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The Influence of Strategic Human Resource Management and Artificial Intelligence in Determining Supply Chain Agility and Supply Chain Resilience

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Abstract: The aim of this research was to investigate factors that influence logistics firms' supply chain agility and supply chain resilience. Therefore, an integrated research model based on strategic human resource management and artificial intelligence was developed to determine the agility and resilience of logistics firms. Empirical data were collected from 221 employees working in manufacturing firms in Saudi Arabia. For the data analysis, a structural equation modeling approach was used. The results indicated that joint leadership, employee skills, organizational culture, competitive intensity, human capital development, and artificial intelligence had substantial explained variance R^2 of 80% for supply chain agility. Similarly, an importance performance analysis revealed that, within the integrated research model of supply chain agility, the factors of leadership, human capital development, and organizational flexibility had greater importance in determining supply chain resilience. Practically, this research shows that factors like leadership, employee skills, organizational culture, competitive intensity, human capital development, and artificial intelligence are positively associated with supply chain agility and, hence, require policymakers' attention. The value of this research lies in its integration of artificial intelligence, organizational flexibility, and strategic human resource management to explore supply chain agility and its examination of the impact of these factors on supply chain resilience.

Keywords: strategic HR management; artificial intelligence; human capital development; competitive intensity; organizational flexibility; supply chain agility; supply chain resilience

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1. Introduction

The constantly changing environment and rising global competition have made it necessary for logistics firms to establish novel strategies that bring agility and resilience to their logistics operations. During the recent COVID-19 pandemic, it was noted that logistics firms showcasing the characteristics of resilience and agility showed continuity in their operations [1,2]. Therefore, it is essential to examine the factors that bring agility and resilience in supply chain operations. Supply chain agility can be seen as a firm's ability to ensure continuity in its logistics operations, while resilience indicates the adaptive ability of a logistics firm to return to normal operations after a disruption [3,4]. Despite the exponential growth in the literature on supply chains, empirical insights into how logistics firms achieve supply chain agility are yet to be obtained [5]. Although the literature has established a positive association between human resource practices and supply chain resilience [6,7], little research is available that discusses the relationship between strategic human resource management and supply chain agility. To bridge this gap, in the current study, we develop a research framework that combines factors such as leadership, employee skills, organizational culture, competitive intensity, human capital development, and artificial intelligence to determine logistics firms' agility and resilience.

The authors of [8] studied strategic human resource management as a single factor in determining employee commitment and competitive advantage. Using an approach differing from that of the current study, they summarized strategic human resource management as five core dimensions, namely leadership, employee skills, organizational culture, competitive intensity, and human capital development, and they investigated supply chain agility. The term "leadership" refers to a leader's role in nurturing a positive, conducive, and supportive environment in an organization and boosting employees' self-motivation and commitment towards their tasks during a disruption [5,9]. Employee skills are defined as employees' abilities to learn new concepts, their familiarity with the latest technologies, and their readiness to deal with unprecedented disruptions [10]. Organizational culture is recognized as a core predictor in measuring the performance of a logistics firm during disruptive events [11]. Furthermore, the competitive intensity factor enables logistics firms' activity and assists firms in adapting to market demands [12]. Human capital can be defined as the collective sum of attributes, including experience, knowledge, enthusiasm, energy, and creativity, that employees invest at their workplace [13]. Besides strategic human resource management, the artificial intelligence dimension is recognized as an important technology enabler that allows logistics managers to manage logistics operations quickly and adequately and enhance their agility in these operations [14]. Thus, these factors are conceptualized to determine supply chain agility and resilience.

2. Literature Review

2.1. Leadership and Employee Skills

The role of leadership is identified as a major strategic requisite in the management of supply chain disruption. Leadership that takes quick action against environmental changes, considers consumer preferences, obtains deep insights into government policies and regulations, and understands stakeholders' requirements has been shown to be sustainable during unprecedented disruptions [5]. Therefore, understanding the role of leadership in determining supply chain agility is critical. Leadership in this study is defined as a management role that nurtures a positive, conducive, and supportive culture in an organization to boost employees' self-motivation and commitment towards task achievement during a disruption. A substantial body of literature supports the assertion that good leadership unites employees and promotes mutual trust, which, in turn, brings a positive impact in terms of employee behavior and agility in logistics operations [5,9]. Consistently, it is assumed that leadership enhances employees' confidence to keep working in disruptive environments and increases the agility in supply chain (SC) operations. Besides leadership, the role of employee skills cannot be ignored in achieving agility and resilience in supply chain operations. Employee skill development is explained as employees' ability to learn new concepts, their familiarity with the latest technologies, and their readiness to deal with unprecedented disruptions. The authors of [10] emphasized that strong employee skills enable employees to respond to changes quickly and, therefore, must be considered in developing new SC strategies. Another study [15] asserted that employees with the right skills have a better capacity to work under turbulent conditions. Therefore, it is assumed that employees' skills are positively associated with agile logistics operations [5,9,16–18]. Thus, the following hypotheses are assumed.

H1: *Leadership is positively related to supply chain agility.*

H2: *Employee skills are positively related to supply chain agility.*

2.2. Organizational Culture, Competitive Intensity, and Human Capital Development

Organizational culture is recognized as a core predictor of logistics firms' performance during disruptive events [11]. To date, organizational culture has been used in studies to predict the innovative work behavior, creativity, and commitment of employees [19,20]; nevertheless, the relationship between organizational culture and agility is rarely concep-

tualized. Within the literature on strategic human resource management, organizational culture is defined as a set of shared values and practices aiming to achieve high performance in a firm [11,21]. According to [11], organizations that have a culture of training their personnel in resilience policies are better able to recognize risks in supply chain operations. Moreover, it is argued that training employees in resilience policies brings internal efficiency and, consequently, better coordination and agility in logistics operations [11,22]. In order to ensure logistics operations' continuity, it is essential that logistics firms are aware of external market forces. The competitive intensity factor is associated with the activeness of logistics firms and assists firms in adapting to market demands. Therefore, managers can calibrate the influence of competitive intensity in managing internal policies and supply chain disruption [12]. Extensive studies in the literature show that logistics firms are highly dependent on human capital [13,23–27], and the author of [23] stated that the human capital factor must be an integral part of logistics policies. The term "human capital" is defined as the collective sum of attributes, including experience, knowledge, enthusiasm, energy, and creativity, that employees invest in their workplace [13]. Recently, the authors of [13] established a positive linkage between human capital and supply chain resilience. Therefore, it is assumed that human capital development increases supply chain agility. Thus, the following hypotheses are formulated.

H3: *Organizational culture is positively related to supply chain agility.*

H4: *Competitive intensity is positively related to supply chain agility.*

H5: *Human capital development is positively related to supply chain agility.*

2.3. Nexus between Artificial Intelligence and Supply Chain Agility

Digital technology has been widely adopted and is used among manufacturing firms to manage logistics operations [28,29]. The recent advancements in technology and the arrival of AI tools have improved the agility of logistics operations. In the literature on logistics, artificial intelligence is explained as a complex technology that has the ability to perform cognitive functions usually linked to human intelligence—for instance, learning, interacting, and solving logistical problems [14]. Artificial intelligence has the capability to communicate with multiple communication devices and machines and ensure the continuity of logistics operations [30]. The authors of [29] postulated that artificial intelligence resolves complex problems with speed and high accuracy and, therefore, must be considered in business operations. In addition, prior studies indicate that artificial intelligence enhances the service quality and ensures timely product delivery to customers, without interruption [31,32]. Similarly, studies have shown that artificial intelligence assists managers in anticipating problems and promptly responding to changes [32,33]. According to the authors of [33], AI enhances the predictive capability and can be used to efficiently track orders. Aside from its operational efficiency, AI can reduce transaction costs through rigorous monitoring and big data analytics [34]. In prior studies, researchers have mutually agreed that the use of artificial intelligence enhances the agility and resilience in logistics operations [4,31,32,34,35]. Thus, the relationship between artificial intelligence and supply chain agility is conceptualized as follows.

H6: *Artificial intelligence is positively related to supply chain agility.*

2.4. Organizational Flexibility

Organizational flexibility enables a firm to effectively and efficiently operate in uncertain and turbulent environments and is positively associated with supply chain resilience. Logistics firms rely on numerous different stakeholders; therefore, a delay in decision implementation could have serious impacts on logistics operations. Consistently, the focus of this study is to shed light on how organizational flexibility enhances logistics firms' agility and resilience. The term "organizational flexibility" is identified as a firm's ability to

maintain control during unprecedented events, with a variety of sources and managerial capabilities, and respond to changes quickly, effectively, and efficiently [36,37]. In the prior literature, organizational flexibility was found to be an important managerial tool to control uncertainty and assist managers in efficiently implementing decisions [36,38–40]. The authors of [36] asserted that flexibility in decision making improves an organization's agility and resilience and enables a firm to operate successfully in a turbulent environment. For instance, the latest technologies, such as big data analytics, may provide better insights in situations of uncertainty; however, timely decision making is as important as performing data analytics. Studies in the literature have indicated that organizational flexibility in manufacturing firms reduces the team hierarchy in processing operations and improves the smoothness of logistics operations by removing delays [36,41]. Therefore, a moderating effect of organizational flexibility is hypothesized between supply chain agility and resilience. Extensive research work has underscored the positive impact of organizational flexibility in determining supply chain agility and resilience [38–40,42,43]. Thus, the following hypotheses are assumed.

H7: *Supply chain agility is positively related to supply chain resilience.*

H8: *Organizational flexibility moderates the relationship between supply chain agility and supply chain resilience.*

3. Methodology

3.1. Research Methods

The focus of this research, as shown in Figure 1, was to examine how strategic human resource management and artificial intelligence influence logistics firms' operational agility and resilience. Consistently, prior research has been designed under a positivist research paradigm [44,45]. Therefore, quantitative data were collected through a structured questionnaire. The survey questionnaire included factor items enumerated on a seven-point Likert scale. Concerning the research population, we selected manufacturing firms for data collection in order to be consistent with prior studies [41,46]. The sample size was selected according to the guidelines provided by [44]. The author of [44] suggested that a sample size of 200 respondents is adequate for structural equation modeling. The data were collected using a purposive sampling technique, as recommended by prior researchers [41,44,47]. The survey questionnaires were distributed among employees working in manufacturing firms in Saudi Arabia. The respondents were approached physically and asked to participate in this logistics research. In order to retrieve a sample of 200 responses, we distributed 256 questionnaires to potential respondents. Participation in this logistics survey was entirely voluntary. Among the 256 potential respondents, 35 refused to participate due to time limitations. Nevertheless, 221 responses were received from employees and used in the data analysis.

The questionnaire items representing latent factors were adapted from previously developed scales. Our research objectives in this study required us to empirically test assumptions; therefore, data were collected through questionnaire items. There are five dimensions of strategic human resource management, namely leadership, employee skills, organizational culture, competitive intensity, and human capital development. The questionnaire items for the leadership factor were adapted from [10,48]; items for employee skills were adapted from [15]; items for organizational culture were adapted from [10]; items for competitive intensity were adapted from [12,36]; and items for human capital development were adapted from [8,13]. Items for factors such as intelligence were adapted from [1]; items for supply chain agility were adapted from [49]; and items for the supply chain resilience factor were adapted from [36]. Finally, items for organizational flexibility were adapted from [36,38]. These scale items were enumerated on a 7-point Likert scale, with 7 labeled as strongly agree and 1 labeled as strongly disagree.

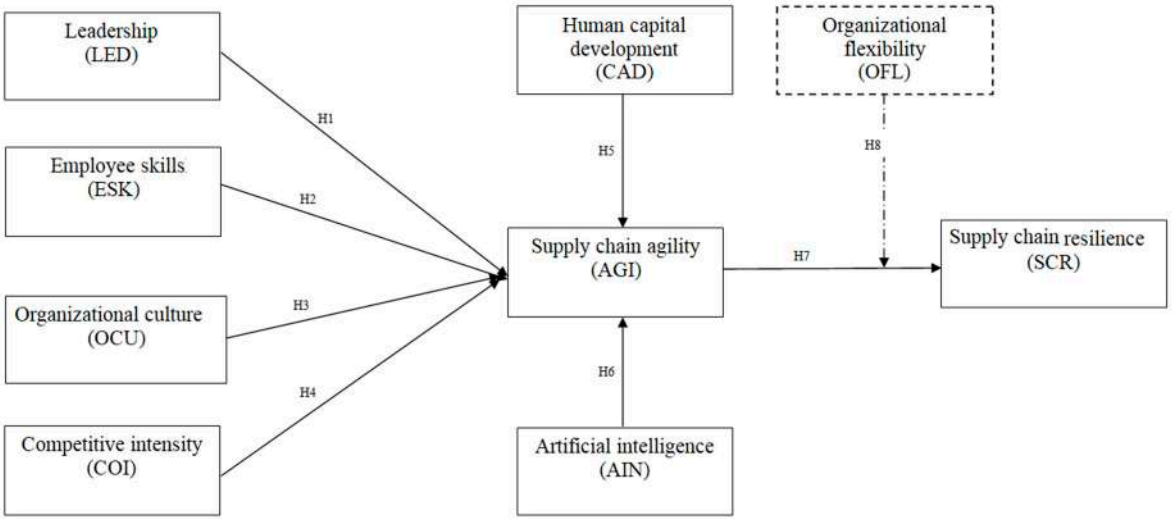

Figure 1. Research model.

3.2. Data Bias Issues

The research model comprised nine latent factors, measured through a quantitative approach. Data relating to all these factors were collected through survey questionnaires. In quantitative research, it is essential to ensure that the data are free of any kind of bias. In particular, common method bias has been identified as a potential issue in quantitative research and must be addressed before any analysis of the hypotheses. To address this issue, statistical and procedural measures are employed in data analysis. In this study, as a procedural measure, the survey questionnaires were mixed before data collection. Harman's single-factor analysis has obtained substantial support in prior studies as a statistical measure and was therefore selected in this study to ensure that the data were free of common method bias [44,50–53]. In Harman's single-factor analysis, to ensure data validity, the value released by the first factor must be less than 40%. The data were computed and revealed 19% variance in the unrotated factor extraction. Thus, Harman's single factor analysis presented a satisfactory value for the first unrotated factor, ensuring the data's validity.

4. Data Analysis and Results

The study data were analyzed through structural equation modeling, following a two-step process [54]. The first step of SEM ensures factor reliability, validity, and convergent and discriminant validity. The hypotheses are then tested in the second step of SEM. Following the guidelines provided by [54], indicator reliability is considered to be achieved when the loadings of the factors are greater than 0.60. For factor reliability and validity, the values of α and CR must be higher than 0.70 to be considered satisfactory [54]. Convergent validity is established with a threshold value of 0.50, indicating the satisfactory convergent validity of the factors [54]. The study data were analyzed, and the PLS algorithm revealed satisfactory values for α and CR. Similarly, indicator reliability was achieved, as the loading values were higher than 0.60 [54]. Finally, the results revealed that the average variance extracted values were higher than 0.50, thus establishing the convergent validity of the factors. Table 1 depicts the loading, α, and CR values obtained and the average variance extracted.

In order to ensure discriminant validity, cross-loading and Fornell–Larcker analyses were incorporated. The cross-loading criterion suggests that the loadings of the indicators must be higher than other factors' loadings. The results of the cross-loading analysis showed satisfactory loading values, thus establishing the discriminant validity of the factors. The results of the cross-loading analysis are exhibited in Table 2.

Table 1. Factor reliability, validity, and convergent validity.

Item	Loading	α	CR	AVE
AGI1: This firm has ability to deliver product quickly during disruption.	0.916	0.926	0.953	0.871
AGI2: This firm meets evolving customer needs and quickly responds to changes.	0.962			
AGI3: This firm is capable to meet customers need without any interruption.	0.921			
AIN1: This logistic firm uses artificial intelligence to track products.	0.866	0.808	0.886	0.723
AIN2: This logistic firm measure uncertainty through artificial intelligence.	0.905			
AIN3: Artificial intelligence enables employees to take quick decisions.	0.774			
CAD1: Employees are highly skilled and efficiently respond to disruption.	0.831	0.876	0.916	0.732
CAD2: Employees are encouraged to be creative at work place.	0.907			
CAD3: Employees are considered best to manage logistic operations.	0.763			
CAD4: Employees in this firm are expert to manage logistic operations.	0.913			
COI1: This logistic firm has high competitive rivalry.	0.872	0.805	0.884	0.718
COI2: The new entrant in this logistic firm is high.	0.827			
COI3: This logistic firm has high market concentration.	0.842			
ESK1: Employees in this firm have exposure to deal with disruption.	0.845	0.879	0.925	0.806
ESK2: Employees get trainings to deal with unexpected events.	0.910			
ESK3: Employees have multi-disciplinary skills to manage disruption.	0.935			
LED1: Leadership of this firm actively participates in operational activities.	0.824	0.822	0.894	0.739
LED2: The leadership of this firm is liable to manage operational activities	0.902			
LED3: Leadership supports supply chain implementation plan.	0.850			
OCU1: Employee in this firm spent significant time in planning.	0.833	0.816	0.890	0.730
OCU2: This firm involves employees into decision making process.	0.881			
OCU3: In this firm employee gets equal opportunity to learn.	0.849			
OFL1: This firm can respond to disruption cost effectively.	0.902	0.875	0.922	0.799
OFL2: This firm can respond to disruption quickly.	0.845			
OFL3: This firm has flexibility to change organizational structure.	0.932			
SCR1: This logistic firm has ability to deal with unexpected events.	0.905	0.901	0.938	0.835
SCR2: This logistic firm can quickly return its original state after disruption.	0.956			
SCR3: During disruption logistic firm has ability to maintain desired level of control over supply chain functions.	0.879			

Table 2. Factor loadings.

Factor	AGI	AIN	CAD	COI	ESK	LED	OCU	OFL	SCR
AGI1	0.916	0.638	0.695	0.571	0.714	0.729	0.700	0.681	0.706
AGI2	0.962	0.706	0.741	0.677	0.755	0.785	0.747	0.678	0.768
AGI3	0.921	0.741	0.733	0.697	0.722	0.767	0.793	0.728	0.815
AIN1	0.652	0.866	0.643	0.542	0.582	0.582	0.649	0.550	0.607
AIN2	0.708	0.905	0.649	0.654	0.619	0.727	0.680	0.663	0.703
AIN3	0.527	0.774	0.620	0.550	0.514	0.510	0.518	0.491	0.545
CAD1	0.592	0.571	0.831	0.662	0.666	0.509	0.589	0.522	0.604
CAD2	0.719	0.656	0.907	0.757	0.797	0.627	0.710	0.567	0.738
CAD3	0.643	0.684	0.763	0.604	0.540	0.552	0.679	0.652	0.576
CAD4	0.687	0.639	0.913	0.739	0.720	0.546	0.738	0.645	0.712
COI1	0.666	0.625	0.779	0.872	0.692	0.634	0.676	0.609	0.722
COI2	0.492	0.517	0.605	0.827	0.555	0.553	0.568	0.404	0.567
COI3	0.592	0.589	0.655	0.842	0.559	0.707	0.576	0.584	0.643
ESK1	0.625	0.546	0.692	0.630	0.845	0.549	0.694	0.547	0.641
ESK2	0.724	0.632	0.712	0.624	0.910	0.717	0.629	0.581	0.701
ESK3	0.750	0.633	0.751	0.676	0.935	0.713	0.743	0.616	0.732
LED1	0.713	0.527	0.550	0.569	0.638	0.824	0.607	0.610	0.656
LED2	0.689	0.621	0.536	0.677	0.578	0.902	0.617	0.559	0.646
LED3	0.698	0.711	0.601	0.684	0.689	0.850	0.642	0.698	0.598
OCU1	0.629	0.520	0.654	0.606	0.700	0.583	0.833	0.557	0.643
OCU2	0.740	0.622	0.703	0.631	0.662	0.663	0.881	0.642	0.689
OCU3	0.679	0.724	0.686	0.611	0.608	0.607	0.849	0.669	0.662
OFL1	0.668	0.641	0.661	0.587	0.586	0.594	0.686	0.902	0.637
OFL2	0.611	0.435	0.505	0.469	0.492	0.613	0.547	0.845	0.489
OFL3	0.712	0.692	0.681	0.636	0.643	0.732	0.706	0.932	0.693
SCR1	0.747	0.700	0.770	0.745	0.683	0.674	0.735	0.688	0.905
SCR2	0.796	0.678	0.712	0.714	0.732	0.733	0.740	0.679	0.956
SCR3	0.697	0.626	0.633	0.640	0.702	0.610	0.653	0.510	0.879

Fornell–Larcker analysis is another prominent analysis technique employed in data analysis and can be used to assess factors' discriminant validity [55]. The average variance extracted must be higher than that of other factors [55,56]. Our findings confirmed the adequate discriminant validity of the factors, as the square root of the average variance extracted was higher in comparison to other factors. The results of the Fornell–Larcker analysis are exhibited in Table 3, comprising the AVE square root values and factor correlations.

Table 3. Discriminant validity analysis results.

Factor	AGI	AIN	CAD	COI	ESK	LED	OCU	OFL	SCR
AGI	0.933								
AIN	0.746	0.850							
CAD	0.775	0.747	0.856						
COI	0.697	0.686	0.810	0.847					
ESK	0.782	0.675	0.800	0.716	0.898				
LED	0.816	0.721	0.655	0.749	0.740	0.859			
OCU	0.801	0.730	0.797	0.721	0.766	0.724	0.855		
OFL	0.746	0.673	0.698	0.639	0.649	0.725	0.730	0.894	
SCR	0.819	0.732	0.773	0.767	0.771	0.738	0.778	0.689	0.914

4.1. Hypothesis Analysis

In the second step of SEM, we analyzed the hypotheses through a bootstrapping procedure. According to the author of [54], the bootstrapping procedure reduces data normality issues and must therefore be incorporated in data analysis. Moreover, multi-collinearity is addressed through the variance inflation factor [54]. None of the VIF values were higher than 3.3, thus establishing that multi-collinearity was not likely to be an issue in our data. The data were bootstrapped and revealed the positive beta values, t-statistics, and significance of the hypotheses. Table 4 depicts the results of the hypothesis analysis and the coefficients of determination.

Table 4. Hypothesis analysis results.

Hypothesis	Path	β	STDEV	t-Statistic	p-Value
H1	LED → AGI	0.449	0.060	7.440	0.000
H2	ESK → AGI	0.119	0.057	2.108	0.018
H3	OCU → AGI	0.215	0.061	3.552	0.000
H4	COI → AGI	-0.175	0.057	3.057	0.001
H5	CAD → AGI	0.289	0.059	4.928	0.000
H6	AIN → AGI	0.089	0.052	1.715	0.043
H7	AGI → SCR	0.693	0.045	15.293	0.000
Coefficient of Determination R^2					
Endogenous factors				Variance explained	
Supply chain agility R^2				80%	
Supply chain resilience R^2				68.7%	

The results of the hypothesis analysis demonstrated that leadership was positively associated with supply chain agility, strengthened by the statistical results of $\beta = 0.449$ and a t-statistic of 7.440, significant at $p = 0.000$; hence, H1 is accepted. Employee skills showed a positive impact on supply chain agility, supported by $\beta = 0.119$ and a t-statistic of 2.108, significant at $p = 0.0018$; thus, H2 is confirmed. Organizational culture showed an influence on supply chain agility, as confirmed by $\beta = 0.215$ and a t-statistic of 3.552, significant at $p = 0.0000$; thus, H3 is accepted. Moreover, competitive intensity was positively associated with supply chain agility, confirmed by $\beta = -0.175$ and a t-statistic of 3.057, significant at $p = 0.0001$; therefore, H4 is established. Human capital development showed a positive influence on supply chain agility, confirmed by $\beta = -0.175$ and a t-statistic of 4.928,

significant at $p = 0.0000$; hence, H5 is accepted. Artificial intelligence showed a positive impact in determining supply chain agility, supported by $\beta = 0.089$ and a t-statistic of 1.715, significant at $p = 0.0043$; therefore, H6 is confirmed.

Supply chain agility showed a positive impact on resilience, confirmed by $\beta = 0.693$ and a t-statistic of 15.293, significant at $p = 0.0000$; therefore, H7 is accepted. These findings reveal that the outlined exogenous factors are positively related to supply chain agility, with satisfactory beta and t-values. Moreover, the collective variance explained was assessed through the coefficient of determination, R^2. Altogether, leadership, employee skills, organizational culture, competitive intensity, human capital development, and artificial intelligence explained substantial variance (R^2) of 80% in supply chain agility. Supply chain resilience, assessed through supply chain agility and organizational flexibility, explained substantial variance (R^2) of 68.7% in supply chain resilience. To summarize, these results indicate that, statistically speaking, all our hypotheses are acceptable in describing supply chain agility and resilience. Moreover, our findings show the substantial variance explained in predicting supply chain agility and supply chain resilience, thus legitimizing the outlined supply chain research model.

4.2. Factor Effect Size Analysis

All our hypotheses were accepted; however, the effect of each factor must be examined through f^2 effect size analysis. The f^2 value in effect size analysis demonstrates three effect sizes: large, medium, and small. Values of f^2 higher than 0.35 denote a large effect size, values between 0.35 and 0.15 correspond to medium, and values between 0.15 and 0.02 represent a small effect size of the factor in measuring the endogenous factor. The results of the effect size analysis revealed that organizational leadership had a medium effect size with regard to supply chain agility. The effect sizes of all the other factors were found to be small with regard to agility. Moreover, logistics agility showed a large impact in determining supply chain resilience, but organizational flexibility showed a small effect towards resilience. The resulting f^2 values are presented in Table 5 for the factors of both supply chain agility and supply chain resilience.

Table 5. Examined effect sizes f^2.

Factor	Supply Chain Agility	Effect Size
Artificial intelligence	0.013	Small
Human capital development	0.076	Small
Competitive intensity	0.040	Small
Employee skills	0.019	Small
Leadership	0.281	Medium
Organizational culture	0.064	Small
Supply Chain Resilience		
Supply chain agility	0.677	Large
Organizational flexibility	0.053	Small

4.3. Post Hoc Analysis

The positivist research paradigm recommends examining phenomena through robust forms of statistical analysis. Therefore, importance performance analysis was employed to obtain a macro perspective on the supply chain model. The first step in importance performance analysis is to select the outcome factor. Therefore, supply chain resilience was selected as the outcome factor to reveal the factors' importance and performance. The data were analyzed, and the results indicated that supply chain agility was the most important factor due to its high total effect. Leadership was identified as the second most important factor determining supply chain resilience. Nevertheless, the importance of human capital development and organizational flexibility was sizeable in predicting supply chain resilience. Moreover, factors like organizational culture and competitive intensity were found

to be important in measuring supply chain resilience. In terms of the performance index, the results showed high values for competitive intensity and organizational flexibility; therefore, policymakers should focus on these factors. The results of the post hoc analysis can be seen in Table 6.

Table 6. Importance performance matrix.

Supply Chain Resilience		
Factor	**Total Effect**	**Performance**
Supply chain agility	0.693	68.093
Artificial intelligence	0.062	68.602
Human capital development	0.200	67.982
Competitive intensity	0.121	70.338
Employee skills	0.083	68.996
Leadership	0.311	69.348
Organizational culture	0.149	65.765
Organizational flexibility	0.214	74.427

4.4. Moderation Analysis

Organizational flexibility was hypothesized as a moderating factor between logistics agility and resilience. For the computation, the product indicator approach was adopted, consistent with prior studies [41,53,57]. The data were bootstrapped, and the results revealed a significant moderating influence of organizational flexibility towards supply chain agility and resilience, supported by $\beta = 0.048$ and a t-statistic of 1.799, significant at $p = 0.036$. Therefore, it is confirmed that organizational flexibility moderates the relationship between supply chain agility and supply chain resilience; hence, H8 is accepted. The result of the moderating analysis is exhibited in Figure 2.

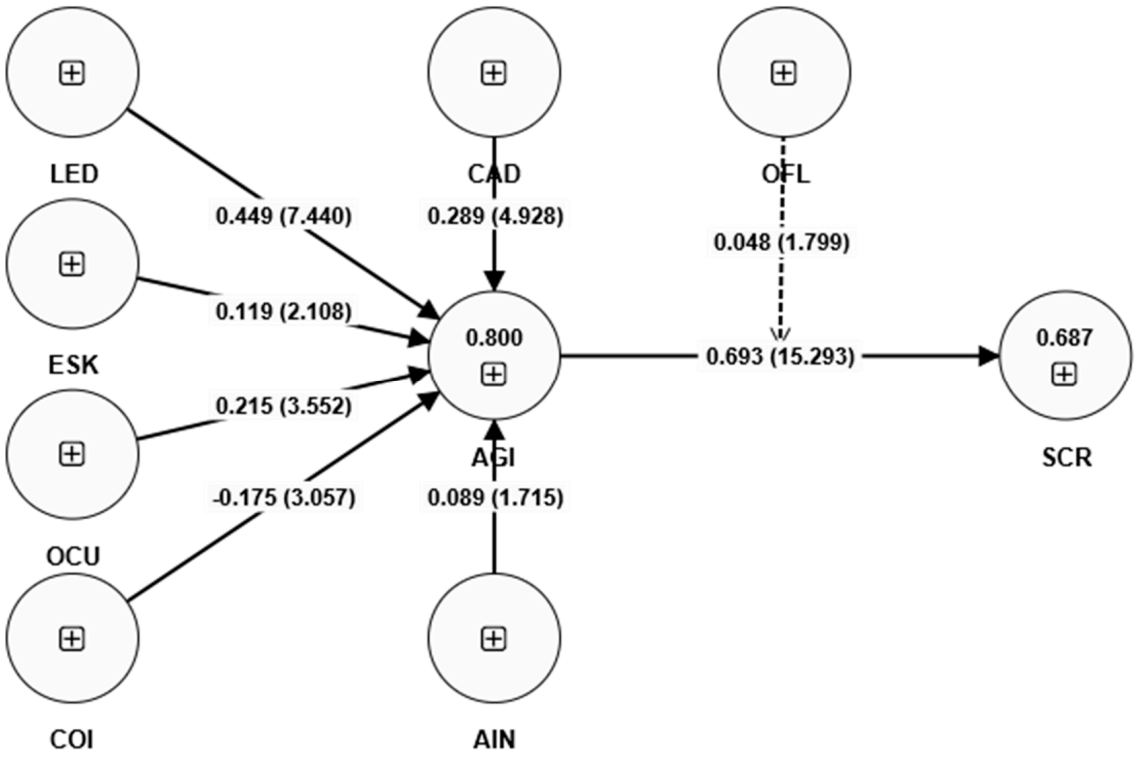

Figure 2. Moderation analysis output.

In addition, a simple slope analysis was considered to examine the trend of moderation and determine whether organizational flexibility positively or negatively moderated the relationship between supply chain agility and supply chain resilience. As depicted in Figure 3, the simple slope analysis demonstrated an uphill trend with OFL at + 1SD. This indicates that a higher level of organizational flexibility in decision making enhances a logistics firm's agility and resilience during disruptive events.

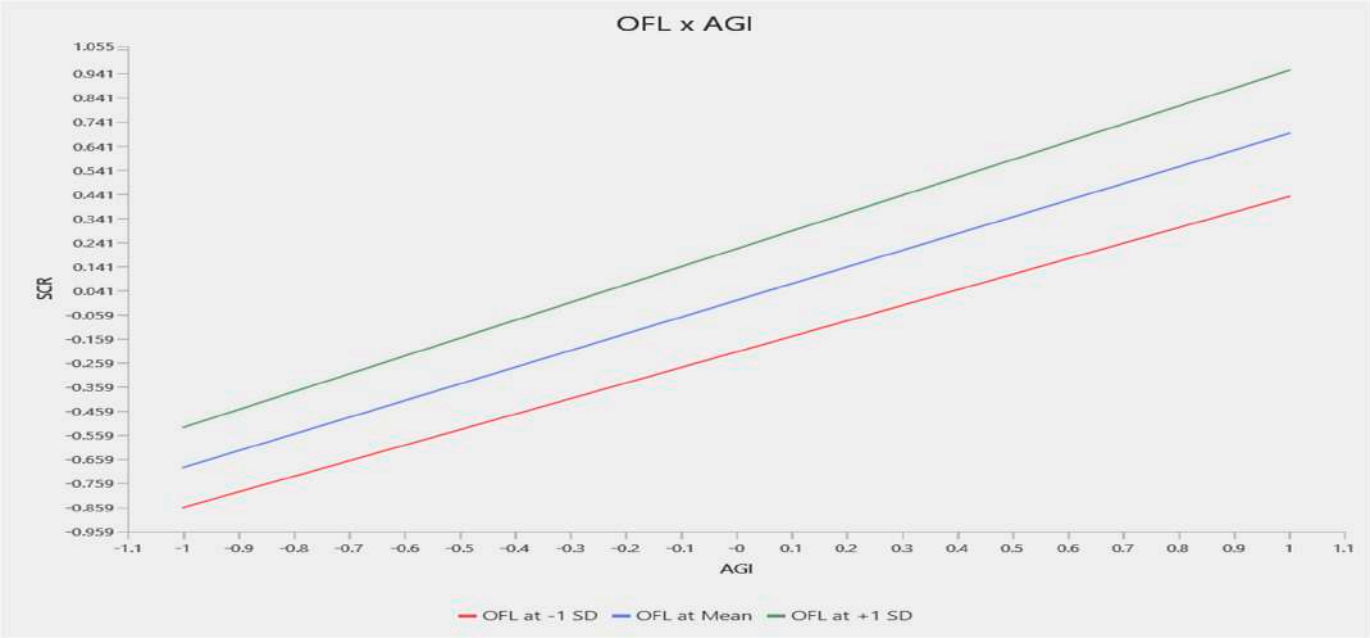

Figure 3. Simple slope graph.

5. Discussion

The recent COVID-19 pandemic and dynamic changes in the business environment have entirely changed logistical operations. Now, logistics firms are striving for better continuity in their logistics operations. Previous studies have revealed that logistics firms that incorporate characteristics of resilience into their policies perform better in the competitive market [41,46,58]. Therefore, it is important to identify the factors that impact supply chain resilience. In this study, we established a model underpinned by strategic human resource management factors and artificial intelligence. We summarized strategic human resource management with five core dimensions, namely leadership, employee skills, organizational culture, competitive intensity, and human capital development, and we investigated the impact of these factors on supply chain agility and resilience. In order to test the relationships among these factors, the data were analyzed via the structural equation modeling approach. The results demonstrated that leadership was positively associated with supply chain agility, which was consistent with prior studies [5,9]. Similarly, employee skills were positively associated with logistics firms' agility, which was also in line with prior studies [5,9,16]. Moreover, organizational culture was positively related to supply chain agility, consistent with prior studies [11,21].

Another dimension of strategic human resource management, namely competitive intensity, was positively associated with logistics firm agility, consistent with prior studies [13,23,24,26]. Similarly, human capital development was positively associated with supply chain agility, consistent with prior research work [13]. Artificial intelligence presented a positive impact in determining supply chain agility, consistent with prior studies [31,32]. Additionally, supply chain agility showed a positive impact on resilience, in line with prior studies [36,40,41]. Another important finding of this research was the concept of organizational flexibility as a moderating factor. This study confirmed the significant moderating

influence of organizational flexibility in the relationship between supply chain agility and resilience, thus supporting the arguments developed by the authors of [36]. These findings suggest that logistics firms can improve the agility and resilience in their operations through leadership, employee skills, organizational culture, competitive intensity, human capital development, artificial intelligence, and organizational flexibility; therefore, policymakers should consider these factors when developing new strategies.

5.1. Contributions to Theory

This study contributes to the literature in numerous ways. Primarily, this study schematized strategic human resource management into five core dimensions, namely leadership, employee skills, organizational culture, competitive intensity, and human capital development. In addition, this study conceptualized the relationship between strategic human resource management and supply chain agility, thus contributing to the literature on human resources and logistics. Another unique theoretical contribution of this study is the integration of artificial intelligence as a single factor within strategic human resource management and its relation to supply chain agility, which is a novel contribution to the literature on information systems. Moreover, organizational flexibility has rarely been considered as a moderating factor between supply chain agility and supply chain resilience. This study confirmed the moderating effect of organizational flexibility and revealed that an increase in organizational flexibility increases supply chain resilience, thus enriching the literature on logistics. Aside from the significant impact of exogenous factors on supply chain agility and supply chain resilience, the results revealed substantial coefficients of determination (R^2). For instance, leadership, employee skills, organizational culture, competitive intensity, human capital development, and artificial intelligence were associated with substantial variance explained (R^2 value) of 80% in supply chain agility, confirming the validity of the research model. Similarly, supply chain agility and organizational flexibility were associated with substantial variance explained (R^2 value) of 68.7% in supply chain resilience, confirming the validity of the extended model. The substantial coefficients of determination showed the high robustness of the research model. This model and its results enrich the literature, especially in the three domains of information systems, strategic human resource management, and supply chain resilience.

5.2. Contributions to Practice

In terms of practical implications, this research showed that factors like leadership, employee skills, organizational culture, competitive intensity, human capital development, and artificial intelligence positively influence supply chain agility and therefore need policymakers' attention. More precisely, the effect size (f^2) analysis suggested that, within the integrated research model, the leadership factor had a greater effect size with regard to supply chain agility. This indicates that, in logistics firms, supply chain agility is strongly linked to leadership values. The effect size analysis revealed that supply chain agility has a large impact in determining supply chain resilience, and this indicates that, for greater supply chain resilience, it is essential that logistical operations have the characteristic of agility. Aside from strategic human resource factors, in this study, we found that artificial intelligence was positively associated with supply chain agility. Therefore, managers should develop supply chain designs that are backed by artificial intelligence to improve the supply chain agility in turbulent environments. Another vital practical contribution of this study is that it revealed the importance of organizational flexibility. This study established the moderating effect of organizational flexibility and showed that an increase in organizational flexibility increases supply chain resilience. Therefore, if policymakers seek organizational agility and resilience in their operations during unprecedented situations, they should improve the organizational flexibility in the workplace. Achieving supply chain resilience with minimal resources is the key challenge for policymakers. The importance performance index values represent a macro perspective on the factors underpinning the current research framework and can assist managers in achieving supply chain resilience with minimal

resources. According to the importance performance index, the factors of supply chain agility, leadership, human capital development, organizational flexibility, organizational culture, and competitive intensity are influential in predicting supply chain resilience; hence, managers and other policymakers must consider these factors when developing supply chain strategies.

6. Conclusions

Despite the exponential growth in supply chain research, there are few empirical insights into how logistics firms can achieve supply chain agility. To bridge this gap, we developed a research framework that combines factors such as leadership, employee skills, organizational culture, competitive intensity, human capital development, and artificial intelligence in order to examine supply chain agility. The results indicate that leadership, employee skills, organizational culture, competitive intensity, human capital development, and artificial intelligence collectively have substantial variance explained (R^2 value) of 80% in supply chain agility. Moreover, supply chain agility and organizational flexibility have substantial variance explained (R^2 value) of 68.7% in supply chain resilience. The results of the effect size analysis revealed that organizational leadership has a medium effect size with regard to supply chain agility. However, the effect sizes of all other exogenous factors were small with regard to supply chain agility. Moreover, the importance performance index analysis revealed that, within the integrated research model, supply chain agility, leadership, human capital development, and organizational flexibility have greater importance in determining supply chain resilience. As part of its contribution, this study schematized strategic human resource management into five core dimensions, namely leadership, employee skills, organizational culture, competitive intensity, and human capital development. In terms of practical applications, our results showed that factors like leadership, employee skills, organizational culture, competitive intensity, human capital development, and artificial intelligence are positively associated with supply chain agility and therefore need policymakers' attention. The moderating effect of organizational flexibility between supply chain agility and supply chain resilience was tested. The results established that organizational flexibility enhances supply chain agility and supply chain resilience. This finding suggests that policymakers should improve the organizational flexibility in the workplace in order to boost logistics firms' resilience. This study is unique as it integrates artificial intelligence, organizational flexibility, and strategic human resource management to investigate supply chain agility and supply chain resilience. In summary, the findings of this research will assist managers in developing resilient supply chain strategies to bring harmony to logistics operations and boost logistics firms' resilience.

Limitations and Future Research Directions

Although this study makes strong contributions to theory and practice, it has some limitations that suggest future research directions. Firstly, this study summarized strategic human resource management as five core dimensions, namely leadership, employee skills, organizational culture, competitive intensity, and human capital development. However, there are some other HR practices, such as staffing, recruitment, training, and development, that could play important roles in measuring supply chain agility and resilience. Therefore, extending the current research model with staffing, recruitment, training, and development could disclose useful findings. Secondly, artificial intelligence was conceptualized as a single factor in this study. However, future researchers are encouraged to extend the current research model with big data analytics to obtain further insights into the agility in logistics operations and supply chain resilience. Additionally, to reduce the complexity of the research model, only direct relationships among hypotheses were tested. Future researchers may examine the mediating effect of supply chain agility between strategic human resource management and supply chain resilience. Lastly, this study was cross-sectional and examined the phenomenon at a single point in time. Future researchers are encouraged to test the current research model in a longitudinal context to obtain further

insights into the impacts of strategic human resource management and artificial intelligence on supply chain agility and supply chain resilience.

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