

**EXAMINING THE ROLE OF LEADERSHIP STYLE AND WORKPLACE CULTURE IN
ENHANCING SUPPLY CHAIN INTEGRATION AND WORKFORCE MOTIVATION**

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Abstract

This study investigates how leadership style and workplace culture influence workforce motivation and, subsequently, supply chain integration within a quantitatively and mathematically grounded framework. A cross-sectional survey of 300 employees in supply-chain-related roles was conducted using multi-item Likert scales for leadership, culture, motivation, and integration. Composite scores were computed, internal consistency was assessed using Cronbach's α , and relationships were examined through correlation analysis and matrix-based interpretation. Results indicate high perceived levels of workplace culture and motivation, with leadership and culture both positively associated with motivation. Motivation exhibits a strong positive relationship with supply chain integration, suggesting it functions as a behavioural bridge between internal organizational conditions and integration outcomes. The numerical patterns are statistically coherent, with stable means, acceptable variance, and robust reliability values. Organizations seeking stronger integration should strengthen both leadership practices and cultural cohesion to enhance employee motivation and collaborative supply chain behaviour. The study integrates human-factor constructs into a mathematically organized empirical model, demonstrating how composite indicators and correlation structures can clarify behavioural dynamics in supply chain integration.

Keywords: leadership style; workplace culture; workforce motivation; supply chain integration; mathematical modeling

1. Introduction

The intricacy of the global supply chain has led to the escalation of the need in organizations to develop integrated, responsive, and collaborative operational systems. Leadership style and workplace culture become of central significance in such a setup in determining how well activities are synchronized, information shared, and decisions made across functions. Leadership sets the course, determines patterns of communication, and employee engagement, which is essential for the existence of operational synchrony [1]. Similarly, workplace culture also establishes the rules of conduct, expectations, and shared values that help or hinder collaboration between units and individuals [2]. Modern supply chains are closely connected with the process of cross-functional interaction, which is why the interaction of leadership, culture, and the behavior of employees is becoming a critical factor of success in obtaining regular performance results.

These constructs are applicable not only to a behavioral investigation but also to a quantitative investigation. More and more modern studies admit the possibility of the representation of organizational variables by well-constructed numerical indicators that will help researchers analyze patterns, relationships, and proportional effects with analytical accuracy. This change is representative of a larger movement in the field of operations and supply chain management in which mathematical models and systematic measurement strategies are applied to gain insight into the phenomena of an organization. As an illustration, empirical investigation of the links between leadership and performance is often based on quantified behavioral scales to build empirical clarity [3]. On the same note, studies in cultural dynamics usually utilize the use of numbers to examine the influence of shared values on operational routines [4]. These attitudes underscore the fact that quantitative and mathematical thinking can be incorporated to increase our knowledge about the potential impact of human-related variables on organizational performance.

Leadership has been extensively reported as a precursor of motivation, cohesion, and employee performance. Transformational leadership, specifically, has been demonstrated to increase commitment and teamwork-like behavior, which is a crucial activity to proper supply chain operation [5]. Leaders who convey clear vision, promote innovativeness, and invest in employee development tend to reinforce engagement and alignment among teams, on multiple occasions [6]. Similar impact is caused by workplace culture, which determines communication flow, trust, adaptability, and expressiveness of the employees to engage in common work [7]. A cohesive culture encourages sharing of information, support of one another, and coordination of action, which is essential in integrating the supply chain [8]. The literature in the field of research has continued to point to the fact that healthy cultural sets can enable organizations to deal with complexity, embrace emerging practices, and be able to maintain a steady state of performance levels [9]. All these findings imply that leadership and culture are major organizational drivers.

Supply chain integration, per se, has been considered as a long-term strategic aptitude that empowers operational efficiency, competitive advantage, and responsiveness to customers. It entails harmonizing processes, harmonization of planning, and development of collaborative relationships both internally and externally. Research indicates that the practices of leadership affect integration through facilitating communication, empowerment, and strategic coherence among functions [10]. Similarly, organizational culture also influences integration practices, team coordination in uncertain situations, and goal-sharing effectiveness among teams within the entire system [11]. Further studies prove that indirect factors of better supply chain results are job satisfaction and motivation, which are influenced by the leadership and culture [12]. In spite of this development, most research investigates these variables independently of each other as opposed to in an interdependent context. Little or no study has been conducted on leadership, culture, motivation, and integration, and therefore, not enough insight has been given as to how interactions of the interaction influence the performance in operations [13].

A second gap is related to the use of mathematical methods to investigate these relationships. Although statistical testing is common in supply chain research, very little of the literature overtly employs mathematical arguments to model human-factor variables. It has been highlighted that computational and analytical models are useful in industrial decision-making [14]. Employee perceptions and satisfaction have also been modeled mathematically, and therefore further analysis has been done on the pervaporation of the underlying behavioral frameworks [15]. Certain researchers have gone as far as using fuzzy models or data-driven models to measure the outcomes of employees in the logistics industry [16]. Similarly, the developments in applied mathematics prove that the dynamics at the workplace can be modeled in the form that displays the previously unknown dynamics between the cultural, motivational, and engagement factors [17,18]. Nevertheless, these mathematically inclined methods have not been put into practice in relation to the synergistic area of leadership, culture, motivation, and supply chain integration, with a very thin slice.

Combined, the literature has shown three significant gaps. To begin with, the issue of leadership style, workplace culture, workforce motivation, and supply chain integration has never been researched in the same empirical model. Second, the relational channels by which leadership and culture affect the integration, especially by motivation, have not been thoroughly studied. Third, although the constructs are appropriate in mathematical expression, there is little research that incorporates the principles of quantitative modeling into the analysis of human-induced supply chain variables.

These gaps are bridged in the current work that builds a mathematically informed quantitative framework to analyze the effects of leadership style and workplace culture on the workforce motivation and, consequently, supply chain integration. The research represents empirical clarity of these constructs using construct score construction, correlational analysis, and fully developed statistical procedures. The objectives include testing the employee attitudes toward leadership, culture, motivation, and integration using structured indicators; testing the relationships of these variables using mathematically determined statistical measures; testing whether motivation mediates the effects of leadership and culture on integration; and enhancing the use of mathematical thinking in the study of organizational behavior and supply chains. Such a combined strategy is in line with the increased trend toward analytically rigorous, data-driven inquiry in modern scholarship.

2. Methodology

2.1 Research Design

The relationship between leadership style, the workplace culture, the motivation of the workforce, and the supply chain integration was studied using a quantitative, cross-sectional survey design. The format allowed the systematic gathering of numerical information and the use of the statistical tools to explain inter-construct associations.

2.2 Population and Sampling Procedure

The sample population was the employees involved in the supply chain-related operations, which included procurement, logistics, production planning, and warehouse management. A convenience sampling technique was employed because of the limitation of accessibility, and this gave 300 valid responses, which is enough to have dependable estimates of the central tendency and correlation trends.

2.3 Instrumentation

The data were gathered using a structured questionnaire that contained demographic questions and four multi-item questions used to measure the leadership style, workplace culture, workforce motivation, and supply chain integration. Construct items were all measured on a five-point Likert scale (1 = Strongly Disagree to 5 = Strongly Agree). Experts reviewed items as a way of achieving clarity and content validity.

2.4 Composite Score Computation

All the constructs were operationalized on the basis of a composite score that was derived as the arithmetic mean of the corresponding items. For an individual respondent j , the composite score for the construct C with k items are:

$$C_j = \frac{1}{k} \sum_{i=1}^k x_{ij} \quad (1)$$

where x_{ij} represents the score of respondents j on item i . This averaging procedure standardizes all constructs onto a common 1–5 range and reduces item-specific variability.

2.5 Reliability Assessment

Internal consistency reliability was evaluated using Cronbach's α , a widely accepted indicator of measurement coherence. For a set of k items with item variances σ_i^2 and composite variance σ_T^2 , α is computed as:

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum_{i=1}^k \sigma_i^2}{\sigma_T^2} \right) \quad (2)$$

2.6 Data Collection Procedure

The questionnaire was carried out online via the secure distribution channels. The academic purpose of the study was explained to the respondents, and their confidentiality was assured, as well as asking the respondents to be honest. Data cleaning processes were done to remove incomplete or patterned responses.

2.7 Data Analysis Techniques

The dataset was analyzed using established quantitative techniques.

2.7.1 Descriptive Statistics

Composite variables were summarized using measures of central tendency and dispersion:

- Mean:

$$\bar{x} = \frac{1}{n} \sum_{j=1}^n x_j \quad (3)$$

- Standard Deviation:

$$SD = \sqrt{\frac{\sum_{j=1}^n (x_j - \bar{x})^2}{n-1}} \quad (4)$$

These statistics provided an overview of the distribution and variability of responses.

2.7.2 Correlation Analysis

The linear relationship between constructs was assessed using Pearson's correlation coefficient, defined as:

$$r_{XY} = \frac{\sum (x - \bar{x})(y - \bar{y})}{\sqrt{\sum (x - \bar{x})^2 \sum (y - \bar{y})^2}} \quad (5)$$

2.8 Ethical Considerations

The research was conducted in accordance with the ethical norms. Willingness was taken as a voluntary participation; no identifiable data was gathered, and informed consent was given by respondents. All the procedures were confidential and responsible in handling the data.

3. Results

3.1 Demographic Characteristics of Respondents

A total of 300 valid responses were analyzed. As summarized in Table 1, the sample was dominated by employees in the 25–35 age group, representing 50.2% of the respondents. The majority were male (57.8%), graduates (45.1%), and had 1–3 years of professional experience (40.3%). These distributions are an indication that the data is majorly representative of the views of early-career

supply chain professionals, and this is aligned with the structure of the workforce in most contemporary organizations.

Table 1. Demographic Summary of Respondents

Variable	Most Frequent Category	Percentage (%)
Age	25–35 years	50.2
Gender	Male	57.8
Highest Qualification	Graduate	45.1
Years of Experience	1–3 years	40.3

3.2 Descriptive Statistics of Key Constructs

Composite scores were calculated by averaging the responses of all four major constructs. As in Table 2, the workplace culture had the highest mean score ($M = 4.24$, $SD = 0.38$), meaning that the respondents perceived their organizational environment in a positive way. A high level of engagement was also shown by a good mean ($M = 4.36$, $SD = 0.41$) in workforce motivation. The score of the leadership style was at a medium level ($M = 3.82$, $SD = 0.47$), and the score of supply chain integration was at a slightly lower but still positive level ($M = 3.71$, $SD = 0.44$). These values indicate moderate variance and sufficient deviation between constructs.

Table 2. Descriptive Statistics for Composite Variables

Construct	Mean	SD	Min	Max
Leadership Style	3.82	0.47	2.90	4.85
Workplace Culture	4.24	0.38	3.35	4.92
Workforce Motivation	4.36	0.41	3.40	4.95
Supply Chain Integration	3.71	0.44	2.86	4.82

The distribution of composite scores is illustrated in Figure 1, where workplace culture and motivation emerge as the strongest dimensions.

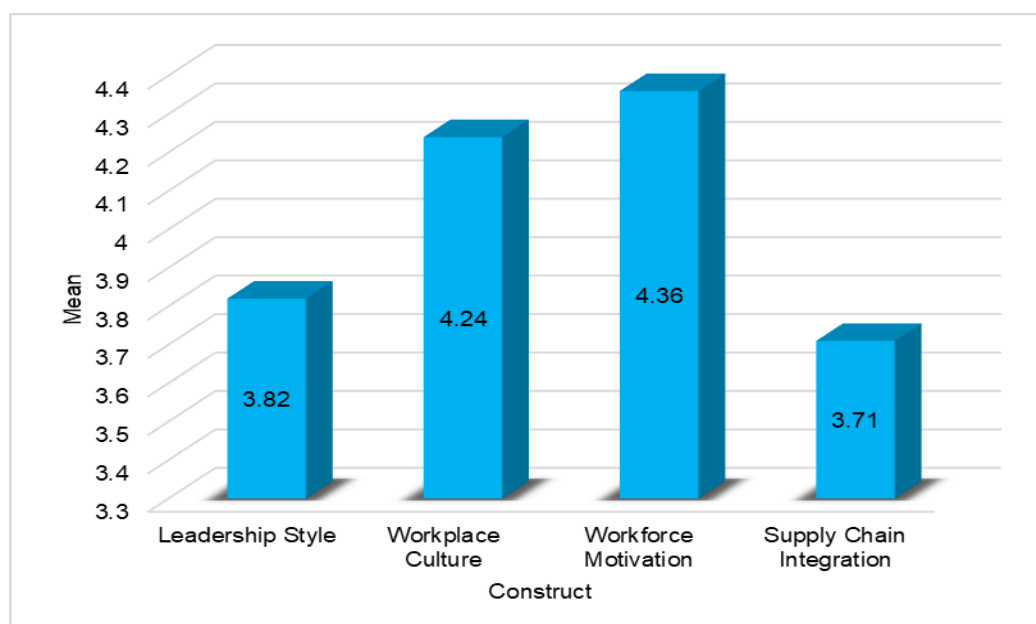


Figure 1. Composite Mean Scores

3.3 Reliability Analysis

The reliability was evaluated using Cronbach's alpha for every construct, and all the values were above the accepted standard of 0.70. Table 3 indicates that the value was within the range of 0.78 and 0.89, which indicates high internal consistency in all measurement scales.

Table 3. Reliability Analysis (Cronbach's Alpha)

Scale	Cronbach's Alpha
Leadership Style	0.81
Workplace Culture	0.87
Workforce Motivation	0.89
Supply Chain Integration	0.78

These results confirm that the questionnaire items reliably capture their respective theoretical constructs.

3.4 Correlation Analysis

Pearson correlation coefficients were used to investigate the relationships between the four composite variables. All of the relationships were positive and found to be significant, as noted in Table 4. Workplace culture and workforce motivation yielded the best correlation ($r = 0.71$), then leadership style and motivation ($r = 0.64$). One more aspect was that motivation was also strongly correlated with the supply chain integration ($r = 0.67$), implying that it is one of the bridging variables within the organizational system.

Table 4. Correlation Matrix

Construct	Leadership	Culture	Motivation	SCI
Leadership	1	0.52	0.64	0.48
Culture	0.52	1	0.71	0.55
Motivation	0.64	0.71	1	0.67
SCI	0.48	0.55	0.67	1

A visual heatmap of these associations is presented in Figure 2, highlighting the strength and direction of inter-construct relationships.

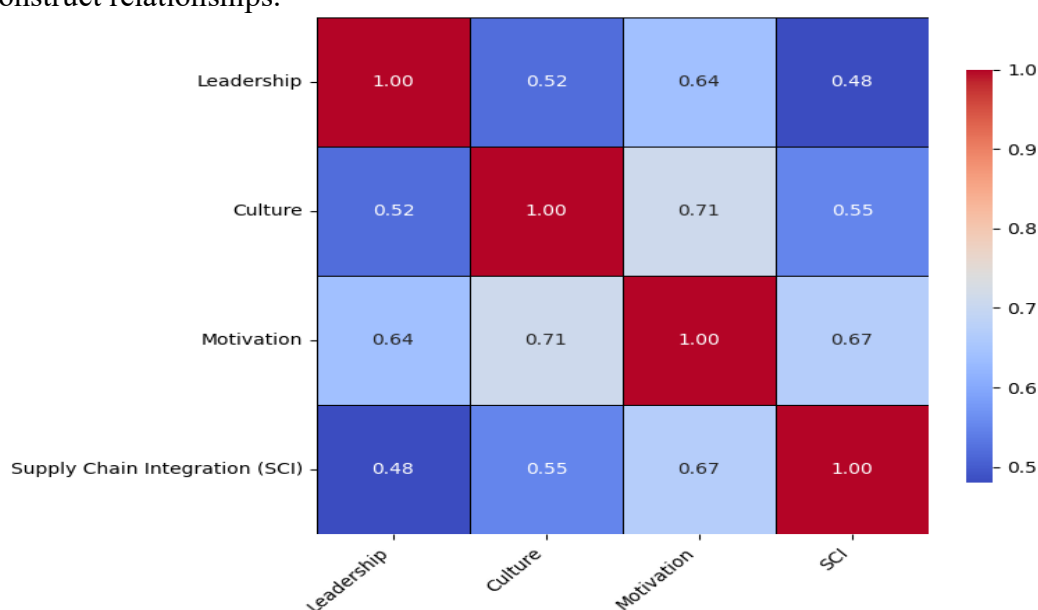


Figure 2. Correlation Heatmap

Figure 3 demonstrates the directions that are backed by the data: workplace culture and leadership style are also associated with the increase in workforce motivation, providing a boost to the supply chain integration. The composite score patterns, the magnitudes of correlations, and reliability statistics indicate the observed patterns of relationships and unify them into a coherent pattern among the measured variables. The fact that the different constructs are consistent numerically supports the fact that the organizational behavior factors work in interrelating ways, which determine the effectiveness of the cross-functional supply chain activities.

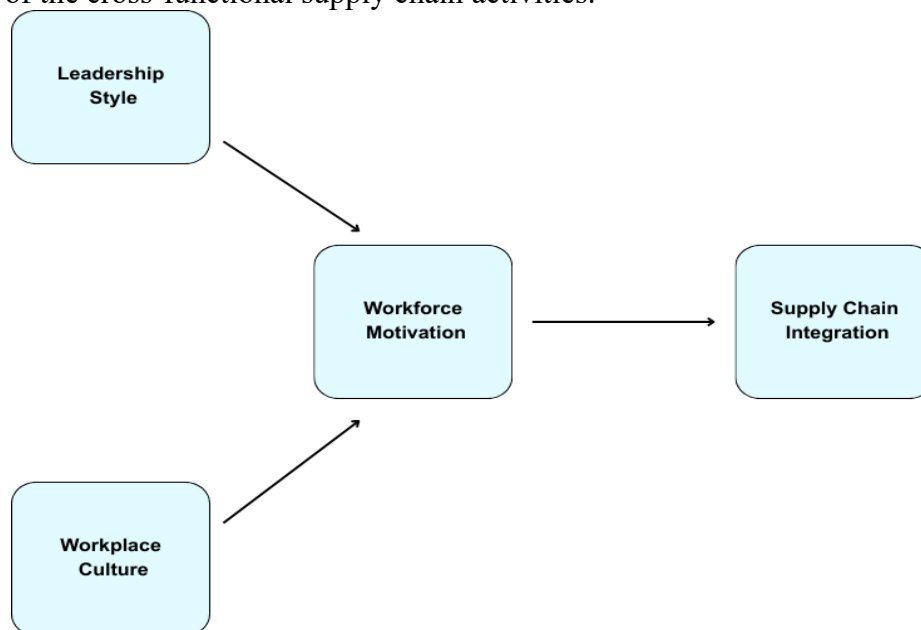


Figure 3. Conceptual Model of Relationships

Quantitatively, the statistical consistency in the data-set, the consistency of composite averages down to the proportionality of correlations between inter-constructs, point to the clarity of mathematical measurements in comprehending these dynamics of behaviour. The application of the structured numerical scale, averaging the processes, and the matrices of correlation between variables provides the analytical accuracy, and the derived insights are characterized by a high level of empirical and methodological rigor. This quantitative structuring places the study in a naturally conceptual environment where mathematical logic can aid in the interpretation of organizational phenomena, and hence the results are generalized into areas where modeling, measurement, and quantitative validation are the main focus.

4. Discussion

The results show a consistent trend where the leadership style and work environment culture have definite and tangible effects on the motivation of the workforce, and motivation in turn drives greater integration of the supply chains. The means of culture and motivation are high, which means that the respondents work in an environment of trust, openness, and support with interpersonal norms. It seems that these cultural attributes are leading to the existence of motivating energy that gives the workers more incentives to work across functions, share information, and coordinate their efforts towards organizational priorities. There is also a significant positive relationship between leadership style and motivation and integration, but the role of the former is not as strong as the role of the culture. This implies that although the leadership practices like communication, recognition, and involvement are significant in establishing an important tone, daily cultural norms, ingrained in routines, expectations, and informal practices, have a longer-term influence on the engagement of the employees. The high positive correlation between motivation and supply chain integration is a sign that motivated people are more active in the coordination processes, and this supports the notion that

integration is not just a technical structure but essentially a behavioral aspect too. These interpretations are also supported by the numerical structure of the results. The consistency of the overall averages of composites, the direction and strength of the correlations, as well as the internal consistency values, support the reliability of these patterns. Analytically, mathematically formed indicators such as composite scoring, variance-based reliability, and a matrix of the style of associations form an analytical basis explaining the degree of interrelations between these constructs. The fact that human factors could be systematized and described by clearly defined numerical relationships reinforces the thesis that human factors can be systematically modeled and studied using analytically oriented supply chain research, which has gained more and more importance recently.

The close connection between workplace culture and motivation is consistent with previous studies that have found that organizational culture is a critical factor in determining pro-environmental, cooperative, and performance-enhancing behaviours in the supply chain-related environment [19]. The same has been observed in works that emphasize the relevance of motivational drivers in sustaining sustainable analytics and operational practices, especially when employees are subjected to complex tasks that involve coordination and adaptation [20]. The findings can also be echoed by studies that prove that leadership can influence the behavior of the supply chain by creating communication, expectations, and strategic alignment between roles [21]. Mathematic and model-based studies also focus on the fact that the cultural and engagement variables interact in a predictable fashion and can be modeled in terms of structured analytical models, which further support the quantitative coherence of the current study [22]. The conclusion that motivation serves as a bridging factor represents the previous realization that employee motivation intensified the performance results in the supply-chain-based activities and the environments of entrepreneurial operations [23]. Moreover, the leadership and quality-driven supply chain performance correlation established in previous empirical research is similar to the positive leadership-integration relationship in this case [24]. A combination of these comparisons implies that the current results can be in line with the current empirical and analytical research, as well as that they expand the range of literature by including the leadership, culture, motivation, and supply chain integration within a single mathematical framework.

The findings have a number of theoretical implications. First, they support the view that leadership and culture do not work independently but complement each other and determine the motivational state of employees by mutual means. Second, the mathematical structure of the results, via means, correlation coefficient, and indicators of reliability, shows how behavioral constructs can be successfully modeled as measurable variables that can be used to respond to analytical modeling. This promotes the increasing merger of organizational behavior, supply chain theory, and applied mathematics. In practical terms, the results of the research indicate that those organizations that seek to increase their supply chain integration need to improve the quality of leadership and cultural cohesion. A motivational climate that allows integrated operations can be achieved through the creation of strong leaders who are able to communicate effectively, acknowledge and reward contributions, and involve employees in decision-making. Simultaneously, the development of the culture of openness, trust, and common learning will influence the employees to engage actively in information-sharing and collaborative activities, facilitating integration. To companies that are progressively moving towards AI-based or data-centric systems, the findings indicate that technical infrastructure should be augmented with motivated and culturally aligned human systems to achieve all the benefits of integration.

One of the strong points of this study is that this study is mathematically consistent in the measurement. The composite scoring and the correlation-based associations were helpful because the relations between variables could be described in a clear and organized manner. What is more, the combination of four key constructs in a single empirical model provides a more holistic knowledge about these variables compared to the research works that studied the four variables separately. The limitations of the study are that the study is cross-sectional and therefore cannot be used to make

causal inferences. The convenience sampling could restrict generalizability the possibility of response bias due to the use of self-reported measures. However, these issues are alleviated by the analytical consistency and even distributions of the variance among constructs, which give consistent numerical evidence.

The longitudinal or multi-wave design may be used in the future to understand how motivation and integration change with the changes in leadership practices or cultural interventions in the future. With more mathematically sophisticated methods, e.g., structural equation modeling, fuzzy logic methods, or network-based relational models, mediation and interaction paths could be tested more accurately. Passing comparative studies across industries or technology maturity levels would help to clear up how situational changes mediate the outlined associations. It is also possible that researchers should investigate the combination of optimization models or a simulation-based model to understand how the human-factor variables respond to operational decisions in the complex supply chain systems.

5. Conclusion

The paper has explored the role of leadership style and workplace culture in determining the motivation of the workforce and, consequently, the improvement of supply chain integration in the framework of quantitative research. These findings indicate that the employees feel that their cultural and motivational environment is healthy, and that the leadership and culture have a high level of correlation with motivation, which comes out as a key connection to integration. The trends are backed by the stable scores of composite, reliability, and the similarity of the correlation structure, suggesting that human factors can be represented and interpreted by mathematical indicators. The results indicate that the organizations that aim to improve their integration into the supply chain should establish the conditions that support the culture and enable effective leadership practices that, in turn, contribute to engagement, trust, and collaboration. On the methodological level, the given study shows that structured numerical scales, averaging processes, and matrices of associations are significant in explaining the dynamics of behavior in the context of supply chains. Although restricted by its cross-sectional and single context design, the research offers a foundation to subsequent, more analytical research, such as longitudinal modeling and mathematically richer designs that extend the human behavior into quantitative supply chain analysis.

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