

***Majors: SCM
Major/No. S10***

“Uses of Artificial Intelligence in Improving Environmentally Sustainable Supply Chain Performance: Mediating Role of Supply Chain Resilience and Moderating Role of Internal Green Supply Chain Management Practices”



By:

Muhammad Hassan Raza Khan

01-222242-005

Supervisor:

Dr. Muhammad Haroon Malik

HR and Management Department

Bahria University Islamabad

Spring 2026

ABSTRACT

The rapid growth of Artificial Intelligence (AI) has significantly changed modern supply chain operations by improving effectiveness, adaptability, and sustainability. As more businesses use AI-powered technologies, it is critical to analyze their effect on Environmentally Sustainable Supply Chain Performance (ESSCP). Furthermore, ability of supply chains be resilient during disturbances, as well as the application of internal green supply chain management practices, play a key role of obtaining environmental sustainability.

The main objective of this research was to examine the effect of AI adoption on Environmentally Sustainable Supply Chain Performance. Furthermore, study intended to explore mediating impact of Supply Chain Resilience (SCR) between AI adoption and ESSCP. Furthermore, this study aimed to evaluate the moderating impact of Internal Green Supply Chain Management Practices (IGSCMP) in enhancing relationship between AI adoption and supply chain resilience.

Primary research has been carried out in this research with the data collected by conducting a survey. The selected group consists of supply chain professionals in various sectors of supply chain management within Islamabad and Rawalpindi. The SPSS software package has been used to analyze the data obtained.

The results suggest that integrating AI into supply chain operations improves environmental sustainability performance, not only on its own but also by strengthening supply chain resilience, which acts as a mediating mechanism. In addition, strong internal green supply chain management practices were found to reinforce the link between AI adoption and resilience outcomes, making that relationship more pronounced. Overall, the study extends existing academic understanding while also offering practical direction for managers and policymakers who aim to build more resilient and environmentally responsible supply chains through the use of AI-driven systems.

Keywords: Uses of Artificial Intelligence, Environmentally sustainable supply chain performance, Supply chain resilience, Internal green supply chain management practices

Abbreviations

AI	Artificial Intelligence
ESSCP	Environmentally Sustainable Supply Chain Performance
IGSCMP	Internal Green Supply Chain Management Practices
IoT	Internet of Things
RBV	Resource-Based View
SCM	Supply Chain Management
SCR	Supply Chain Resilience
UAI	Use of Artificial Intelligence

Table of Contents

CHAPTER 1. INTRODUCTION	1
1.1. Background of study	1
1.2 Problem Identification	5
1.3 Research Gap.....	7
1.4 Research Questions.....	8
1.5 Research Objectives.....	8
CHAPTER 2: LITERATURE REVIEW	10
2.1 Artificial Intelligence (AI) Adoption in Supply Chain Management	10
2.2 Environmentally Sustainable Supply Chain Performance (ESSCP)	13
2.3 Supply Chain Resilience (SCR)	17
2.4 Internal Green Supply Chain Management Practices (IGSCMP).....	21
2.5 Underpinning Theory	25
2.6 Hypothesis Development	28
2.7 Conceptual Model of the Study.....	29
Chapter 3 RESEARCH METHODOLOGY	31
3.1 Introduction.....	31
3.2 Research Method.....	32
3.3 Research Approach.....	32
3.4 Research Design.....	32
3.5 Research Strategy.....	33
3.6 Research Philosophy	33
3.7 Time Frame	33
3.8 Unit of Analysis	34
3.9 Population	34
3.10 Sample Size.....	34
3.11 Sampling Technique	35
3.12 Data Collection	36
3.13 Data Analysis	36
3.14 Research Instrument	37
CHAPTER 4: RESULTS	39
4.1 Data Cleaning and Preprocessing	39
4.2 Demographics Profiles of Respondents.....	39
4.3 Descriptive Examination of Scales	40
4.4 Correlation Analysis.....	42

4.5	Measurement Model Assessment	43
4.5.1	Reliability Statistics	43
4.5.2	Validity Statistics	43
4.6	Diagnostics Tests	45
4.6.1	Common Method Bias	45
4.6.2	Normality Assessment	45
4.6.3	Response Bias Assessment	47
4.7	Hypothesis Testing	48
4.7.1	Hypothesis 2(UAI positively impacts ESSCP)	49
4.7.2	Hypothesis 1 (SCR mediates the relationship between UAI and ESSCP).....	49
4.7.3	(IGSCMP moderates' relationship between UAI and ESSCP)	51
4.7	Hypothesis Summary	55
CHAPTER 5 DISCUSSION AND CONCLUSION.....		56
5.1	Discussion	58
5.1.1.	Hypothesis 1.....	58
5.1.2.	Hypothesis 1.....	63
5.1.3.	Hypothesis 2.....	61
5.2.	Managerial and practical implications.....	65
5.3.	Limitations and Future Directions	67
5.4.	CONCLUSION	68
References		71
Annexures		78
Annexure A: Questionnaire		78
Annexure B (No. of Companies Registered in Pakistan)		81
Annexure C: Single Factor PCA Extractions.....		82

List of Tables

Table 1: Research Instrument of the Study.....	38
Table 2: Demographics Profile of the Study	40
Table 3: Descriptive Statistics of Study Scales	41
Table 4: Correlation Statistics of Study Variables.....	42
Table 5: Cronbach's Alpha Statistics of Scales.....	43
Table 6: Principal Component Analysis Statistics of Study Scales	44
Table 7: Independent Samples T-Test Results for Response Bias Assessment (Wave Analysis).....	48
Table 8: Results of Ordinary Least Squares Regression for Hypothesis 2(UAI → ESSCP)..	54
Table 9: Results of Mediation Analysis for Hypothesis 1 (UAI → SCR → ESSCP).....	51
Table 10: Results of Moderation Analysis for Hypothesis 2 (UAI × IGSCMP → ESSCP) ..	52
Table 11: Highest Order Unconditional Interaction Effect of UAI × IGSCMP on ESSCP ...	52
Table 12: Conditional Effects of UAI on ESSCP at Different Levels of IGSCMP	53

List of Figures

Figure 1: Conceptual Model of the Study (Developed by Researcher)	30
Figure 2: Histogram of Uses of Artificial Intelligence (UAI) Score Distribution with Normal Curve...	46
Figure 3: Histogram of ESSCP Score Distribution with Normal Curve.....	46
Figure 4: Histogram of SCR Score Distribution with Normal Curve	47
Figure 5: Histogram of IGSCMP Score Distribution with Normal Curve.....	47
Figure 6: Interaction effect of UAI at different levels IGSCMP on ESSCP	53