

Leveraging Real-Time Data to Anticipate and Mitigate Supply Chain Risks in Volatile Environments

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ABSTRACT

In the current world, global risks are likely to occur at the blink of an eye and therefore a proper supply chain is variable on how one is capable of handling risks as they occur. Using real-time information has become one of the strategic angles of building the defense of the supply chain, which allows identifying conflicts, manage a performance indicator, and make relevant adjustments. Tools like IoT sensors, AI, and analytics help to keep track of inventory position, transportation, and even suppliers' performance contributing to decisions as soon as possible. Real time information enables organisations and companies to identify changes, gains and losses likely to occur in the market and make relevant decisions in volatile terrains such as market volatility, political instability, and other natural disasters. It means that, combining data flows from different sources, it becomes possible to provide organizations with a single vision of supply chain networks that can enhance the transparency of the intercompany cooperation. The application of other tools of advanced analytics also foster scenario planning and demand forecasting to minimize risks and guarantee business sustainability. This abstract aims at discussing the management of risks in supply chain networks with the help of authentic time data during volatile situations. This underlines a necessity of data integration, the predictive model, and even auto monitoring in order to efficiently deal with the disruptions. Based on the analysis which indicates that technology improves visibility, responsiveness and adaptability this paper encourages the use of analysis and data to protect and improve supply chain resilience. Real-time analytics also enhance the ability to sustain operational efficiency, minimize loss and longevity of competitive advantages within a volatile global environment.

Keywords: Dynamic global economy, Geopolitical instability, Supply chain adaptation, Real-time data management

INTRODUCTION:

The real data interpretation of the dynamic global economy needs more effective supply chain management to increase the complexity and rate of volatility in a business. The disruption can be caused by different kinds of natural disasters, geopolitical instability, and the fluctuation of the need and demand of the customer to a market which cause the decrement of the productivity in a business (Aljohani, 2023). The technical breakdowns can also be caused by the lack of stability in the static data and the reactive strategies for the volatile environment. Real-time data refers to the data and information which can process and collect the data network to increase the informed decision for an organisation (Anozie et al., 2024). In the context of supply chain management, the importance of delta and data cannot be denied which provides a business more ability to monitor their track shipments.

Research Aim

The study aims to explore the impact and the importance of real-time data in developing the supply chain residence and the strategies to mitigate the risk in the different kinds of volatile environments in a business.

1. Objectives
2. RO1: To analyze the impact of real-time data in risk identification in the volatile environment
3. RO2: To access the effectiveness of the real-time data this can improve the ability of supply chain adaptation
4. RO3: To explore the process by which the real-time data strategy can be faster in order to make accurate decisions for rapidly changing condition
5. RO4: To identify the risk of monitoring the supply chain in the context of real-time data management

LITERATURE REVIEW

Impact of real-time data in risk identification in the volatile environment

In today's dynamic and interconnected economic world, the impact of supply chain management on managing market fluctuations and different kinds of political events cannot be denied. Real-time data, or RTD, leads to a business's invisibility, which helps in monitoring the different elements in the supply chain management system (Stylos, Zwiegelaar & Buhalis, 2021). Short-term tracking of shipments becomes easier with the help of GPS or RFID, a system that enhances the potential for transparency in the transit process.

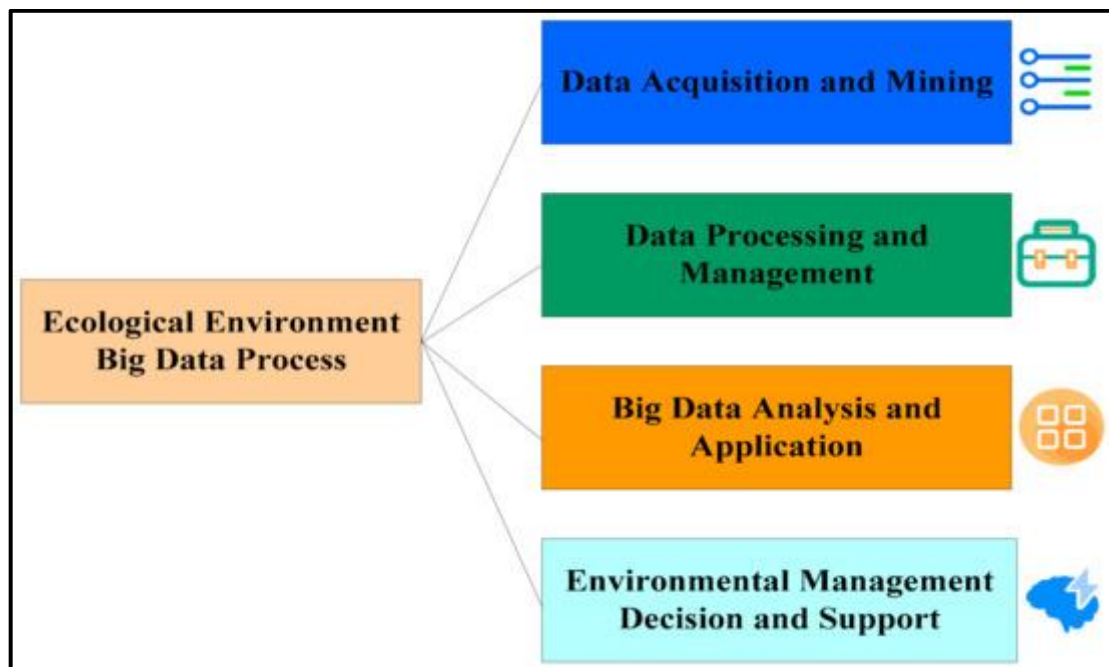


Figure 1: Financial loss in the big data analysis process

(Source: Olaiya et al., 2024)

The above figure indicates the possible financial loss for the application of the big data analysis process which includes the loss in data processing and the environmental management decision. Therefore, to improve the accuracy in read detection the RTD has to be properly executed by determining the dynamic risk assessment.

The effectiveness of the real-time data which can improve the ability of supply chain adaptation

In today's volatile world, the increase in the global economy and supply chain management poses different kinds of challenges like the frustration of marketing demand which needs a proper strategy to maintain the fluctuations in the marketing world. The RTD is important to enhance the visibility of the supply chain process by making a quick decision for the rerouting of the shipment to meet the customer demands (Nimmagadda, 2021). Moreover, can be said that, the real-time GPS tracking process is one of the most effective processes in today's world which can track weather disruption as well as traffic conditions. This above factor increases the rate of customer engagement by delivering their product on time and also fulfilling the demand surges of the customer (Ikevuje, Anaba & Iheanyichukwu, 2024). Thus, making the informed decision-making process easy and increasing the customer satisfaction.

Risk of monitoring the supply chain in the context of real-time data management

Monitoring the supply chain risk leads to the direction of inherent business risk and the issue in data accuracy of a business. Maintaining the risk in the supply chain can be the reason for increasing the data accuracy and reliability and also managing the risk of sensor malfunctions (Odimarha, Ayodeji & Abaku, 2024). In today's world, the cyber security trade becomes the current risk for a business at the time of implementation of the RTD system which can increase the hacking and ransom attacks.

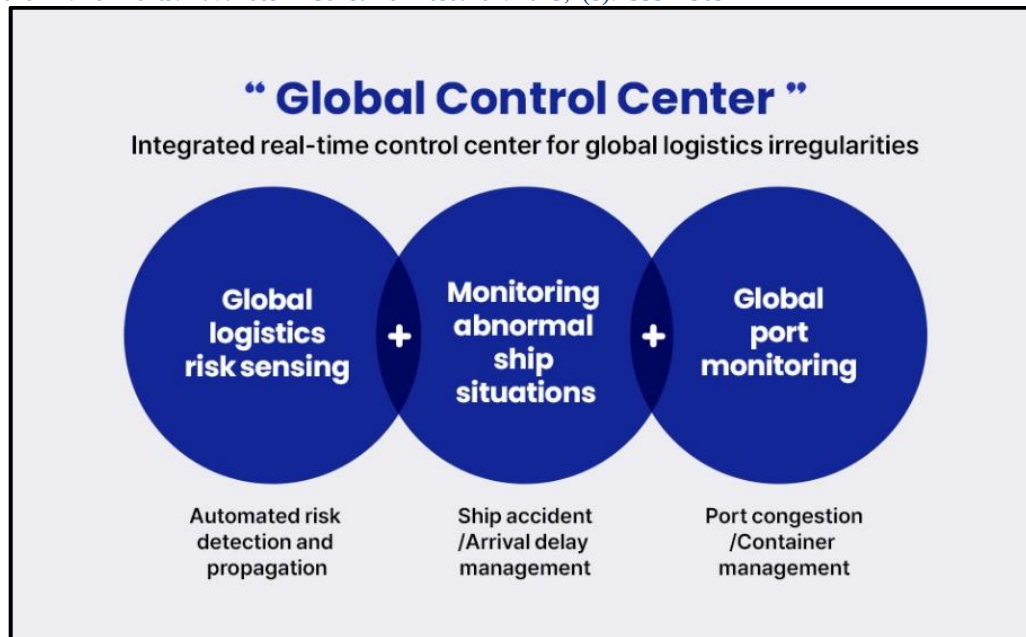


Figure 2: Risk management of the supply chain with the help of global control

(Source: Ivanov & Dolgui, 2021)

Figure 2 is the indicator of different processes to mitigate the risk of the global supply chain by the “Global Control Centre” which includes the Global Logistic risk sensing, monitoring the abnormal situation, and managing the global port. With the help of the discussed process, the technical method becomes more reliable and this excessive reliance reduces the human over side and improves decision-making skills (Aljohani, 2023).

METHODOLOGY

The research method used is descriptive analysis. Primary data was gathered using structured questionnaire. The data gathered was analyzed statistically and inferences made from the analysis are presented. A pre test of the questionnaire was conducted to establish the validity and reliability. Reliability test was done using Cronbach’s Alpha. The data processing was done using SPSS. With the help of this method, direct reviews from people related to different kinds of business sectors and supply chain management was gathered for the proper investigation. The deductive approach has been applied with the process of random assembling and the data has been analyzed with the help of SPSS software. 100 people were selected as the respondent in the study and the collected data was analyzed with the help of descriptive analysis, reliability, factor analysis, and hypothesis testing (Ganesha & Aithal, 2022). The use of experimental strategy makes the study more effective and the proper impact of the RTD on mitigating the risk in the supply chain management process in a volatile environment can be evaluated in the study.

Analysis

Demographic analysis

Age

What is your age?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	25-30 year	51	51.0	51.0	51.0
	31-35 year	14	14.0	14.0	65.0
	36-40 year	17	17.0	17.0	82.0
	41 year and above	18	18.0	18.0	100.0
Total		100	100.0	100.0	

Table 1: Age distribution

(Source: SPSS)

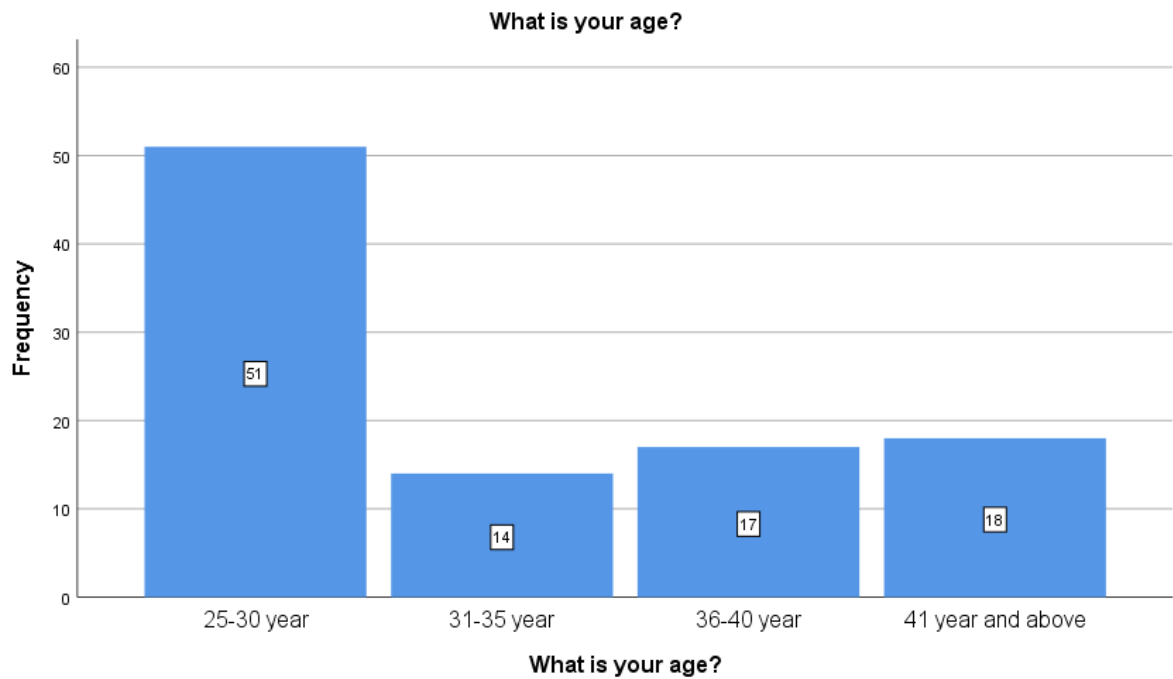


Figure 3: Age distribution

(Source: SPSS)

The above age distribution bar graph and the table show that the highest number of participants in the survey are with the age where is from 25 to 30 years. The cumulative percentage of the preparation formed 25 to 30 years is 51% where the frequency of the people is 51. The cumulative percentage of people aged 36 to 40 years is 82% which is the highest percentage among all participants in the survey.

Gender

What is your gender?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	49	49.0	49.0	49.0
	Male	34	34.0	34.0	83.0
	Prefer not to say	17	17.0	17.0	100.0
	Total	100	100.0	100.0	

Table 2: Gender distribution

(Source: SPSS)

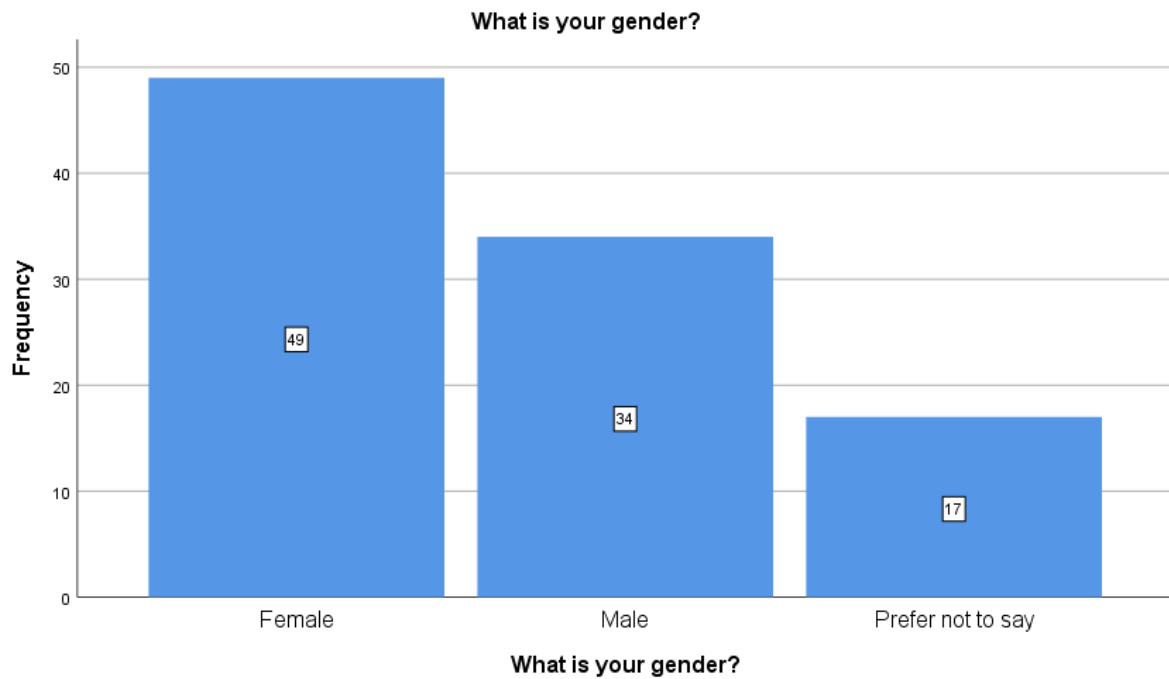


Figure 4: Gender distribution

(Source: SPSS)

Table 2 indicates the gender distribution of the participants from where it can be clearly said that the highest distribution is the females who do not want to say their gender participants and the percentage is 17%. The frequency of female participants is also 49 and the cumulative percentage of females is 49%.

Designation

What is your monthly income?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15000-20000	31	31.0	31.0	31.0
	20000-25000	34	34.0	34.0	65.0
	26000-30000	18	18.0	18.0	83.0
	30000 and above	17	17.0	17.0	100.0
	Total	100	100.0	100.0	

Table 3: Designation distribution

(Source: SPSS)

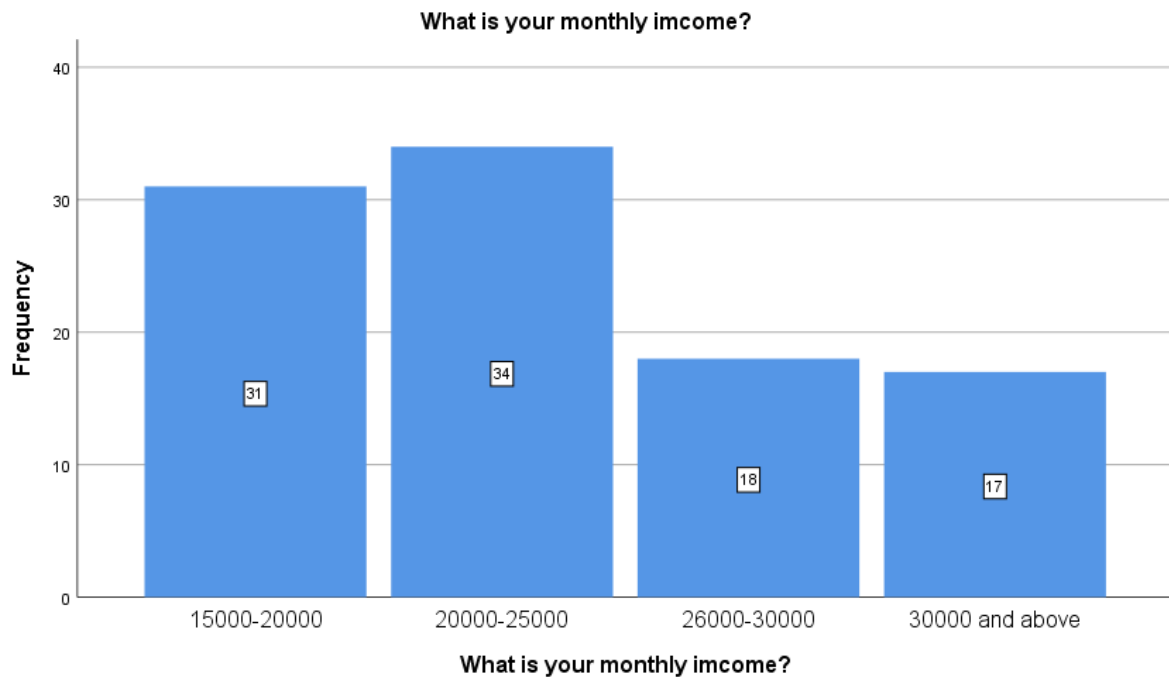


Figure 5: Qualification distribution

(Source: SPSS)

From the above table and Figure, it can be concluded that the people who are participants in the survey have different amounts of monthly income in the business. The highest frequency of the people who have a monthly income of 20000-25000 and the frequency of the people is 34 and the valid percentage is 34%. The valid percentage of the people who earned monthly 26000-30000 in the survey is 18%. The people with the monthly income of 30000 and above are the lowest participants and the frequency of the response is 17.

Descriptive analysis

Descriptive Statistics									
	N Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Skewness		Kurtosis	
						Statistic	Std. Error	Statistic	Std. Error
DV_Operational Efficiency	100	2	5	3.66	.956	-.470	.241	-.678	.478
IV1.2_Technology Adoption	100	1	5	3.35	1.725	-.162	.241	-1.846	.478
IV2.1_Geopolitical instability	100	2	5	3.65	.957	-.440	.241	-.712	.478
IV3.1_Collaboration with suppliers	100	1	5	3.26	1.502	-.219	.241	-1.401	.478
IV4.1_blockchain technology	100	1	5	3.11	1.325	-.286	.241	-1.133	.478
IV4.2_Supply chain management	100	2	5	4.23	1.014	-1.310	.241	.610	.478
Valid N (listwise)	100								

Figure 6: Descriptive analysis

(Source: SPSS)

The above formation of the study presents the descriptive analysis between the dependent variable or DV and the independent variables or IVs of the study. From the above table of descriptive statistics, it can be concluded that the value of skewness statistics for IV1.2 is the highest among the other and the value is -0.162. The highest skewness value indicates the high asymmetrical distribution of the technical adoption on the change of the operational efficiency of a business. By locating the table of descriptive statistics, the positive and negative considerations between the IVs and DV of a study can be estimated (Zahid et al., 2020). The value of core process statistics for IV4.2 is 4.23 which refers to the positive impacts of supply chain management in order to the growth of a business.

Factor analysis

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.500
Bartlett's Test of Sphericity	Approx. Chi-Square	12.249
	df	1
	Sig.	.000

Figure 7: Factor analysis

(Source: SPSS)

The section of the underlying research of investigation can be properly executed from the table of the KMO and Bartlett's test or the factor analysis. From the above figure of factor analysis, it is clear that the approximate value of Chi-square is 12.249, from which it can be concluded that this value indicates a positive and effective relation and dependence on the resilience of the supply chain of a business of the increment of the agility of the supply chain.

Reliability test

Reliability Statistics

Cronbach's Alpha ^a	Cronbach's Alpha Based on Standardized Items	N of Items
-.002	.164	5

a. The value is negative due to a negative average covariance among items. This violates reliability model assumptions. You may want to check item codings.

Figure 8: Reliability test

(Source: SPSS)

The above reliability tests of the IVs and DV of the study give the value of Cronbach's alpha of the study as -0.002 the value of the standardized items is 0.164. The negative value of Cronbach's alpha shows the inner connection of the DV and the IVs of the study. The frequency of the total items taken for the examination is 5 for the analysis. The above value indicates the impact of data quality and accessibility on the mitigation of the risk in a business.

Hypotheses Testing

Hypothesis 1:

Model Summary^b

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.882 ^a	.778	.776	.453	.778	343.110	1	98	.000	2.054

a. Predictors: (Constant), IV2.1_Geopolitical instability

b. Dependent Variable: DV_Operational Efficiency

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	70.347	1	70.347	343.110	.000 ^b
	Residual	20.093	98	.205		
	Total	90.440	99			

a. Dependent Variable: DV_Operational Efficiency

b. Predictors: (Constant), IV2.1_Geopolitical instability

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	6.874	.179		38.335	.000
	IV2.1_Geopolitical instability	-.880	.048	-.882	-18.523	.000

a. Dependent Variable: DV_Operational Efficiency

Figure 9: Hypothesis testing 1 (Source: SPSS)

From the above ANOVA chart of the table of the first hypothesis, the regression value of the sum of squares for IV2.1 and DV is 70.347. The regression value of IV2.1 for DV is high, and the high value means a high dependency on the operational efficiency of the geographical instability of the consumers. The resolution of the value of the sum of squares in SPSS analysis helps to anticipate the split value from a study's observed value (Sayed, William & Said, 2023).

Hypothesis 2:

Model Summary^b

Change Statistics										
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change	Durbin-Watson
1	.295 ^a	.087	.078	1.345	.087	9.345	1	98	.003	2.668

a. Predictors: (Constant), IV3.1_Collaboration with suppliers

b. Dependent Variable: DV_Risk Mitigation

ANOVA^a

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	16.898	1	16.898	9.345	.003 ^b
	Residual	177.212	98	1.808		
	Total	194.110	99			

a. Dependent Variable: DV_Risk Mitigation

b. Predictors: (Constant), IV3.1_Collaboration with suppliers

Coefficients^a

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	4.567	.323		14.150	.000
	IV3.1_Collaboration with suppliers	-.275	.090	-.295	-3.057	.003

a. Dependent Variable: DV_Risk Mitigation

Figure 10: Hypothesis testing 2 (Source: SPSS)

From the above Figure 10 of the second hypothesis, it can be described that the residual value of the sum of squares for IV3.1 and the DV of the study is 177.212. This value guides the high dependency on risk mitigation of the collaboration suppliers in a business. Also, the standard error from the coefficient table for collaboration suppliers in a business is 0.090, which is less than the value of 0.5. This low standard error value indicates the DV's less dependence on the IV3.1.

DISCUSSION

In the discussion of the study after the whole analysis, it can be clearly said that mitigation strategies like investing in robust cyber security measurement can be effective in protecting the data integrity and confidentiality of a business. This process of cyber security management helps to measure the rate of cyber security risk and this increases the transparency of the data and ensures the data validation by minimising those inaccuracies (Pansara, 2022). Adaptation of scalable and parable platforms in a business also made a great and positive impact on the interrogation of the data properly. From the above research, it can be concluded that the operational efficiency made a strong impact on the geopolitical instability as the value of the main square in the ANOVA table is 70.347. Also, from the study, the process of managing the risk in the supply chain can be evaluated which includes the monitoring process and monitoring the global port to manage the issue of port congestion (Wylde et al., 2022). Therefore, by determining the proper risk and productivity businesses can be able to increase their value for RTD systems and this also helps in reducing the vulnerability in the monitoring process of supply chain management.

CONCLUSION

It can be concluded from the overall analysis of the study that the application of RTD in supply chain management is essential for enabling productivity and addressing the risks of a business. The above RTD approach is also used to integrate the diverse sources and the predictive analysis which enhances the additional efficiency of tools. Moreover leveraging the process of RTD also empowers the manager of supply chain management to react with their Strategies and fostering the sustainable growth in the global world. In the future the supply chain management process is going to one of the most demanding strategy for transferring the data and cornerstone the resilience.

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