

Double-Edged Sword: Concerns & Expectations of AI For Supply Chain Optimization in Saudi Companies

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Abstract

AI is an emerging technology, particularly in developing countries, where it is viewed with both praise and scepticism. This dual view is more pronounced in supply chain management, where managing resources through technology is a high priority for all firms. Saudi Arabia, the largest economy in the GCC, serves as a representative sample. Surveying 300 Saudi companies yields an interesting trend. They possess a moderate understanding of AI in supply chain optimisation and are concerned about its impact and future implications. So, AI, for them, is a double-edged sword.

Keywords: AI, supply chain optimization.

Introduction

The development of AI has undergone different cycles, starting in the 1970s and then in the 1980s, but then it stalled due to a lack of significant improvement. Artificial Intelligence (AI) has experienced a revival after two earlier attempts in the 1970s and 1980s. The advent of improved algorithms, computing power, and society digitisation, along with new developments, has led to significant advances in image recognition/classification, mapping, voice recognition, pattern identification, and data brokering using AI.

It can impact various sectors of the economy, ranging from information technology (IT) to Finance. This also includes comprehensive supply chain management, from sourcing raw materials to supplying finished goods to the end user. The level of effectiveness in each of these sub-areas of the supply chain needs to be established. Still, overall, there is no doubt it has the potential to increase efficiency, reduce costs, and improve processes.

Literature has demonstrated this effectiveness in demand forecasting, inventory management,

transportation routes, network design, and optimising stock levels (Zhu et al., 2019; Younis et al., 2021). It has also highlighted the initial disappointment among supply chain practitioners regarding inflated expectations from AI (Sodhi et al., 2022). This can be due to limited understanding, different organisational goals, or non-alignment with other stakeholders. However, this dual view of improvements & disappointments is not validated in all countries and sectors due to the unique nature of the supply chain industry, country dynamics, AI infrastructure limitations, and limited access to empirical data.

This gap can also highlight broader AI implementation issues related to utility, knowledge, and perceived benefits for overall supply chain management in those countries and industries. This is especially true for developing countries, where AI is still in its infancy and its perceived benefits have not yet materialised; hence, potential scepticism about its advantages can exist.

This leads to the following research questions

Q1: What is the current level of AI knowledge in developing countries, especially in supply chain management?

Understanding this question is critical as a basic understanding of AI in supply chain management is paramount to see its potential benefits and pitfalls for developing countries with scarce resources. Using them wisely decides the survival of the companies/sectors.

This key question leads to another one, exploring how AI knowledge in supply chain development influences their expectations and the risks they foresee for their future business needs from this emerging technology. A multidimensional view is needed to understand the complex interplay of AI applications in supply chain management within a given country setting. Country-wise analysis will generate novel insights, as each country has different infrastructure, AI understanding, and limitations in its supply chain for adoption. This will also help in understanding the readiness of its supply chain actors about this emerging technology. A country-specific context across different supply chain sectors is critical for understanding AI from a practitioner's perspective and recognising its real utility.

Another key question arising from this is how AI knowledge will translate into perceived advantages or disadvantages for these companies, particularly in terms of waste management and optimising resources for their supply chain management. Therefore, the following research question is

Q2: What is the AI perception from risk and rewards point of view in these companies' supply chain management?

To address both the above questions, a critical review of the literature and primary data is necessary to validate the research questions and understand how developing countries perceive AI from a supply chain management perspective.

Literature Review

Saudi Arabia is the largest economy in the GCC (Gulf Cooperation Council) and serves as a representative example of how AI implementation is carried out in this region. Different AI initiatives under the Umbrella of Vision 2030 have been developed or proposed.

Literature around supply chains and AI in Saudi Arabia is evolving. Different themes arise from reviewing it. This includes utilising AI for productivity and efficiency, as well as automation & integration with existing supply chain processes (Mohamed et al., 2022). Most studies have a limited sample size or a scope that is too narrow to be critically considered (Khan et al., 2013). Diverse sectors are not included, and the hype surrounding AI is often discussed without consulting practitioners.

Hangl et al. (2022) have examined the barriers to the adoption of AI in supply chain management and highlighted technical limitations, change management, and human factors as key barriers to its adoption. These barriers appear to be more closely aligned with cost-related and process-based issues. Domain knowledge, privacy issues, utility concerns, usability, capabilities, and documentation were other key issues mentioned in this study, all of which are required for the adoption of AI. It emphasises that supply chain management must function as a system if AI is to be adopted, and this requires deliberate efforts from top management, especially to mitigate internal resistance to the processes within companies/sectors. This needs to be examined from a different country's supply chain lens, as stakeholders, regulations, documentation, and infrastructure are widely different.

This leaves a considerable gap in the fundamental understanding of AI in supply chain management across different sectors of Saudi Arabia and developing countries. This gap needs to be filled by empirical research, which utilises a considerable sample size for generalisation purposes.

Data collection & Research methodology

More than 300 Saudi companies with extensive supply chains were contacted to understand the impact of AI on supply chain optimization. A survey questionnaire was administered using multiple online & offline channels.

The survey consisted of five sections: demographics of the respondents, knowledge & awareness, current practices, challenges & concerns, and prospects & recommendations. There were some open-ended questions at the end of the survey to better understand respondents' insights about both optimisation and AI.

The data was then consolidated using an Excel sheet, and all redundant/missing/ incorrect entries were removed/filtered. Given the significant sample size, the companies belong to the services and product sectors. Initially, descriptive statistics were applied to the respondents' demographics to identify overall trends. Subsequently, data visualisation and analysis software, such as Tableau & SPSS, will be employed to understand the interplay of different variables and their impact on the supply chain optimisation of Saudi companies.

Multiple linear regression is planned for this primary research, as it offers a robust analysis and will clarify the impact of input variables, such as knowledge & perceived effectiveness of current practices, on future expectations of AI & supply chain optimisation.

Initial Results & Discussion

Based on the demographics of the respondents, most of them have a service length of 2 to 10 years within the company. So, they range from new to relatively experienced people to see the impact of this emerging technology on its supply chain management, as shown in Table 1 below

Length of Service (Years)	n	%
0-2	70	25.27%

2-5	55	19.86%
5-10	61	22.02%
10-15	36	12.98%
15-20	15	5.42%
20-50	7	2.53%
Missing	33	11.91%

Table 1: Length of Service of Respondents

Although the data is tilted towards relatively middle-experienced respondents, given the quality of answers, there was also a considerable segment of experienced managers. This can be an advantage, as younger respondents tend to be more familiar with emerging technologies, whereas experienced respondents are adept at understanding supply chain dynamics within a company.

The company's size is a significant indicator of its understanding of this emerging technology in its supply chain management. Most reported respondents belong to medium-sized companies with 500 to 5000 employees, as shown in Table 2 below. Although a significant number of companies do not disclose their employee numbers due to privacy concerns, it is suspected that these companies are medium to large-sized.

Number of Employees	n	%
0-50	10	3.61%
50-150	15	5.42%
150-500	35	12.64%
500-1000	25	9.03%
1000-5000	35	12.64%
5000-10000	12	4.33%
10000-30000	8	2.89%
30000-50000	1	0.36%
50000-100000	1	0.36%
100000-200000	1	0.36%

200000-300000	1	0.36%
1000000	1	0.36%
Missing	132	47.66%

Table 2: Number of Employees in Respondent's Companies

The most prominent AI concerns of Saudi companies are data integration, data security & data inaccessibility, as shown in Figure 1 below.

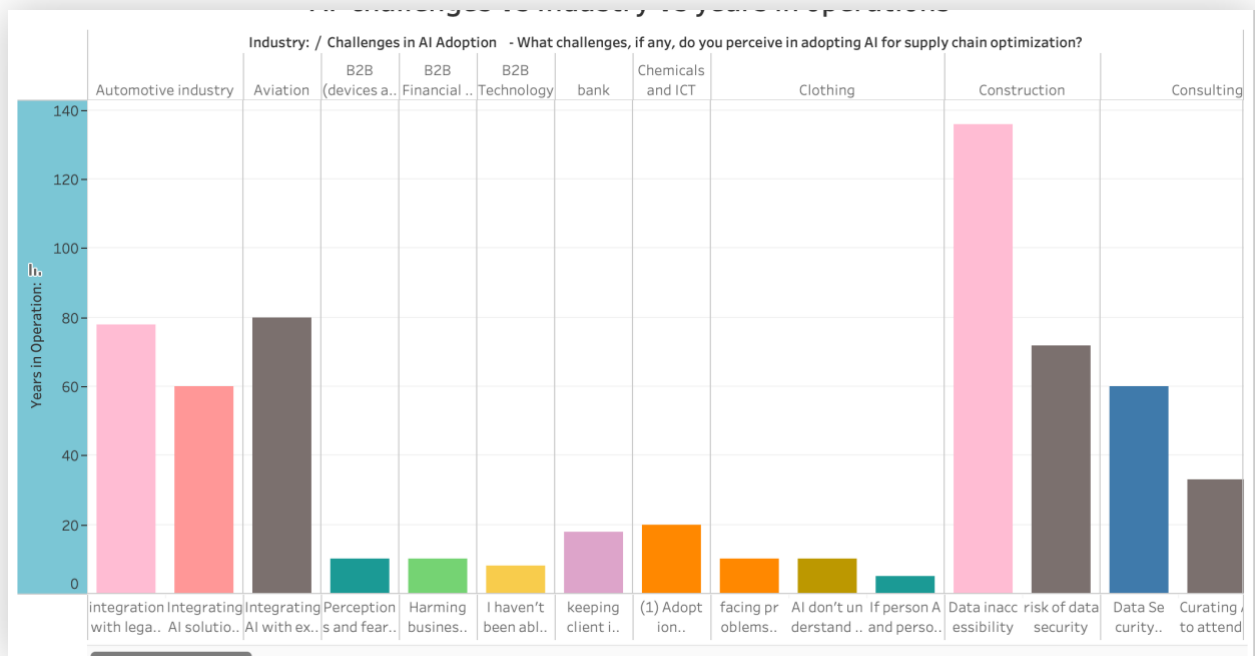


Figure 1: AI adoption challenges vs years in operation

This trend of concerns about AI integration was present in all types of companies, whether old or new.

Descriptive Statistics

Knowledge, AI Impact, Implementation & Concerns

Statistics					
		Knowledge of AI in Supply Chain – To what extent are you familiar with the use of Artificial Intelligence in supply chain optimization?	Aware of AI Impact – How aware are you of the potential impact of AI on supply chain ...	Current AI Implementation – Is your organization currently implementing AI technologies in supply chain processes?	Concerns about AI Impact – To what extent are you concerned about the potential drawbacks or risks associated with AI in supply chain optimization?
N	Valid	283	283	283	236
	Missing	78	78	78	125
Mean		2.96	3.31	2.59	2.84
Std. Deviation		1.234	1.210	1.272	.993
Skewness		-.058	-.326	.213	.171
Std. Error of Skewness		.145	.145	.145	.158

Figure No. 2: Descriptive statistics about AI's knowledge, impact & concerns

As shown in Figure 1 above, respondents were moderately familiar with AI in SC and considerably aware of its impact. Meanwhile, AI implementation is relatively moderate, and concerns about its risks are higher.

Correlation

AI Familiarity Vs. Perceived Effectiveness in Optimizing Supply Chain Process

Correlations			
	Knowledge of AI in the Supply Chain - To what extent are you familiar with using artificial intelligence (AI) in supply chain optimization?	Perceived Effectiveness - How effective do you think AI technologies are in optimizing supply chain processes?	
Knowledge of AI in the Supply Chain	Pearson Correlation	1	.200**
	Sig. (2-tailed)		<.001

- To what extent are you familiar with using artificial intelligence (AI) in supply chain optimization?	N	283	283
Perceived Effectiveness	Pearson Correlation	.200**	1
	Sig. (2-tailed)	<.001	
- How effective do you think AI technologies are in optimizing supply chain processes?	N	283	283
** . Correlation is significant at the 0.01 level (2-tailed).			

Figure No. 3: Correlation between AI Familiarity and Perceived Effectiveness

There is a weak, positive, and significant relationship between AI familiarity and perceived effectiveness in optimising supply chain management. This clearly shows that Saudi companies at this stage do not consider having AI familiarity to improve their supply chain optimisation.

Similarly, awareness of AI is closely linked to its concerns in the supply chain management of Saudi companies, as illustrated by the correlation between the two.

Correlations			
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	Aware of AI Impact	Concerns about AI Impact - To what extent are you concerned about AI's potential drawbacks or risks in supply chain optimization?	
Aware of AI Impact	Pearson Correlation	1	.217**
- How aware are you of the potential impact of AI on supply chain efficiency?	Sig. (2-tailed)		<.001
	N	283	236
Concerns about AI Impact	Pearson Correlation	.217**	1
- To what extent are you concerned about AI's potential drawbacks or risks in supply chain optimization?	Sig. (2-tailed)	<.001	
	N	236	236
**. Correlation is significant at the 0.01 level (2-tailed).			

Figure no 4: Correlation between AI awareness and AI concerns

Multi-linear regression model

To gain a deeper understanding of these relationships, a multilinear regression model was developed to examine the interplay between them. Multicollinearity diagnosis was made at the start ($VIF < 3$, tolerance > 0.2), and the significance of independent variables was also validated. The model parameters are shown in Figure 3 below.

Model	R	R Square	Adjusted R Square	the Estimate
1	.651 ^a	.424	.408	.909

a. Predictors: (Constant), AI improves inventory management efficiency., Concerns about AI Impact

- To what extent are you concerned about the potential drawbacks or risks associated with AI in supply chain optimization? , Knowledge of AI in Supply Chain
- To what extent are you familiar with the use of Artificial Intelligence in supply chain optimization?, Future Expectations
- How optimistic are you about the future impact of AI on supply chain optimization?

ANOVA ^a						
Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	92.361	4	23.090	27.929	<.001 ^b
	Residual	125.665	152	.827		
	Total	218.025	156			

a. Dependent Variable: To what extent do participants perceive the impact of AI on supply chain optimization, particularly in areas such as demand forecasting accuracy, inventory management efficiency, supplier relationship management, agility of supply chain operations, and optimization of transportation and logistics?

Figure 5: Multi-regression model for measuring the impact of AI on SC optimization

R square was 42% at a 95% confidence interval, which is not ideal. Still, given that all the variables were significant earlier, the correlation results are supported by the multiple-regression model equation below.

Perceived Impact of AI on SC optimization= $-0.265 + 0.193(\text{AI knowledge in SC}) + 0.158(\text{AI concerns}) + 0.06(\text{future AI expectation}) + 0.080(\text{AI on efficient inventory management}) + 125.665$

Initial Conclusion

Clearly, Saudi companies lack sufficient exposure to AI and are concerned about its integration, security, and accessibility. The regression equation indicates that their future expectations from this emerging technology are also not high. Middle and senior managers share this view in both young and old companies. Therefore, a more in-depth analysis is necessary to comprehend the underlying causes of such scepticism and concerns. This means adding more sectors and doing qualitative research to further understand the underlying causes of these dual views.

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