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INTEGRATION OF ARTIFICIAL INTELLIGENCE IN SUPPLY CHAIN MANAGEMENT: CHALLENGES AND OPPORTUNITIES

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Abstract

In today's quickly developing global market, supply chain management has become an essential constituent for businesses to persist in the competitive market. With the ever-emerging difficulty of supply chains, businesses are continuously seeking traditions to improve competence and decrease costs and artificial intelligence (AI) has appeared as an auspicious solution.ANT struggles for individuality in the explanation of human executors and non-human technical policies such as Artificial intelligence in the SCM. Primary data were composed of 75 individuals who contributed to the survey. The survey was based on the applicable questionnaire having 10 questions to sustain the established variables and hypothesis, however, the collected data was analyzed by SPSS analytical software.

Keywords: *Artificial Intelligence, Supply chain management, Technological integrations, Operations and supply chain management, etc.*

Introduction

Background of the study

Artificial intelligence (AI) has been presented to advance and generate “thinking machines” that are proficient in impersonating, learning, and substituting human intelligence. As highlighted by Jan et al. (2023), AI has exposed great potential in refining human decision-making procedures and the succeeding efficiency in numerous business activities due to its capability to distinguish business patterns, absorb business phenomena, pursue information, and analyze data perceptively.

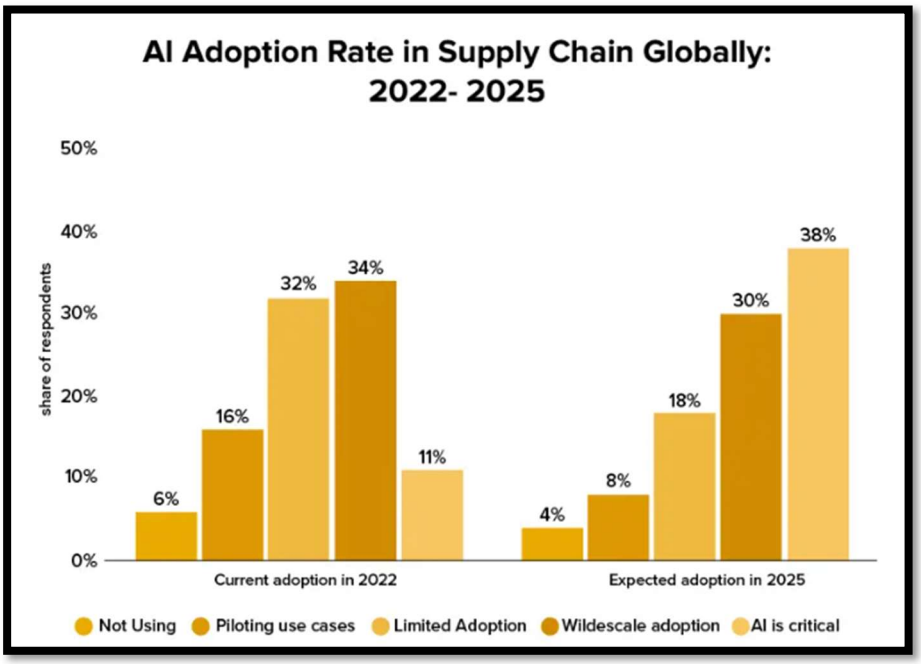


Figure 1: Artificial intelligence Adoption rate in supply chain management Internationally
(Source: Influenced by Dwivedi et al. 2021)

Artificial intelligence has progressively been measured as a foundation of competitive advantage in "operations and supply chain management" also referred to as OSCM. However, many business organizations still brawl to adopt AI effectively. As per the notion of Abioye et al. (2021), globally the rate of adoption of AI is progressively up surging as it helps to boost efficiency, productivity, and sustainability in SCM. The current adoption rate of AI in SCM is 34% and is expected to enhance to 38% by the year 2025.

Problem statement

The indirect application of AI for the expansion of supply chain management services within the business sector has not been progressively utilized. Moreover, data quality is the major issue that needs more attention to reduce the forthcoming challenges of AI integration in SCM (Bécue& Gama, 2021). In addition to this, developing and mixing AI results into prevailing supply chain structures can be inefficient and exclusive. AI in SCM allows informed professional decisions, working speed, and market flexibility as compared to traditional operational procedures. Companies must capitalize on infrastructure development, training, and continuing maintenance to entirely realize the latent aids of AI (Benzidia et al. 2021).Hence, this study is worth and the need of the hour.

Research aim and objectives

Research aim

The study aims to highlight the challenges and opportunities of integration of artificial intelligence in supply chain management.

Research objectives

RO1: To highlight the role of Data security measures for the higher productivity and efficacy of supply chain management.

RO2: To analyse the key factors of Artificial intelligence integration in supply chain management.

RO3: To examine the impact of Artificial Neural Networks on the procedures of supply chain management.

RO4*:* To examine the integration of Predictive analytics in the SCM for demand forecast estimation.

Research questions

RQ1*:*What is the role of Data security measures for the higher productivity and efficacy of supply chain management?

RQ2: What are the key factors of Artificial intelligence integration in supply chain management?

RQ3: What is the impact of Artificial Neural Networks on the procedures of supply chain management?

RQ4:What is the integration of Predictive analytics in the SCM for demand forecast estimation?

Significance of the study

The academic significance of the research study focused on the utilization of the study for identifying the factors connected with Artificial Intelligence to generate greater productivity and efficiency in the SCM. Along with its increasing position in the industry, AI displays an increasing and wider presence in the academic discourse, and this existence has impacted many operational fields, AI is now-a-days researched from a more all-inclusive viewpoint. As highlighted by Modgil et al. (2022), using AI leads to problem-solving with advanced accuracy, developed speed, and a greater number of involvements in the SCM. Supply chain and logistic businesses lately exposed the value of AI. Machine learning is modelled to transfigure industries, from loading automobiles to forecasting the future.

Literature review

Integration of AI in supply chain management and its associated challenges and opportunities.

As Artificial Intelligence (AI) continues redefining the supply chain management landscape, Fortune 500 companies and global enterprises are keen to harness its potential. However, integrating AI into existing supply chain systems poses significant challenges and considerations (Rodríguez- Espíndola et al. 2020).

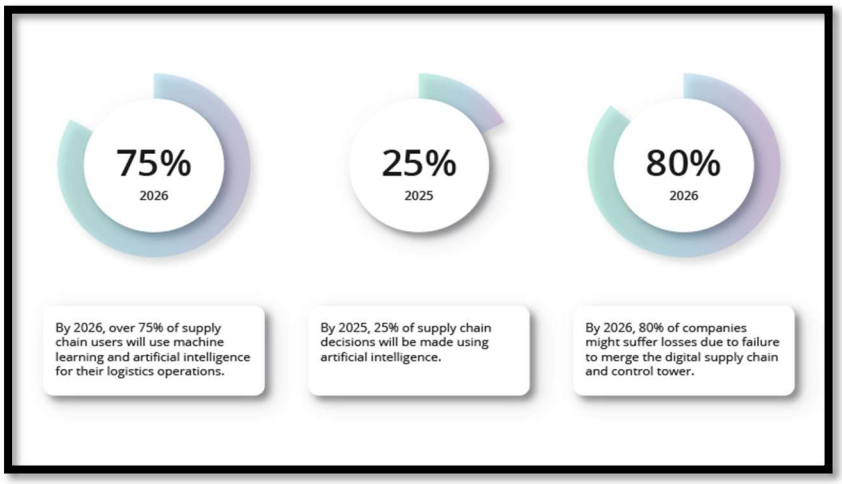


Figure 2: Rate of adoption of AI for supply chain

(Source: Influenced by Riahi et al. 2021)

The above-highlighted figures display the application of artificial intelligence in the SCM. AI-powered systems lower the errors of the supply chain by 20% to 50%, which aids in reducing lost orders by up to 65%. Moreover, AI can upturn patterns in big data pools, recognizing new information from apparently disconnected data points. Gartner highlights that 25% of pronouncements in the SC industry will be completed using AI-driven structures as of 2025 (Wamba& Queiroz, 2020). Understandings from these schemes' data help to automate ordinary processes, join in previously non integrated systems, and advance the efficiency of the supply chain.

Actor-network theory (ANT)

Actor-network theory (ANT) is about a varied network of individuals and even non-humans as equally interconnected actors. It struggles for independence on the account of human performers and nonhuman technical devices such as Artificial intelligence in the SCM.

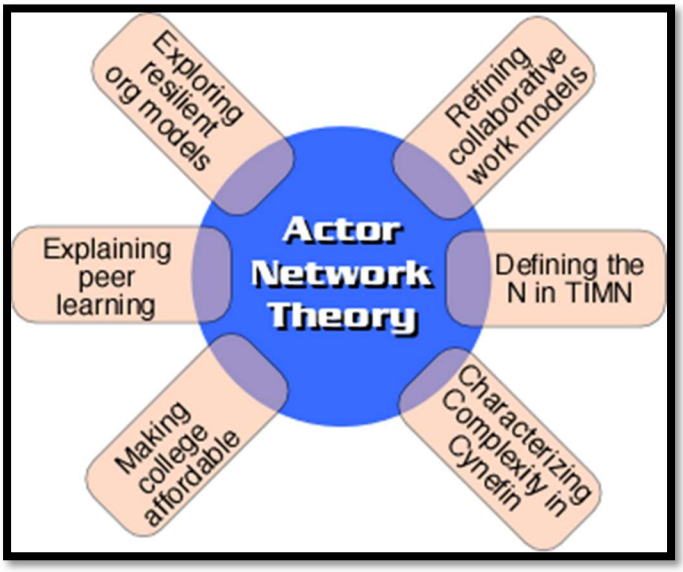


Figure 3: ***Actor-network theory (ANT)***
(Source: Influenced by Crawford,2020)

As per the argument of Crawford (2020), instead of worrying about making anthrop morphological technology, intrinsically humanlike as technology is after all developed by humans, and alternates for the activities of humans, and consequently reduces human errors. This is a progressively influential, nevertheless still intensely contested, method to comprehend humans and their communications with inert objects.

The Gap in Literature

In the past display of literature, the chief issues and lack have been acknowledged in the application of AI tools in the operational procedures of SCCM. According to the comment of Helo& Hao(2022), the meticulous factors predominant in Artificial intelligence that demonstrate to have a positive effect on the business industrial supply chain have not yet been resolved extensively.

On the other side, as per the notions Pournader et al. (2021), the application of strategies by the SC professional to improve effectiveness and efficiency within the business realm has not been deliberated at a detailed level. Hence, for the vindication of such characteristics, the advance of the respective integration of artificial intelligence in supply chain management along with its relevant challenges and opportunities has been beneficial.

Methodology

The implication of a streamlined course in the research technique relates to the accomplishment of step-wise data gathering and examination (Mohajan, 2018). Positivism philosophy and deductive approach were deployed in the research study as they permitted the linking of actual info and assisted in deducing the hypotheses development for the study. According to the explanations by Pandey & Pandey (2021), primary sources are derived from authentic information directly obtained from the respondents of the study in the form of an interview or survey. However, in this study, primary data were collected from 75 individuals who participated in the survey. The survey was based on the relevant 10 questionnaires to support the developed variables and hypothesis. The examination of such primary quantitative informational data was accomplished through the incorporation of SPSS software where numerous tests such as multiple regression analysis and descriptive examination were executed.

Hypotheses development

Alternative hypothesis (H1): There is a sturdy linkage between Artificial intelligence integration and supply chain management

Alternative hypothesis (H2): There is a strong connection between Data security measures and supply chain management

Alternative hypothesis (H3): There is an effective interrelatedness between Artificial Neural Networks and supply chain management

Alternative hypothesis (H4): There is a significant relationship between Predictive analytics and supply chain management

Findings

Demographic analysis

Age

What is your age group?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	20 to 35 years	22	29.3	29.3	29.3
	35 to 50 years	24	32.0	32.0	61.3
	50 to 65 years	21	28.0	28.0	89.3
	Above 65 years	8	10.7	10.7	100.0
	Total	75	100.0	100.0	

Table 1: Age range of the respondents

Table 1 highlights the frequency of the participants involved in the survey based on the age groups. The most frequent were in the age group of 35-50 years, and the least frequent were from the age group of above 65 years which were 24 and 8 in number respectively.

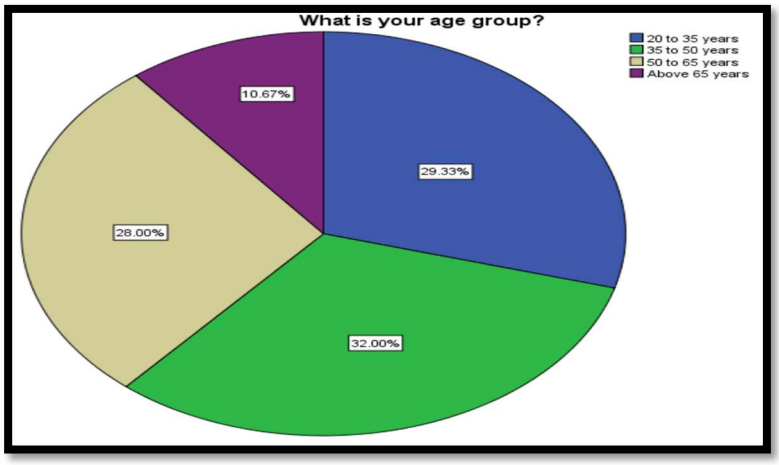


Figure 3: Different age brackets of the respondents

Figure 3 demonstrates the rate of percentage of the participants involved in the survey based on the age groups. The most frequent were in the age group of 35-50 years having a percentage of 32 and the least frequent were from the age group above 65 years having a percentage of 10.67.

Gender

What is your gender?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	28	37.3	37.3	37.3
	Male	36	48.0	48.0	85.3
	Prefer not to say	11	14.7	14.7	100.0
	Total	75	100.0	100.0	

Table 2: Gender of the respondents

According to Table 2, 28 female candidates and 36 males participated in this data collection procedure. Therefore, there were 75 candidates among whom 11 did not disclose their gender, and the most frequent were males having a frequency of 36.

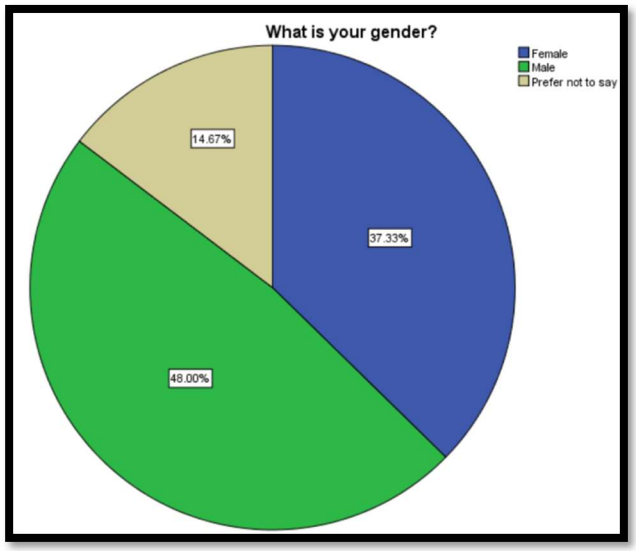


Figure 4: Gender of the respondents

Figure 4 highlights that the maximum response rate for respondents belongs to the male category, and their response rate is 48%. Contrarily, females were 37.33% and 14.67% were unrevealed gender groups that participated in the survey.

Marital status

What is your Material Status?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Married	43	57.3	57.3	57.3
	Unmarried	32	42.7	42.7	100.0
	Total	75	100.0	100.0	

Table 3: Marital Status of the respondents

According to Table 3, there were 43 married persons and 32 unmarried persons who participated in this data collection procedure. The most frequent were married respondents and the least frequent were the unmarried respondents.

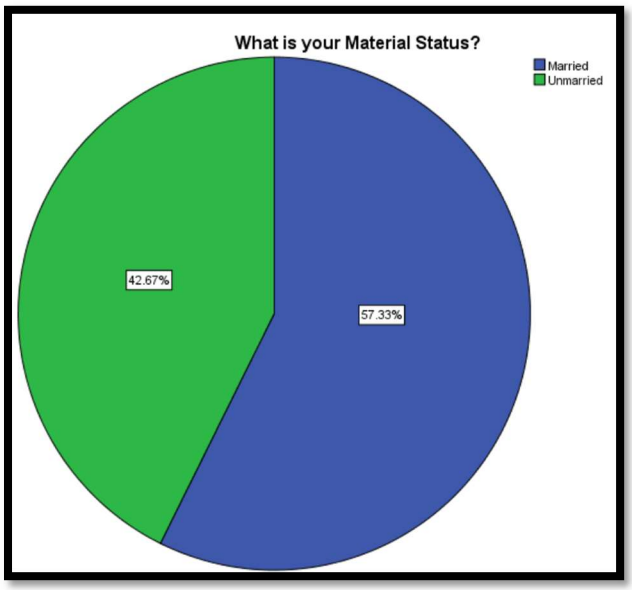


Figure 5: Marital Status of the respondents

Figure 5 highlights that the maximum frequent rate for respondents belongs to the married category, and their response rate is 57.3%. Contrarily, unmarried were 42.7% that participated in the survey.

Variable related analysis

Descriptive analysis

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
DV	72	1	5	3.86	.969	.862	.283	.739	.559
IV1	75	1	5	3.76	1.184	1.024	.277	.297	.548
IV2	75	2	5	3.85	.896	.283	.277	.743	.548
IV3	75	2	5	4.17	.844	1.172	.277	1.278	.548
IV4	75	2	5	4.03	.716	.720	.277	1.103	.548
Valid N (listwise)	72								

Table 4: Descriptive statistics

Table 4 highlights the score value of Descriptive statistics of the variables gathered with the assistance of this statistical analysis. The mean values of both independent and dependent variables are 3.76, 3.85, 4.17, 4.03, and 3.86 respectively.

Validity test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.482
Bartlett's Test of Sphericity	Approx. Chi-Square	43.330
	df	10
	Sig.	.000

Table 5: Validity test

Table 5 highlights the score value of "Bartlett's Test of Sphericity Approx. Chi-Square" which is 43.33. However, the score value of "Kaiser-Meyer-Olkin Measure of Sampling Adequacy" is 0.482.

Pearson's correlation test

Correlations

		DV	IV1	IV2	IV3	IV4
DV	Pearson Correlation	1	.013	.014	.076	.011
	Sig. (2-tailed)		.260	.227	.528	.341
	N	72	72	72	72	72
IV1	Pearson Correlation	.135	1	.187	.434**	.247*
	Sig. (2-tailed)	.260		.109	.000	.033
	N	72	75	75	75	75
IV2	Pearson Correlation	.144	.187	1	.248*	.373**
	Sig. (2-tailed)	.227	.109		.032	.001
	N	72	75	75	75	75
IV3	Pearson Correlation	.076	.434**	.248*	1	.030
	Sig. (2-tailed)	.528	.000	.032		.798
	N	72	75	75	75	75
IV4	Pearson Correlation	.114	.247*	.373**	.030	1
	Sig. (2-tailed)	.341	.033	.001	.798	
	N	72	75	75	75	75

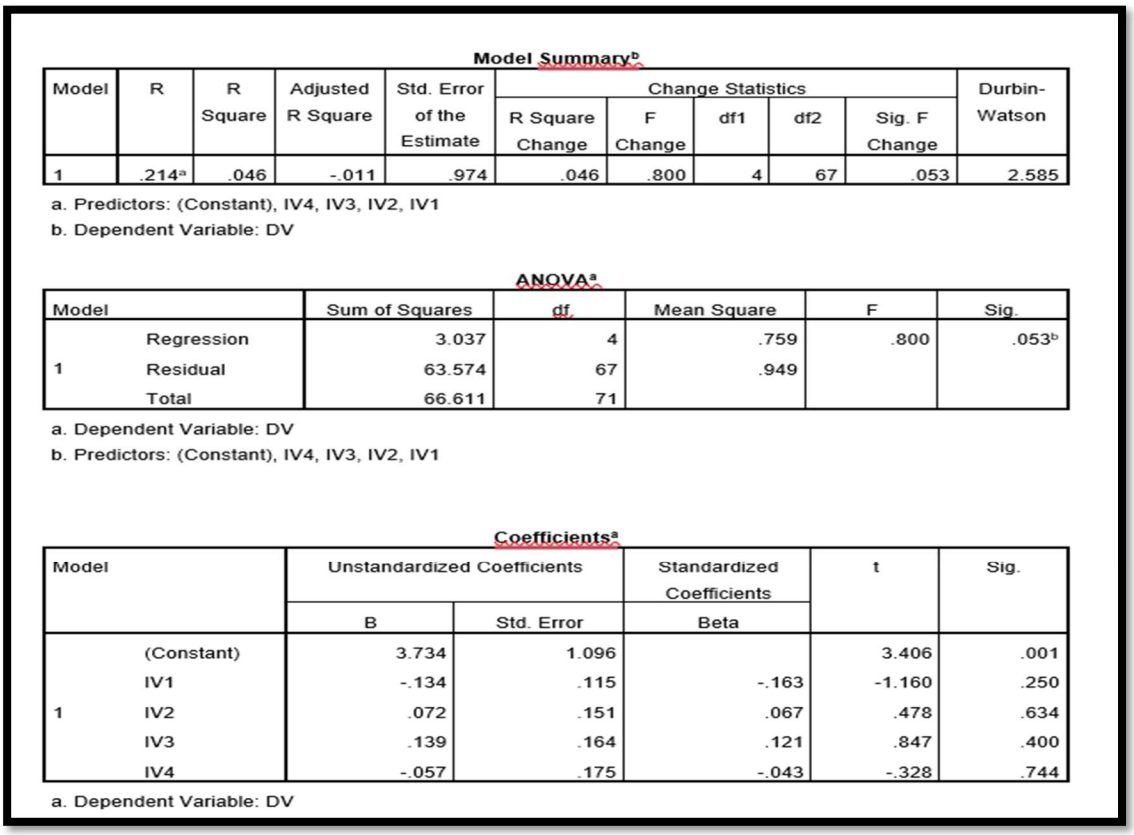
**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Table 6: Pearsons's correlation test

Table 6 demonstrates suitable relationships between the variables. Consequently, according to this table, the "significance value" of IV1 is 0.013, which is near the value of 0.05 (Morgan et al. 2019). Subsequently, it is exposed that there is a robust encouraging connection between the variables. Additionally, the "significance value" of IV2 is 0.014, representing a positive association between the variables. Furthermore, the third variable also had a noteworthy score value of 0.07, denoting that it similarly confirmed a momentous value that is not as much as 0.05. There was also a connection between these factors. The last variable is also effectively connected with the dependent variable cohesively.

Multiple regression



Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.214[a]	.046	-.011	.974	.046	.800	4	67	.053	2.585

a. Predictors: (Constant), IV4, IV3, IV2, IV1
b. Dependent Variable: DV

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3.037	4	.759	.800	.053[b]
	Residual	63.574	67	.949		
	Total	66.611	71			

a. Dependent Variable: DV
b. Predictors: (Constant), IV4, IV3, IV2, IV1

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	3.734	1.096		3.406	.001
	IV1	-.134	.115	-.163	-1.160	.250
	IV2	.072	.151	.067	.478	.634
	IV3	.139	.164	.121	.847	.400
	IV4	-.057	.175	-.043	-.328	.744

a. Dependent Variable: DV

Table 7: ***Multiple regression analysis***

As per Table 7, regression analysis displays the score values of the variables. The R-value is 0.21 and the R-square value is 0.05. Moreover, the ANOVA table highlights the score value of significance which is 0.05, and this is equivalent to the normal distributional value of significance (Pallant, 2020). Therefore, this analysis supports the hypothesis and the strong connection between the variables.

Discussion

While mixing AI into SC promises important compensations in efficiency and quickness, it is not deprived of its encounters. Corporations must approach AI implementation with planned considerations of the complications involved, harmonizing technological modernization with real-world data management deliberations, system incorporation, skill expansion, ethical morals, and cyber security (Modgil et al. 2022).Circumnavigating these challenges positively will be vital to connecting the full possibility of AI in renovating the operations of the supply chain.

Artificial intelligence is a game-transformer for the progress and advancements of SCM, flattering a necessity rather than an extravagance. The market for AI in the SC is predicted to reach $41 billion by 2030, increasing 39% annually as compared to 2023. Imagine a world where SCs are self-automated, can predict tomorrow's customer requests, and can investigate their inadequacies and redirect deliveries in real-time based on rapid weather variations (Benzidia et al. 2021). Though predictive analytics is one of AI's greatest praised features in SCM, attaining a

balance between accuracy and practical pertinency is challenging. Integrating AI upsurges the menace of cyber intimidations, making cyber security a perilous deliberation. AI technology is uninterruptedly developing, necessitating businesses to stay flexible and effective. Keeping up with technological progressions and frequently apprising AI systems are essential to uphold a competitive edge in SCM (Riahi et al. 2021). The rate of integrating AI into SC is considerable, surrounding the skill itself and allied expenditures such as training, system advancements, and ongoing maintenance.

Conclusion

It can be concluded from the study that an important challenge in AI incorporation is the excellence of data. AI structures are only as upright as the data they course. Only precise, comprehensive, and rationalized data can result in good AI yields, hypothetically causing disturbances in supply chain processes. Progressing integrated AI schemes or emerging innovative AI-compatible daises requires considerable investment, period, and proficiency. AI in supply chains also hinges on the obtainability of skilled employees, satisfactory training, and hiring original talent becomes critical for industries implementing AI.

Picture warehouses resemble separately with distributors and control stock before hand shop managers are even conscious there's a requirement to restock it. Self-automated cars and drones will deliver goods and be intelligent enough to see the location of an order in an app.

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