites, sharp losses in performance, and significant market losses [7],[8].

As a result of the increasing exposure and vulnerability to risk events, supply chain risk management (SCRM) has become an important part of supply chain management (SCM) to maintain the SC network's long-term existence and continuity [9],[10],[11]. So, both practitioners and academics have done a lot of research on SCRM to deal with supply chain risks (SCRs) by figuring out how likely it is that risk events will happen and how they will affect performance when a risk does happen.

Despite the extent of inquiry, it is noted that empirical research on SCRM is still limited [12], particularly regarding the extent of the impacts of risk incidents on performance. The literature is replete with conceptual studies that have focused on describing and classifying supply chain risks (SCRs) [9],[11],[13],[14], as well as discussing SCRM strategies and procedures [4],[15],[16].

Even though this line of research tells us a lot about the sources, drivers, effects, and management strategies of SCRs, very few empirical studies have looked at how the

levels of different types of SCRs affect the performance of the SC as part of SCRM. This is needed to determine the relevant risk factors that can negatively affect the performance of the SC so that the right strategies can be adopted to deal with them.

Previous studies have found that SCRs generally harm the performance of SCs. While anecdotal evidence has shown that SCRs, particularly catastrophic risks such as earthquakes and terrorist attacks, have substantial negative impacts on SC performance [17],[18],[19], empirical evidence has produced mixed and inconsistent results. Some studies have reported that SCRs have considerable effects on SC performance, while others have found marginal levels of impact. The different situations in which the studies were conducted could be a possible explanation for the different results. This shows that study results are only true for the specific research context and may be misleading when applied to other situations.

The impact of SCRs on SC performance might be dependent on prevailing environmental conditions [20]. Thus, the notion of risk, its sources, and impact levels may differ for each context, suggesting that the study context is an important factor in assessing the impacts of SCRs on SC performance. Reference [21] argued that the uniqueness of the SC affects the relevant risks it may face and the risk management responses that can be employed. So, a risk that is important in one SC context might not be important in another, depending on the source of the risk events and how dire their impacts are on the SC.

It is noted that most of the earlier survey-based empirical studies on SCRs were conducted in developed countries. Similar research is sparse in less developed countries. Furthermore, previous studies have either used data from manufacturing industries or lumped different industries together [2]. Furthermore, the present evidence contends that SCRM strategies aid in reducing the frequency and level of the negative repercussions of SCRs. However, reference [20] noted that the existing literature does not adequately analyze the effect of SCRM strategies on the link between SCRs and SC performance. Past empirical studies have either analyzed the impact of risk mitigation strategies on performance [22],[23] or used it as a control variable in their analysis [20].

Aside from the conflicting results outlined above, it should be emphasized that past research has primarily focused on the manufacturing industry in industrialized countries [23]. Moreover, there was no direct measurement of the impact of risks on SC performance in these studies, so there is a dearth of studies on the effects of SCRs on performance, especially in the case of a hospitality SC. This paper's contribution is to explore various SCR factors affecting the hospitality industry, with a focus on hotels in Ghana, and analyze how these risks affect their SC performance using empirical data. SCRM strategies are also evaluated for their moderating effects in this study.

The rest of the paper is organized as follows: Section I contains the introduction of the study, including the rationale and the context or background of the study; Section II contains a review of previous work on the impact of supply chain risk as well as the conceptual research model and hypothesized relationships; Section III explains the research methodology, including the measures for the variables studied and statistical analysis procedure used to carry out the research; Section IV contains the results of the research analysis and discussion of important findings; Section V concludes the research work with recommendations for practitioners as well as the limitations and future research directions.

Study Context

This study was carried out using data from hotels operating within the Ghanaian hospitality industry. As previously stated, there is a dearth of studies on the effects of SCRs on the supply chain performance of the hospitality sector in developing nations like Ghana. Ghana's economy has shifted from being driven largely by agriculture to being driven by services. According to the Ghana Statistical Service (GSS), the service sector contributed roughly 50.6 percent of the country's GDP in 2013, and it has remained the leading sector in terms of contribution since then. Given the apparent political stability and the accompanying attractiveness of foreign investors, the hospitality business in Ghana is garnering a lot of interest in the increasingly global environment [25]. This has resulted in significant growth over the last decade, particularly in the hotel and restaurant segments, which have seen rising demand and increased consumer spending. The effect of this growth is evident through the overall number of jobs created, both directly and indirectly, and the contribution to the national GDP. Although the hospitality industry plays a key role in Ghana through the creation of income and further contributions to economic growth, it is not highly considered in the present SCRM literature. Few studies have been conducted on SCRM in Ghana, and these are limited to the agricultural sector [26], [27].

Risk management is a critical component for hospitality industry players to develop resilience to maintain business competitiveness and long-term success [28]. The quality of service delivery is a discriminating factor in the hospitality industry. Therefore, the quality of service can be a critical competitive strategy, particularly in a developing country such as Ghana [25]. It is therefore important for the hospitality industry to take cognizance of all potential risks inherent in the business and assess their impacts to effectively manage them to ensure their continuity. Reference [16] stresses that to reduce any adverse effects, it is key for organizations to discover all relevant risks along the supply chain and its sources to enhance visibility and develop proactive management risk strategies. Firms that are unaware of the risk factors that may adversely affect SC operations may be greatly impacted when such unidentified risks materialize [11]. This study attempts to analyze different types of risks and their impacts on SC

performance, focusing on hotels in the Ghanaian context to broaden the theory of SCRM and provide an avenue to facilitate a better understanding of how different SCR factors impact SC performance within such a business context. This can facilitate risk management and support the evolution and growth of the industry.

II. RELATED WORK AND HYPOTHESES DEVELOPMENT

A. *Supply Chain Risk*

The concept of risk has been the subject of many studies across different disciplines and has been given a variety of definitions [21]. Risk is defined as the probability that a negative event will occur and the severity of the event's impact. Some researchers have argued that risks may be associated with different outcomes (either positive or negative), each with differing probabilities of occurrence. Risk in SCM refers to the potential and impact of unanticipated occurrences that negatively impact any segment of the supply chain [5]. Thus, SCRs are usually associated with negative outcomes concerning performance [29]. There are an almost endless number of variables that could have a major impact on the SC's risk profile [21].

Effective SCRM that includes identification, assessment, application of risk response strategies, and monitoring of risks, is necessary to reduce vulnerability and ensure continuity of the SC [16],[30]. The identification and assessment of relevant SCRs are critical for the overall preparedness of the SC in response to risk events [31]. Assessment of identified risks may be done quantitatively by evaluating the sources of the risks, their likelihood of occurrence, and potential impacts on the SC's performance [14],[16] to prioritize them and provide a basis for decisions regarding effective response strategies [3].

B. *Measuring Supply Chain Performance*

The performance of the SC is typically measured by assessing the SC's effectiveness and efficiency by utilizing both tangible and intangible elements [32]. SC performance is a multi-complex construct and choosing the right performance measures for a particular SC can be difficult. Hence, there have been several attempts to organize and classify the SC performance measures and metrics [33], resulting in numerous frameworks and models for measuring SC performance [34]. The Supply Chain Operations and Reference (SCOR) model, designed by the Supply Chain Council [35], is one such performance model that has grown in popularity. The model identifies five key criteria for gauging supply chain performance: reliability, responsiveness, flexibility, cost, and asset management aspects [36]. The SCOR model is used in this study to create indicators to quantify SC performance.

C. *The Conceptual Framework and Hypotheses*

The conceptual framework draws on SCR and SCRM literature as well as contingency theory. From a theoretical standpoint, SCRs are thought to have a negative impact on the SC's performance, resulting in several vulnerabilities and business continuity issues [2]. Individual SCR elements' impacts on SC performance may be altered by certain contextual variables present in the SC setting, according to contingency theory. The contingency theory explains that the complexity of the prevailing contextual situation should inform organizational decision-making [37]. According to the contingency theory, it is posited that efforts to manage a specific risk would be contingent on the perceived level of impact of that risk within the SC environment. Due to the uniqueness of the SC environment, the level of the impact of various risk variables will vary. It suggests that not all supply networks are subject to the same risk factors nor suffer the same effects when these events occur [15]. According to reference [24], the scope of a specific SC and the features of its major product will determine the sources of risks and vulnerability to risk occurrences. The context of this study is specifically hotels within the hospitality industry. While hospitality supply networks may resemble other service-based supply chains, the cyclical nature of the industry may increase their exposure and vulnerability to specific risk factors. A report by reference [6] indicates that beyond the traditional insurable risks, firms in the hospitality industry are faced with a myriad of potential operational, informational, and reputational risks.

Given the multidimensional nature of the SC and the wide variety of risk sources, researchers have proposed various typologies and classifications of risk factors to aid practitioners in the identification of SCRs [11]. The classifications are often determined by the risk sources, which are the specific factors originating from within the organization, external environment, or structure of the SC. The present study adapted the classification of SCRs by [38] and assessed the impacts of six dimensions of SCR sources. The present framework was adapted as it is very comprehensive, covering the dimensions of a complete SC and incorporating dimensions from previous works.

The following subsections describe the hypotheses for this study. It is important to note that the hypotheses are developed from previous research that has been modified to suit the hospitality industry within the Ghanaian context.

1) Environmental risk

Environmental risk, also called disruption or catastrophic risk, is external to the SC. It comprises all unexpected risk occurrences that interrupt the SC's smooth flow of activities [39], resulting in customer disruptions and lost profits [40]. These risks emerge from events outside the SC and include factors related to negative macroeconomic conditions, natural disasters, political instability, industry-related problems, health crises, etc. [14]. These risks are very hard to predict because they are usually out of the SC's control, and they can have devastating consequences.
The hospitality industry is particularly vulnerable to external risk factors, which are more difficult to control but also prevalent in most developing countries, including

Ghana. Any drastic economic downturn caused by health crises, natural disasters, or political unrest may lead to low occupancy rates or reductions in service charges, which increase costs and revenue reductions and affect firm profitability. External risks such as economic fluctuations, natural disasters, political unrest, terrorism, and pandemic diseases, according to [6], are major risk sources for Indian hoteliers. Reference [22] found that external risks have a higher impact on performance compared to internal risks, although they have a lower likelihood of occurrence. It is therefore hypothesized that

H1: Environmental risk has a statistically significant negative impact on SC performance.

2) Supply risk

Supply risk encompasses all difficulties that arise in the upstream portion of the supply network, resulting in the purchasing firm's failure to meet customer demand. The increasing dependence of companies on suppliers to maintain quality and guarantee service delivery makes supply risks highly critical [41]. Hotels typically operate around the clock to meet customers' needs throughout the year [42], and so any form of disruption caused by supply failure, in the form of raw material shortages, sudden changes in material costs, etc., can create glitches in internal operations and affect the performance of the hotel, creating huge financial losses for the company. Flaws in delivery times and product quality, supplier delivery failure, lack of supplier flexibility, etc., can lead to customer loss, revenue reduction, and higher costs. Reference [20] found supply risk as a relevant risk factor that has a significant negative impact on SC performance. Similarly, supply risk has a major detrimental impact on the SC's performance, according to [43]. It is hypothesized that

H2: Supply risk has a statistically significant negative impact on SC performance.

3) Demand risk

Demand risks are associated with factors situated downstream along the supply chain like demand uncertainties, poor demand forecasting, etc., that cause disruptions to outbound consumer markets. Unstable demand is usually a big challenge within the service industry since the underlying supply capacity for most service firms tends to be fixed and inflexible, making it difficult to accommodate changes in customer demand. Demand in the hospitality industry, in particular, is highly volatile and seasonal [28]. Therefore, service providers need to continually modify their practices to accommodate the various requirements of their customers and react quickly to shifts in demand patterns, which are required to survive in the competitive environment. Since the customer is the primary source of revenue for any SC, risks associated with uncertain demand can affect the competitiveness and profitability of the firm. Failure to accurately forecast customer demand and adequately plan resources to respond to such changes can result in high inventory or shortage costs, inefficient use of operating capacity, unreliable deliveries, and poor customer service, all of which can result in significant market and financial losses [6]. Empirical evidence shows that demand risk can have a significant adverse effect on SC performance [20],[38]. It is therefore hypothesized that

H3: Demand risk has a statistically significant negative impact on SC performance.

4) Operations risk

Operations risk involves all the risk factors originating from the internal practices of the main firm that affect its ability to produce and supply goods and services [14]. It is associated with a range of factors related to the organization's internal systems that disrupt usual business activities. Operational risks that affect the performance of hotels primarily include all the factors related to guest and employee health and safety; employee retention and recruitment; the unpredictability of operating costs; the security of properties and physical assets; fraud and illegal acts by employees; fire and accidents; etc. [6]. The internal operations of a focal firm may still be prone to difficulties that can result in varying effective capacity and quality and disrupt performance irrespective of the measures to improve internal quality and reduce waste [38]. It is hypothesized that

H4: Operations risk has a statistically significant negative impact on SC performance.

5) Information risk

Information risk originates from inefficiencies in electronic systems and flows of information such as data integrity and transfer, information processing, market intelligence, and system failure, among others [44]. Recent advancements in IT and computing systems have resulted in the digitization and automation of several SC activities and increased collaboration between firms in the SC network. This has exposed the SC to a myriad of risks, including cyber-attacks, unauthorized system access, malware, viruses, etc. [46], [47] all of which impair IT systems, causing a breakdown in communication and limiting the SC's efficient operation.

Where there is inadequate security of information systems, a company faces the risk of leaks of proprietary information through hacking and unsolicited emails, which can create transaction risks and affect the efficiency and effectiveness of SC operations and collaborative performance [46]. Within the hospitality industry, [6] noted that firms may be vulnerable to information risk sources related to inappropriate choice of IT systems due to high costs, obsolescence, and system failure, all of which impact the SC performance. Reference [23] found that technological risks, including ICT disruptions and infrastructure failures, have significant negative effects on organizational performance. Reference [43] further reported that information systems risk has a significant effect on firm performance. It is therefore hypothesized that

H5: Information risk has a statistically significant negative impact on SC performance.

6) Logistics risk

Logistics risk relates to the movement and storage of materials and includes risks associated with transportation, storage, material movement, delivery, and inventory systems. A well-established logistics system is a key component of a hotel's operations for improving the quality of service delivery and reducing costs [47]. As such, risks resulting from inefficiencies in the logistics process may affect the hotel's ability to consistently deliver excellent service at the best possible cost [44]. These risks typically appear as late deliveries, interrupted transportation, damage to goods, shortages of stock, missing products, etc. Where logistics are not properly managed, a firm could experience losses and greater costs. Reference [17] found that disruptions in the logistics component of the SC may result in poor delivery performance, leading to poor customer satisfaction and, consequently, losses for the organization.

H6: Logistics risk has a statistically significant negative impact on SC performance.

D. The Moderating Effect of Supply Chain Risk Management Strategies

Reference [20] noted that firms that face higher levels of SCRs are expected to achieve lower SC performance, all other things being equal, compared to firms that are exposed to lower levels of SCRs. The adoption of SCRM strategies, on the other hand, is predicted to assist in reducing the frequency of risky occurrences and their effects on SC performance [9]. The literature indicates five generic strategies for dealing with SCRs, which are risk acceptance, avoidance, transfer, sharing, and mitigation [2], but selecting a specific strategy to use depends on the relevance of the risks to the SC [48]. Moreover, [2] stressed that selecting strategies for dealing with SCRs can be difficult given the diversity of risk events and the complexity of SCRM. This has led to further classification of risk management strategies as either proactive or reactive [9],[49]. Proactive strategies are those that are implemented before the occurrence of a risk event to reduce the likelihood or impact of the risk event [50]. Reactive measures, on the other hand, are contingency measures used to build flexibility into the SC after an event has been documented [9], [49], [50]. To appropriately mitigate risks [3], [30], [51], a combination of proactive and reactive strategies are required, particularly for those with high impacts and a high probability of occurrence. So, strategies for managing risk should try to lower the likelihood and negative effects of risk by making sure that the SC can respond to or handle bad things faster or better.

This research is directed at examining the moderating effects of implementing SCRM strategies on the impacts of SCR occurrences on SC performance. The likelihood of the occurrence of each risk is not considered. The moderating effects of each strategy, be it proactive or reactive, on SC performance are the focus of the present study. As a result, the various SCRM strategies are viewed as a single construct to assess their moderating effects on the impacts of SCRs on SC performance. The following hypotheses are put forward about how SCRM strategies might moderate the effect of the six SCR constructs on SC performance:

H7a: SCRM strategies moderate the impact of environmental risk on SC performance.
H7c: SCRM strategies moderate the impact of supply risk on SC performance.
H7c: SCRM strategies moderate the impact of demand risk on SC performance.
H7d: SCRM strategies moderate the impact of operational risk on SC performance.
H7e: SCRM strategies moderate the impact of information risk on SC performance.
H7f: SCRM strategies moderate the impact of logistics risk on SC performance.

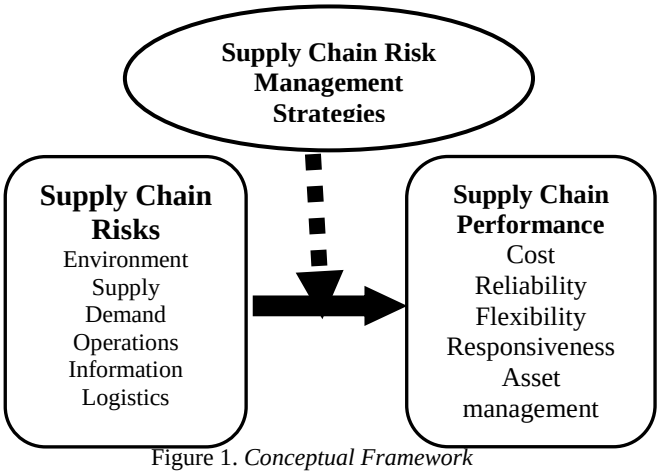


Figure 1. *Conceptual Framework*
Source: author's idea based on literature review

III. METHODOLOGY

A quantitative research methodology was employed for this study. This method allows the use of numerical data and statistical methods to explore the correlations between variables. A cross-sectional survey was utilized to examine the hypothesized correlations as it facilitates the collection of information that is not generally accessible and enables the statistical generalization and replication of results [51]. The study's target population consisted of registered hotels and guest houses in Ghana. The sample consisted of those located in the Greater Accra area. This region is the country's administrative and commercial capital, with the largest number of hotels. The sample hotels and guest houses were chosen using a purposive sampling method based on the population's characteristics [52]. It was decided that purposeful sampling was the best way to make sure that each hotel grade is represented in the sample.

Reliability constructs with the corresponding measurement scales that had been proven to be valid in prior studies were incorporated into the questionnaire. Constructs for measuring all the six (6) SCR variables were adapted from [38]. The indicators for the constructs were modified with additional items that reflect the context of this study. The SCOR model [53] was used to assess SC performance based on previously verified financial and non-financial metrics. SCRM strategies were operationalized with eight

indicators, some of which were adapted from [20]. These earlier studies helped come up with indicators and constructs that are right for the specific context and environment of the current study, which is the hospitality industry in Ghana.

The survey instrument used a five-(5) point Likert scale. A draft questionnaire was first checked for clarity and then pretested with 21 hotel managers and 10 academic experts for the adequacy of its content, readability, and ease of completion. Results from the pretest were used to modify the draft questionnaire accordingly. The questionnaire was self-administered to enhance the response rate. The data collection occurred over seven months.

A total of 255 questionnaires were administered. Out of this number, 148 completed questionnaires were returned and only 136 were valid, yielding a response rate of 53.3%. According to [54], 75 datasets are sufficient to provide a high statistical power required for identifying R-squared values of 0.25 when the highest number of predictor variables in the measurement and structural models is six (with a 5 percent probability of error). The sample size of 136 was therefore considered adequate for the Partial Least Squares Structural Equation Modeling (PLS-SEM analysis).

Hotel-grade (star rating) was considered a control variable that is likely to have an impact on the SC's performance. It was, therefore, necessary to include "hotel grade" to control for the potential impact of star ratings on SC performance. Hotel-grade was measured as a categorical variable using 2 for star-rated (i.e., 1-to-5-star hotels) and 1 for non-star-rated (i.e., guest houses and budget hotels). These were introduced as categorical exogenous variables into the PLS path model [55].

IV. RESULTS AND DISCUSSION

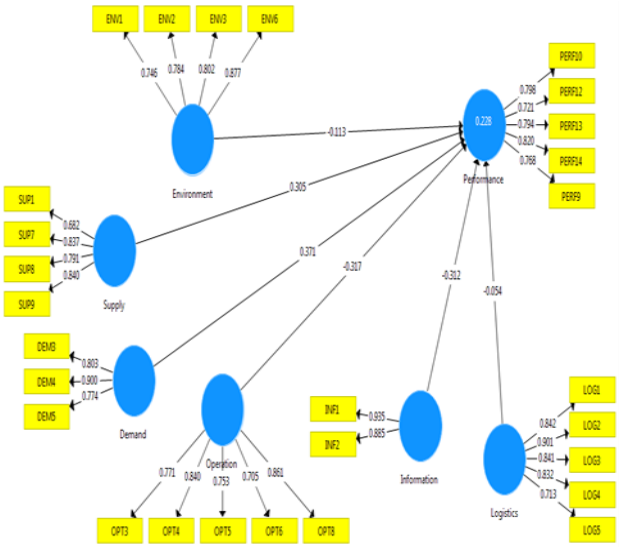
A. Results of Data Analysis

The hypothesized relationships were tested using the PLS-SEM technique, a variance-based SEM technique that is widely accepted for its flexibility because it permits the use of various types of data and comparisons across alternative models [56]. This technique was chosen to test the causal relationship between SCR and SC performance, as it is appropriate for the present study where the sample size is relatively small [53].

The PLS-SEM method functions similarly to multiple regression analysis [57], but it is based on an adaptive method that optimizes the explained variance of an intrinsic construct [58]. It concurrently considers the variability inherent in each latent construct's measurement while estimating the structural model. In this study, the PLS-SEM findings were analyzed in two stages: measurement model evaluation and structural model evaluation. The next sections cover these issues.

1) Evaluation of the measurement model

Before analyzing the hypothesized relationships, the measurement model was first used to estimate the validity and reliability of the constructs [58]. The reliabilities of the outer loadings were used to determine convergent validity. Outer loads greater than 0.70 on a construct indicate that the associated indicators share many characteristics. This characteristic, which is sometimes referred to as indicator dependability [57], draws attention to indicators that are necessary for adequately defining the various constructs. The findings of the outer loadings of the indicator items, which are shown in Figure 2, demonstrate that the measurement model has an adequate level of convergent validity. The extracted average variance (AVE) is another factor that is used to establish convergent validity. The fact that the AVE values were higher than the required threshold of 0.5 demonstrates that the measurement model is both convergently and divergently valid.



Source: Primary Data

Figure 2. *Results of structural and measurement analysis*

Cronbach's alpha and composite reliability scores were used to assess the internal consistency of the constructs. When all variables' internal consistency values exceed 0.7, they are considered fitting [59]. The values of the composite reliabilities and Cronbach's alpha values indicate appropriate internal consistency and thus the model's constructions' reliability (Table 1).

Table 1: Cronbach's (α), Composite Reliability, and (AVE)

Construct	***Cronbach's (α)***	***Composite Reliability***	***(AVE)***
Environment	0.823	0.879	0.646
Demand	0.770	0.866	0.685
Information	0.797	0.906	0.829
Logistics	0.893	0.916	0.686
Operation	0.859	0.891	0.621
Supply	0.808	0.869	0.624
Performance	0.840	0.886	0.610

Source: Primary data

Discriminant validity, which evaluates the extent to which any single item is uniquely and markedly dissimilar to other constructs, is another way to gauge the measurement model. The square root of the AVEs of each construct is compared to the correlations between components using the Fornell-Larcker criteria. Table 2 shows the results, which show that the square root values are greater than the correlations among constructs, establishing construct discriminant validity.

Table 2: Discriminant Validity - Fornell-Larcker Criterion

Con	***Env***	***Dd***	***Info***	***Log***	***Opt***	***Perf***	***Sup***
Env	**0.804**						
Dd	0.490	**0.828**					
Info	0.515	0.635	**0.910**				
Log.	0.391	0.415	0.536	**0.828**			
Opt	0.531	0.621	0.690	0.715	**0.788**		
Perf.	-0.162	0.089	-0.221	-0.177	-0.212	**0.781**	
Sup.	0.393	0.625	0.530	0.530	0.620	0.101	**0.790**

Source: Primary Data

NB: Con=Construct, Env=Environmental risk, Dd=Demand risk, Info=Information risk, Opt=Operational risk, Perf=Performance, Sup=Supply risk

2) Evaluation of the structural model

The structural model was assessed with PLS-SEM to analyze the model fit and test the hypotheses. The following metrics are used to evaluate the structural model in this study: (i) Pearson's coefficient of determination (R^2), (ii) the adjusted model's predictive relevance (Q^2), effect size, and (iii) the direction and magnitude of the path coefficients [60].

R^2 measures how well a model can predict the future. R^2 values of 0.25, 0.50, and 0.75 are commonly considered insufficient, medium, and robust [54]. But in the behavioral and social sciences, R^2 values of 0.02, 0.13, and 0.26 can be described as having a slight, moderate, and massive effect, respectively [61]. With an R^2 of 0.228, the results show a medium effect based on the Fornell-Larcker criteria. This number shows that the measures used to define the predictor variables (risk constructs) can explain some of the differences in the predicted variable (SC performance).

The Stone-Geisser (Q^2) value and the effect size (f^2) were used to judge the quality of the structural model. The Q^2 is an indicator of a model's predictive relevance. The Q^2 shows how good a model is at making predictions. It measures how good or accurate a model is at making predictions about datasets of measures in reflective measurement models of endogenous latent variables. The effect size evaluates the usefulness of each exogenous construct in explaining the endogenous construct. According to [54], f^2 values for regressors should be greater than zero, while Q^2 values of 0.02, 0.15, and 0.35 are considered to have slight, moderate, and substantial predictive relevance, respectively. The results show a Q^2 value of 0.096 (see Table 3), indicating small predictive relevance for SC performance. Similarly, the f^2 values for all the six risk constructs are between 0.021 and 0.79. This shows that each construct has some measurable effect when explaining SC performance. It was also found that the demand risk has the most impact on SC performance, while the logistics risk has the least.

Table 3: Predictive Relevance (Q^2) and Effect Size (f^2)

Construct	**SSO**	**SSE**	**Q^2**	**f^2**
Environmental risk	544.000	544.000		0.028
Supply-side risk	544.000	544.000		0.060
Demand-side risk	408.000	408.000		0.079
Operations side risk	680.000	680.000		0.039
Information side risk	272.000	272.000		0.055
Logistics risk	680.000	680.000		0.021
Performance	680.000	614.560	0.096	

Source: Primary Data

The last stage of the structural model analysis involved the evaluation of the significance of the hypothesized relationship based on the sign, size, and path coefficients. The hypothesized relationships linking the model's constructs are indicated by these coefficients. Using *p*-values and the t-test, the path coefficients were examined to determine whether they were statistically significant. The study is predicated on a 5% significance threshold (p=0.05). As a result, the critical t-test's region lies between -1.96 and +1.96. The t-tests and their accompanying *p*-values are shown in Table 4 at a 5% significance level.

The analysis was conducted for three scenarios of the impacts of risks on SC performance: (i) without considering the effect of control and moderating variables; (ii) examining the effects of control variables; and (iii) examining the impacts of moderating variables. The signs and significance of the path coefficients in each scenario were tested using the bootstrapping procedure in SmartPLS software. The results of the first scenario are summarized in Table 4.

Table 4: Hypothesis tests, path coefficients, and significance levels

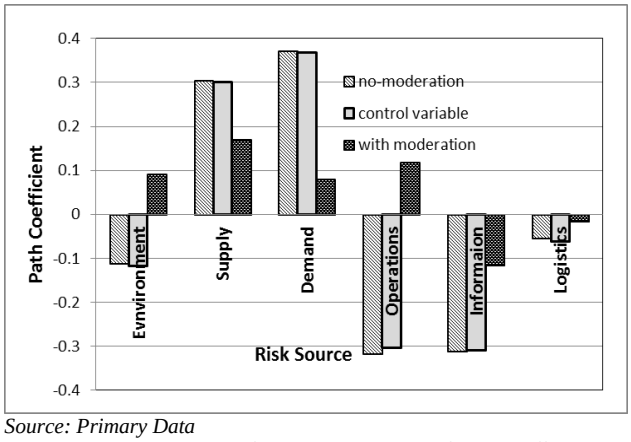
Hypotheses	**Path coefficient**	**t-statistic**	**p-values**	**Results**
H1	-0.113	1.108	0.268	Not supported
H2	0.305	1.923	0.054	Not supported
H3	0.371	2.312	0.021	Not supported
H4	-0.317	2.035	*0.042	Supported
H5	-0.312	2.598	*0.009	Supported
H6	-0.054	0.423	0.673	Not supported

Source: Primary Data

Note: *, indicate significant where =0.05

In the second scenario, the control variable was introduced into the model. The relationship between the control variable and SC performance was found to be statistically insignificant at a 5% level with a p-value of 0.479 and a weak path coefficient of 0.057. In Figure 3, the signs and magnitudes of the path coefficients for the three scenarios are compared. The inclusion of the control variable marginally affects the path coefficients of the constructs in the model. In other words, the control variable does not

influence the impact of the risks on SC performance. The control variable was therefore removed from the model and was not considered for further analysis.



Source: Primary Data

Figure 3. *Comparison of sign and magnitude of path coefficients*

1) **Results of Moderation Analysis**

The third scenario evaluates the interactive effects between SCRM strategies and each SCR construct to examine the moderating effects of SCRM strategies. It is assumed that implementing appropriate SCRM strategies will moderate the effects of the risks on SC performance. The path coefficients of the interaction terms between the moderating variable and each of the six SCR constructs were used to test H7a–H7f.

Reference [62] recommended the two-stage approach in the PLS-SEM analysis where both the moderating and independent variables are composite-indicator variables. This two-stage approach was used in this analysis. In the first stage, the indicators of the moderator variable (i.e., SCRM strategies) were introduced into the model as an additional latent variable. Since establishing interaction variables at different periods could increase both Type I and Type II errors, the six SCR constructs were included in the model at the same time. The latent scores for the moderating, exogenous, and endogenous factors were calculated by estimating the model coefficients using the indicators in their original scale. The reliability and validity of the latent scores were investigated using the PLS algorithm. All of the acceptance requirements for the measurement model, such as convergent validity and reliability, internal consistency, and discriminant validity, were met, as shown by the results.

In the second stage, the first stage latent scores were used to create the interaction terms. The latent scores of SCRs, the independent variable, and SCRM strategies, the moderator variable, were mean-centered before the creation of interaction terms. Reference [73],[74] suggests that using the mean-centered values of the indicators helps to reduce the effects of multicollinearity on the results. Nevertheless, this does not change the values of the interaction effect. The Bootstrapping algorithm in SmartPLS was then used to analyze the significance of the path coefficients [57].

As noted in Figure 3, the introduction of SCRM strategies results in changes in the signs and magnitudes of the path coefficients. However, these changes are statistically insignificant for all risk sources at a 5% significance level. Hence, hypotheses H7a, H7b, H7c, H7d, H7e, and H7f were not supported. Table 5 summarizes the moderation hypotheses examined in this study.

Table 5: Summary of Moderation Analysis

Hypotheses	**Path Estimate**	***p*-value**
H7a	0.091	0.359
H7b	0.169	0.076
H7c	0.080	0.467
H7d	0.118	0.441
H7e	-0.116	0.349
H7f	-0.016	0.896

B. Discussion of Results

This study examined the effects of various SCR factors on SC performance as well as the moderating effects of SCRM strategies. This current study has found that generally, SCRs have evident effects on the performance of the SC under consideration. This finding supports some previous studies concerning the susceptibility of SC networks to SCRs. Specifically, the results show that the combined effects of the six SCR constructs can explain about 23% of the SC performance, which is quite substantial compared to the 6% effect found by [20] for manufacturing firms in Germany. It has been discovered that contextual variables play an important role in the relationship between SCRs and SC performance [20], and given that environmental settings vary across industries and countries, the results from this study reflect the study context. It is important to recognize that the SC of the hospitality industry is relatively more complex because tangible materials must be procured to offer services, compared to the manufacturing industry where the focus is on creating or producing tangible items. Furthermore, respondents' perceptions and understanding of SCRs may be different and influence the consistency of the information gathered.

Four out of the six SCRs have varying degrees of negative impacts on SC performance when performance is assessed in terms of the SCOR model. The negative impacts of operations and information risks are statistically significant at a 5% level. Operations risk was observed to have the highest negative impacts, as indicated by the path coefficients, on SC performance. This reinforces the findings by [65] that operational risks are the highest risks for hotels' SCs. Similar results have been reported by reference [6] and reference [28] for operational risks, especially guest health and safety, as key risk factors that affect Indian hotels. The relationship between information-related risks and SC performance is expected given that information is known to be a great SC driver, and for the hospitality industry, in particular, information is a critical

performance indicator [63],[64],[65]. Performance can be directly affected by the risks associated with the flow of information between potential customers and hospitality establishments about the availability and quality of services provided.

Environmental and logistics risks also have negative impacts on SC performance as hypothesized but are statistically insignificant. The environmental risk indicators used in the study relate to external factors such as epidemics, natural disasters, political instability, and terrorist attacks. While these environmental risk factors are major causes of disruption to the performance of hoteliers elsewhere [6],[28],[65],[66], the results indicate that the negative effects of these factors are insignificant within this research context. The respondents are generally aware of the potential negative impacts of environmental risk factors. However, these risk sources are not prevalent in Ghana, which could explain the insignificant effect on performance. At the time of the data collection, none of these factors had been reported in the last decade, and thus, respondents did not consider them as major risks that affected the performance of SC activities. However, their occurrences can have a negative impact on performance. Currently, the hospitality industry and hotel operations, in particular, have become one of the industries heavily affected by the recent COVID-19 pandemic [67],[68]. This shows that environmental risks can have a substantial negative impact on SC if they should occur.

Moreover, the findings did not show significant support for the consequence of logistics risk on the SC performance of Ghanaian hotels. Logistics risk factors relate to inventory, handling, damage, and loss issues, which are not typical SC issues in the service industry. The quality of service offerings, which is the main focus of the hospitality industry, is not directly and highly impacted by these types of logistics indicators. Orders are processed in response to customer requests, and if they are not consumed when they are ready, they perish.Besides, suppliers are responsible for inbound logistics, reducing the likelihood of the occurrence of logistics-related risks and their consequent impacts on hospitality SC performance. So, it is not surprising that the negative effect of logistics risks on SC performance is not statistically significant.

The study also showed some unexpected results where demand and supply risks have positive relationships with SC performance. This is contrary to the general notion of the negative impacts of risk events. These results are also contrary to the findings by [20] and [43], who found statistically significant negative impacts of demand and supply risks on performance in the manufacturing industry. At the same time, [20] found that regulatory, legal, and bureaucratic risks impact the performance of German manufacturing firms positively, justifying the positive impacts found in this study. The fact that the study is about the hospitality industry, which is a service industry, could help explain some of the good effects of demand and supply risks.

Similar to most service industries, demand, and supply within hospitality are instantaneous. The SC in this industry relates more to the management of tangible supporting products and materials to meet the anticipated demand for services [69]. These are usually consumables, some of which are perishable. As such, the performance of the service SC may not necessarily be identical to that of the SC of the products and materials used to directly support the service offerings. Furthermore, with regards to demand risk, there is a general awareness that demand in the hospitality sector is seasonal, and therefore demand volatility is a recognized phenomenon. As a result, hotels usually plan for fluctuations in demand and come up with good ways to deal with these variabilities throughout the year.

As noted by [70], a key decision for players in the hotel business is to decrease the extent of demand and supply uncertainty. Thus, awareness of vulnerability to various demand risks requires that appropriate measures be put in place to counteract these risks [6]. The demand risk indicators used in this study include volatility in customer demands, insufficient or distorted information on customer orders, demand forecast errors, and inability to meet customer demands. Occurrences of these risk events, individually or in combination, are expected to adversely impact performance as reflected in the metrics in the SCOR model. For example, the risk of volatility in demand or forecast errors is expected to be reflected in low reliability and non-responsiveness to customer demands. So, the positive impact on SC performance could be due to the ability to predict and design SCs well enough to handle changes in demand so that the impact of demand risk doesn't hurt performance.

A possible explanation for the positive effect of supply risk is the objective of ensuring consistent customer satisfaction, which characterizes the service industry. In the hotel industry, executives are always striving to attain 100% customer satisfaction [71]. Proper inventory management is crucial to maintaining a competitive advantage within the industry [72], as it reduces their susceptibility to stock-outs and other demand forecasting errors. This may potentially eliminate the negative impact of supply risk, as a hotel must plan for demand variations and ensure that customers' needs are consistently met. Supply risk indicators used in the study include the flexibility of suppliers to changes in demand, supplier quality problems, and the responsiveness of suppliers, among others. While the risk of flexibility and responsiveness could impact the SCOR model's performance measures, these were not deemed to be risks that could affect the supply of service products offered.

Additionally, the results clearly show that the rating of a hotel does not influence the level of SCRs' impact on the performance of the SC. In other words, the impact of a given risk level on the SC performance of a 5-star rated hotel is identical to that of a guest house that is not rated. SC activities are not used or considered in rating hotels.

This is similar to findings by [25] that the quality of service offerings in the hospitality industry has very little impact on how the hotels are rated. Also, the study tested the idea that putting SCRM strategies into place lessens or moderates the effects of SCRs on SC performance.

The introduction of SCRM strategies to the model shows that it has a positive impact on SC performance, as indicated by changes in the path coefficients. This finding lends support to earlier studies by [22] and [51] that showed that the implementation of SCRM strategies is necessary for improving SC performance. However, the results showed that the implementation of risk management strategies generally has a statistically insignificant impact on the effect of SCRs on SC performance. A possible explanation for the largely insignificant effect is that, currently, the SCRM strategies implemented by firms within the industry are not strong enough or efficient enough to significantly reduce the impact of risks on SC performance. This indicates to hotel managers and executives that it is crucial to invest in implementing robust SCRM strategies, as these investments can mitigate the impact of risks on SC performance.

Overall, the findings in this study appear consistent with the contingency theory that underlies the conceptual framework of this study. The unique characteristics of the SC environment are reflected in the relationships between the various risk sources and SC performance. As noted previously, some of the hypotheses cannot be supported and appear counterintuitive, contrary to expectations as per extant literature. It is important to note, however, that the effects of a given SCR on performance depend on extenuating factors such as industry type (service versus manufacturing) and the economic environment (less developed versus developed). Based on the contingency theory, it can be noted that SC influences the impact level of different SCR factors on SC performance and that those contextual variables are critical in strategic decision-making regarding relevant risk management strategies. Furthermore, for a given risk source, the impact on SC performance is not sensitive to (or not contingent upon) the control variables used in the study. Moreover, the results indicate that investments in risk management strategies have the potential to lessen the effects of risk events on the SC's performance.

V. CONCLUSION AND FUTURE SCOPE

Based on the results, the SCRs examined do have noticeable effects on the performance of SC in the hospitality industry. The study concludes that SCRs from various sources have varying degrees of impact on SC performance. Operations and information-related risks have the greatest negative impacts on SC performance. It is also noted that SC performance is less sensitive to environmental and logistics-related risks within the context of the hospitality industry in a less developed economy. A key finding in this study is that SCRs do not always have negative impacts on SC performance; some risks may have positive impacts. Contrary to the arguments advanced in the existing literature on SCRs, the study's findings indicated that both supply and demand risks have positive effects on performance. Contextual variables largely determine the type and level of impact of SCRs on SC performance. It is further concluded that in the hospitality industry, SCRM strategies have positive but insignificant effects on the level of impact of SCRs on SC performance. Finally, it can be concluded that the hotel's star rating does not affect how SCR factors affect SC performance.

The study adds to the existing knowledge of SCRM. This is, as far as the researcher is aware, the first study to analyze the influence of various risk types on the performance of SCs in the context of a service-based business in a developing country using empirical data. The study also theoretically demonstrates the application of the PLS-SEM method to analyze the effects of SCRs on SC performance in the service industry using latent variables that cannot be measured directly and are industry and economic-specific. The results suggest that in practice, not all risks have negative impacts, as advanced in the extant literature. So, in some situations, some SCRs can improve the performance of the SC instead of hurting it.

Practically, the research findings may guide decision-making regarding focus areas in the implementation of risk management strategies for the Ghanaian hospitality industry, which could benefit managers of similar environments. The results indicate that within the Ghanaian hospitality industry, operations and information risks are the most critical risk factors that deserve the highest priority and particular attention above all other types of risks. Moreover, players in the hospitality industry must take note of environmental and logistics risk factors and devise strategies to reduce the probability of occurrence because, although they currently have an insignificant effect on performance, they have the potential to cause considerable adverse consequences. However, demand and supply risks should not be areas of major concern for hoteliers in Ghana, given their positive effects on performance.

The study has several limitations. First, the data collected covered hotels and guest houses in one country. The characteristics of the sample might not be a true reflection of the hospitality industry in other less developed countries. Besides, the study only considered the impact of SCRs without a corresponding evaluation of their prospect of occurrence. An assessment of the probability of risk occurrence will help establish the specific context of each risk, which is useful in selecting the appropriate risk management strategies.

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