

## THE IMPACT OF SUPPLY CHAIN DIGITALIZATION ON SUPPLY CHAIN RESILIENCE AND PERFORMANCE

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### Abstract

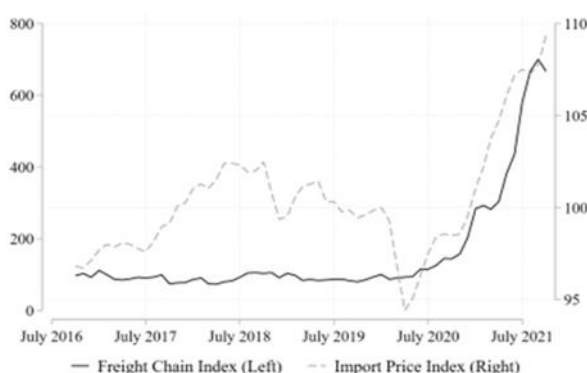
*In the recent era after the COVID-19 pandemic has ended, many companies, both large and small, are still experiencing difficulties caused by increasing inflation in shipping and import costs. As a result, companies experience a drastic decline in demand levels that can lead to losses and damage to the supply chain system. To be able to address these problems, companies must be able to innovate in the use of digital technology in an effort to achieve better supply chain performance so as to be able to mitigate price inflation and also reduce the risk of potential problems. Data collection was gathered with the help of questionnaires which targeted at industrial companies that involve supply chain systems in their operations. The results of the collected data and later analysis show that use of digital technology has a big effect on resilience and performance of the supply chains system, thus having a positive impact for the company. This research is anticipated to serve useful for other researchers as a concrete data source to determine the impact it brings on a company's performance.*

**Keywords:** Inflation, Digital Technology, Supply Chain

### Introduction

Business organizations and companies on a global scale have faced operational challenges caused by disease outbreaks in recent years. The pandemic caused by the spread of COVID-19 has had a devastating impact on various businesses and supply chains (Chowdhury et al., 2021). Analytical studies of economic research after the COVID-19 pandemic shows that there has been gradual increase in shipping and import costs of goods caused by inflation, so much so that companies, both large and small, faces difficulty dealing with increasing cost in their supply chain systems (Isaacson & Rubinton, 2023). However, the COVID-19 pandemic has prompted lots of research into the impacts and consequences it has on businesses and supply chains, to the point that the formation of supply chain resilience becomes more advanced in overcoming problems in the future events (Zhao et al., 2023). As time goes by, the use of digitalization on the supply chain system gained researcher attention and the study of it brings expectation of being able to increase the resilience and performance of the firm supply chain operation (Zhao et al., 2023). However, studies ongoing about the implementation of digitalization are still minimal and not widely known by most companies (Chowdhury et al., 2021).

**Freight Price Index and Import Price Index**



Source: Isaacson & Rubinton (2023)

**Figure 1.** Index of Increasing Price in Supply Chain Goods Compared with Imports of Goods.

In order for a company to survive and thrive, the company must be able to handle obstacles in their supply chains system and also prevent any backlash for the company's operations, finances and markets (Li et al., 2022). Regarding the context of supply chain management, resilience holds the key role for any company, organization, and other business entity to slowly adapt, change, and also recover from losses. Since then, resilience becomes one of the most important roles in managing the supply chain (Tian et al., 2024). The role of resilience is not only limited to recovering from any disruptions (Spieske & Birkel, 2021), but to also responding to any changes and adapt to it (Li et al., 2022). Therefore, resilience plays a huge role in

maintaining stability and sustainability of supply chain operations in a business organization or companies (Gu et al., 2021).

In an effort to prevent disruptions and losses caused by unexpected events such as the COVID-19 pandemic, many business organizations and companies are improving their resilience in supply chain systems by using digital technology (Dubey et al., 2023). Implementation of advanced technology may optimize a company's supply chain and provide resilience as well as security and stability (Ye et al., 2022). Implementation of digital technology during the era of COVID-19 pandemic theoretically could help companies in achieving feats such as transparency to customers, replacing employees work who are absent due to the pandemic, and also reduce uncertainty in demands (Ye et al., 2022). Although many companies and researcher say that digitalization in the supply chain system has great potential, the use of digital technology in itself is still not widespread and optimal enough, so much so that many companies have not yet made much progress in building resilience on their supply chains system (Nasiri et al., 2020). This may happen due to lack of evidence for practitioners to observe the impact it brings on supply chain, so it might necessary for this research to continue it studies and investigate the effectiveness of digital technology on the supply chains system (Nasiri et al., 2020).

This research is determined to make research and analyze the impact generated from digital technology on the supply chain systems, and analyze how digital technology can affect both the resilience and performance of the company's operations (Anzani Siregar et al., 2025). The results that this research will get to know are anticipated to provide benefits such as of insights and study materials for researchers as well as business organizations and companies in order to better understand the effectiveness of digitalization on the supply chain and how it affects resilience and also performance in organization.

### **Literature Review**

Before the COVID-19 occurred, operations of all sorts of supply chain had already under heavy pressure due to globalization and complexity in supply chain networks, which hampered production in a company (Rodríguez-González et al., 2023). Complexities in supply chain operations can include things like errors in product delivery or additional costs and time needed resulting from changes in delivery schedules (Al-Talib et al., 2020). However, COVID-19 pandemic has made companies aware of the weaknesses in their supply chain systems, so that many studies and research have been conducted on supply chain resilience (Rodríguez-González et al., 2023). However, digital technology has the possibility to solve these problems in supply chains systems (Sunmola et al., 2021). Digitalization is the use and implementation of technology that includes the use of various software functions such as the well-known Internet of Things (IoT), blockchain, cloud, and also the one that is currently being widely used by many large companies, namely artificial intelligence (AI) for various supply chain activities to make it easier for companies to make decisions supported by data (Al-Talib et al., 2020). Digital technology has a significant role in improving resilience during the COVID-19 pandemic (Shobariyah & Darmawan, 2025). To overcome problems caused by the pandemic or other global issues and also maintain competitive advantage in the digital era, organizations and companies need to improve and adopt digital technology in their supply chain resilience (Dubey et al., 2023).

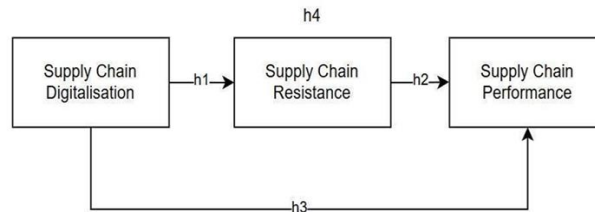
Performance that is linked to supply chain in an organization or company refers to how much the system is capable of completing customer orders accurately and efficiently and also with the lowest possible costs (Cantele et al., 2023). Digitalization in the supply chain can facilitate companies with data integration in their supply chain systems, so that companies and stakeholders can utilize data analysis in the market effectively (Perano et al., 2023). This can increase efficiency and also promote much better products and services, so that the company will move towards market dominance and also excellency in performance (Al Tera et al., 2024). Due to the established digital infrastructure in some parts of the continent such as Asia and Europe, data collection, data analysis, and also virtual communication can be more practical and cost-effective, thus increasing profits for an organization or company (Cantele et al., 2023). Therefore, its implementation can be proven to increase productivity and performance while reducing costs for the company (Al Tera et al., 2024).

Supply chain performance means how much the system is capable of fulfilling customer orders accurately and efficiently, while resilience is the company's strength to overcome obstacles or problems and maintain the sustainability of supply chain operations (Gu et al., 2021). Supply chain bottlenecks can slow down operations or reduce the quality of products and services, thereby affecting supply chain performance (Huang et al., 2023). Therefore, resilience does have an important part in preventing these obstacles and increases the performance and quality of the supply chain (Spieske & Birkel, 2021).

Digital technology holds the potential to brings support on resilience by increasing information responsiveness and flexibility to prevent disruptions. The information provided by using digital technology may increase the speed and positive changes of the supply chain in predicting market uncertainty (Tian et al., 2024). Supply chain digitalization can provide knowledge of digital information in the system to increase resilience when facing supply chain obstacles (Kusumastuti et al., 2025). An organization or company that can recover faster than its competitors will maintain an advantage in the harsh and very competitive market, in which cases there is an important role for digital technology in the resilience of the company which then improves the overall performance of an organization or company (Zhao et al., 2023).

**Methods**

For this study of the effect of digital technology on the system, a quantitative research method based on primary data will be employed to develop hypotheses regarding the effect of digitalization on resilience and the performance of the firm. This research will focus on collecting data obtained through surveys to determine statistical data for research purposes. With quantitative data collection, the research will be supported by concrete data based on established statistics (Seyedghorban et al., 2020). In order to collect data through surveys, a research questionnaire will be designed and distributed online via various social media. Data collection method implemented in this study was a question of a specific population to effectively support the research hypothesis. The population in this study was specifically Indonesian citizens, and the sample consisted of Indonesian citizens who worked at a company engaged in logistics operations. To know the required size of the sample, this study adopted the principle of a minimum sample of 10 for each questionnaire item (Hair et al., 2019). The questionnaire designed for this study has 16 questions, which means that the required sample calculation is  $16 \times 10 = 160$  samples, which if rounded up, this study will require 150 respondents to obtain consistent data. This questionnaire was designed using a Google form distributed through various social media and for each question uses a Likert scale where there are five options that can be chosen by respondents to find out how much they agree or disagree with the questions provided. After reaching the required number of respondents through the questionnaire, the next stage is testing and processing the collected data. This data will be processed using specialized applications such as SPSS and Smart PLS to determine the validity and reliability, as well as to test the significance of each variable (Hair et al., 2019; Nazaruddin & Fatmaningrum, 2021; Setiaman, 2021). By testing the data using the SPSS and Smart PLS applications, it is hoped that it will be able to produce final data on how much influence digitalization has on resilience and the performance as well, whether there is a significant positive or negative influence, or whether there may be no influence at all.



**Figure 2.** Research Model

**Results and Discussion**

With the collected demographic data of the respondents was processed using SPSS to present structured descriptive data. The demographic statistics consist of three variables: gender, age, and length of service. These variables aim to determine how respondents understand the research subjects conducted through the questionnaire.

**Table 1.** Results of Processing Respondent Demographic Statistical Data

Respondent Demographics	Frequency	Percent	Valid Percent	Cumulative Percent
Gender	Male	66	44	44
	Female	84	56	56
	Total	150	100	100
Age	18-21 years old	9	6	6
	22-30 years old	122	81.3	87.3
	31-40 years old	3	2	89.3
	More than 40 years old	16	10.7	100
	Total	150	100	100
Length of service	1-2 years	42	28	28
	2-4 years	25	16.7	44.7
	2-5 years	11	7.3	52
	Less than a year	25	16.7	68.7
	More than 5 years	47	31.3	100
	Total	150	100	100

With the obtained statistical information or data in the table above, there were 150 respondents who took the questionnaire. The majority of respondents in the gender variable were female with a frequency of 84 or 56% of respondents, next to males with 66 people or 44% of the total number of respondents. Meanwhile, in the age variable, the majority of respondents were in the 22–30-year age range, amounting to 122 or 81.3% of respondents, and the fewest had been in the 31–40-year age range, amounting to 3 people or 2% of the total number of respondents. Finally, in the length of service variable, the majority of respondents had a length of service greater than 5 years, amounting to 47 or 31.3% of the total number of respondents, while the fewest were 2-4 years, amounting to 11 people or 7.3% of respondents. Based on its demographic statistical data, it is known that majority of respondents were adults consisting of men and women aged around 22-30 years who have work experience ranging from 1 to 5 years and above. Results of it indicate shows that the average respondent has a good understanding of the subject of this study, thus preventing bias in the way respondents understand which can be questioned when answering the questionnaire questions. Honest respondents' responses can help a study to be more certain in proving the subject or variable to be studied, therefore there is an importance in honesty in conducting research or studies (Imran et al., 2021).

In order to obtain an optimal data processing results, this research will be validated through Harman's test. Harman's trial is a research trick that aims to identify variance in commonly used methods. If one or a common factor can explain most of the variable variance in the measurement, then it can be said that there might be a huge amount of common variance present in the trial (Jordan & Troth, 2020). When there are several common method variants found in the test, it can be seen that the variables in this study have a false relationship or connection, so that it will have an impact on the validity of the results of this study (Kock et al., 2021).

**Table 2.** Results of VIF Data Processing in The Harman Test

	VIF
SCD1	1.874
SCD2	1.696
SCD3	1.516
SCP1	2.124
SCP2	2.130
SCP3	2.052
SCP4	2.284
SCR1	2.978
SCR2	2.205
SCR3	2.274
SCR4	2.124

The table above shows Harman test result processed in this study. Based on the data obtained, it can be seen that each indicator in each variable such as digitalization, resilience, and performance of supply chain has a VIF value of less than five (5). Variance Influence Factor (VIF) is an indicator used to measure the level of multicollinearity or correlation between independent variables. When the VIF value exceeds 5, then the variable indicates a strong correlation between several other independent variables, this is what can affect the results of this study. Multicollinearity between independent variables can make it difficult to know regarding the influence of each individual variance on the dependent variable, thus negatively affecting the validity of the results of this study. In this Harman test, the data obtained for each variable has passed the symptoms of multicollinearity, which means that each individual variable can explain the dependent variable without any high correlation.

In addition to testing common method variants, this research will also undergo validity and reliability tests to further support the hypotheses discussed. Validity is crucial for research, demonstrating the accuracy of the measurements used to test the variables. Research that fails or avoids validity tests risks misleading researchers and other readers with information that cannot be scientifically justified (SÜRÜCÜ & MASLAKÇI, 2020). This study will conduct two types of validity tests: convergent validity and discriminant validity. Convergent validity tests can be useful for determining the relationships between indicators and a number of variables that cannot be directly measured, thus proving that the research indicators can underlie one of these unmeasured variables (Rönkkö & Cho, 2022). Meanwhile, discriminant validity testing is useful in ensuring that each latent variable discussed has a large difference with other variables in order to find out how big the differences are between these variables (Cheung et al., 2024).

**Table 3.** Results of Outer Loading Statistical Data Processing.

	SCD	SCP	SCR
SCD1	0.873		
SCD2	0.827		
SCD3	0.812		
SCP1		0.842	

SCP2	0.832
SCP3	0.831
SCP4	0.858
SCR1	0.855
SCR2	0.797
SCR3	0.797
SCR4	0.769
SCR5	0.823
SCR6	0.816
SCR7	0.757
SCR8	0.798
SCR9	0.769

**Table 4.** Results of AVE Statistical Data Processing.

Average Variance Extracted (AVE)	
SCD	0.702
SCP	0.707
SCR	0.638

The convergent validity test in this study was processed using Smart PLS, which was assessed based on Outer Loading and Average Variance Extracted (AVE). Based on the statistical data table, it can be seen that all indicators have met the testing criteria with values greater than 0.70. The following table shows that the AVE values meet the 0.5 criterion for each variable. This means that this study successfully demonstrated the validity of the relationship between each indicator and its latent variables.

**Table 5.** Results of Cross Loading Statistical Data Processing.

	SCD	SCP	SCR
SCD1	0.873	0.703	0.278
SCD2	0.827	0.609	0.269
SCD3	0.812	0.653	0.272
SCP1	0.657	0.842	0.236
SCP2	0.641	0.832	0.336
SCP3	0.662	0.831	0.336
SCP4	0.675	0.858	0.321
SCR1	0.290	0.332	0.855
SCR2	0.238	0.322	0.797
SCR3	0.258	0.305	0.797
SCR4	0.208	0.217	0.769
SCR5	0.322	0.369	0.823
SCR6	0.294	0.281	0.816
SCR7	0.158	0.190	0.757
SCR8	0.245	0.274	0.798
SCR9	0.270	0.266	0.769

**Table 6.** Results of Statistical Data Processing in The Fornel-Lacker Test.

	SCD	SCP	SCR
SCD	0.838		
SCP	0.783	0.841	
SCR	0.326	0.365	0.799

**Table 7.** Results of HTMT statistical data processing.

	SCD	SCP	SCR
SCD			
SCP	0.949		
SCR	0.371	0.397	

The discriminant validity test in this study was also processed using Smart PLS which was assessed based on Cross Loading, Fornel-Lacker Test, and HTMT. In the Cross Loading statistical data table, it can be seen that all indicators marked exceed the value of 0.7 and meet the validity criteria standards. The same discriminant test was also carried out on the Fornel-Lacker test which showed that all variables had a higher correlation value than the value of other variables, this means that the differences between each variable are clearly visible. The final discriminant validity test is the HTMT (Heterotrait-Monotrait ratio), based on the table above, it can be seen that all indicators have an HTMT value less than one, this proves there are no serious symptoms in the discriminant validity test. With these three tests meeting all criteria, it can be said that this study is valid in proving the hypotheses that will be discussed.

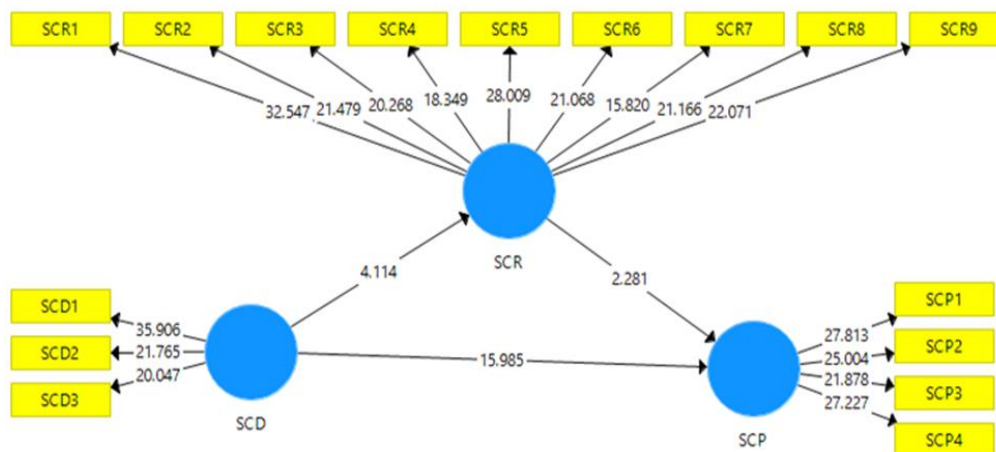
After passing the validity test, this study then tested the reliability of the variables studied. Reliability testing plays a crucial role in ensuring that the data collected in this study achieves the appropriate consistency or stability over time. This testing is useful for determining how accurately this study achieves the same results when the data processing is repeated at different times and locations, thus ensuring that this study maintains accurate consistency in each data test (SÜRÜCÜ & MASLAKÇI, 2020).

**Table 8.** Results of Cronbach's Alpha and Composite Reliability Statistical Data Processing.

	Cronbach's Alpha	Composite Reliability
SCD	0.787	0.876
SCP	0.862	0.906
SCR	0.929	0.941

In this reliability test, this study used Smart PLS to test Cronbach's Alpha and Composite Reliability for each variable. Cronbach's Alpha reliability testing is useful for measuring the lower limit of the latent variable's consistency, while Composite Reliability testing focuses more on measuring the true value of the latent variable's reliability (Nha, 2021). Based on the reliability test results table above, each variable achieved a Cronbach's Alpha and Composite Reliability value above 0.70, indicating consistency and stability in the instruments used in this study. Having passed the validity and reliability tests, this study is ready to test its hypotheses without the risk of bias or other uncertainties.

The data processing results in this study will be used to test hypotheses regarding the extent of influence of one variable on other variables. Using Smart PLS, the results can be formed into a research model that includes coefficient paths obtained from the collected data processing.



**Figure 3.** Results of processing the inner model hypothesis test data using Smart PLS.

To determine the extent of influence of each variable, this study uses a statistical approach to analyze the P-value on the relationship between these variables. The P-value can be interpreted as the probability or likelihood of achieving extreme and random test results when the null hypothesis is true. This means the P-value can determine how likely it is that data can continue to be observed when the hypothesis stating there is no effect or difference is true. The smaller the P-value, the stronger the evidence supporting the rejection of the null hypothesis (Andrade, 2019). If the P-value obtained is lower than the significance level, then it can be seen that there is statistical support or evidence for a significant effect or difference in the relationship between each variable. Conversely, if the P-value obtained is higher than the specified significance level, then there is not enough evidence to prove a significant difference in the relationship between the variables. By using Smart PLS, data processing produces an inner model which will then be analyzed for direct and indirect effects on each of the variables studied. This analysis aims to determine each P-value for each variable relationship discussed in the hypothesis test.

**Table 9.** Results of Data Processing for Direct Influence Hypothesis Testing.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ( O/STDEV )	P Values
SCD -> SCP	0.743	0.745	0.046	15.985	0.000
SCD -> SCR	0.326	0.338	0.079	4.114	0.000
SCR -> SCP	0.123	0.122	0.054	2.281	0.023

**Table 10.** Results of Data Processing for Testing The Indirect Effect Hypothesis.

	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics ( O/STDEV )	P Values
SCD -> SCR -> SCP	0.040	0.041	0.022	1.856	0.064

Based on the table above, the results of the direct influence hypothesis test show three relationships between variables that have a direct influence, namely SCD affects SCP, SCD affects SCR, and SCR affects SCP. Data processing using Smart PLS shows statistical results on Original Sample (O), Sample Mean (M), Standard Deviation (STDEV) and also P-Values. By looking at the P-value for the influence of each variable, it can be seen that SCD (Supply Chain Digitization) affects SCP (Supply Chain Performance) with a P-value of 0.000, this means there is a significant influence on the relationship between these variables because the resulting P-value is smaller than 0.05 as a benchmark. While in SCD (Supply Chain Digitization) affecting SCR (Supply Chain Resistance) it is known to get a P-value of 0.000 as well, this proves that there is a significant influence on the relationship between these variables because the P-value obtained is smaller than 0.05 as a benchmark. Finally, the relationship between the influence of the SCR (Supply Chain Resistance) and SCP (Supply Chain Performance) variables obtained a P-value of 0.023, this means that there is a significant influence on the relationship between these variables, because the P-value is still lower than 0.05 as the benchmark.

In addition, the results obtained from the indirect influence hypothesis data test results testing the influence given by the mediator, namely SCR, to SCD with SCP showed a P-value of 0.064, this means there is no significant influence on the SCR variable as a mediator in explaining the relationship between SCD and SCP. With the findings obtained from the results of the hypothesis test, it is known that all relationships between variables have a significant influence, which means the use of digital technology is proven to influence growth in resilience and performance in the supply chain system. However, the resilience of the supply chain system as a mediator does not provide a clear effect between supply chain digitalization and supply chain performance. Research on this mediation effect cannot support the hypothesis discussed previously, this may occur because the direct influence between variables is higher than the influence given by the mediator, so that SCR as a mediator does not play a major role in influencing SCD on SCP growth, this can also be interpreted that SCD plays a greater role in influencing growth in SCP and also SCR (Liu & Chiu, 2021).

## Conclusion

In an era of increasingly sophisticated digital technology, many business organizations and companies, particularly in Indonesia, are still unable to utilize digital technology in their operations. This puts them at high risk of failure when facing natural disasters such as the recent virus outbreak and rising inflation. One solution to address these risks is to utilize digital technology across the company's operational systems. Experts believe digital technology can significantly impact growth, resilience, and profitability. Therefore, this study aimed to validate hypotheses regarding the impact of supply chain digitalization on a company's resilience and supply chain performance. To test these hypotheses, a questionnaire based on similar research was developed and distributed to employed Indonesians. This resulted in a pool of at least 150 respondents to begin processing the collected data. Data processing was primarily conducted on respondent demographic data along with Harman's single factor test, validity test, and reliability test to prevent potential bias and invalid test results. After taking these tests, the data was then processed to test the hypothesis on the influence given by each research variable. The conclusion of this study shows that digital technology certainly has a significant influence on supply chain resilience and also supply chain performance in a company, supply chain resilience has also been shown to significantly affect company performance. However, this study also found that supply chain resilience as a mediator between supply chain digitalization and supply chain performance did not prove to have a significant impact, this could be caused by the greater influence of digital technology compared to the mediator, so digital technology can be said to play a greater role in improving company performance and resilience.

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