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Behavioral Pattern Analysis of Customers in Value Co-Creation Processes in the Omnichannel Retail Industry

Abbas Baseri[1]*

1. Department of Management, Qa.C., Islamic Azad University, Qazvin, Iran

***Correspondence: e-mail: Baseri2285@gmail.com**

Abstract

This study was conducted with the aim of identifying and classifying customers' behavioral patterns in omnichannel retailing and explaining their role in value co-creation. Given the heterogeneity of consumer behavior in omnichannel environments, the present study seeks to reveal hidden differences among customers based on the level of interaction, shopping experience, and participation in value-creating processes. Therefore, the study adopted a descriptive–analytical approach with a data mining orientation. Data related to 1,000 active customers within an omnichannel retail platform were collected and analyzed in RapidMiner using clustering and classification techniques. To determine the optimal cluster structure, the Davies–Bouldin Index was employed alongside the K-Means and X-Means algorithms. The findings demonstrated that customers are heterogeneous in terms of participation level, information sharing, channel usage, and value co-creation, and they can be categorized into three distinct clusters: mainstream customers, active value co-creators, and passive customers. The results further indicated that the group of active co-creators generates the highest level of interaction and value creation for retailers, whereas passive customers require trust-building, education, and simplification of the shopping experience. Consequently, omnichannel retailing is not only a competitive necessity but also a platform for shared value creation, enhancement of customer experience, and development of behavior-based segmentation strategies.

Keywords: Omnichannel retailing, value co-creation, customer behavior, customer participation, behavioral segmentation

1. Introduction

The retail industry has undergone profound transformation over the past two decades as technological advancements, digital communication platforms, and changing consumer expectations have reshaped the structure of customer interactions and purchasing processes. Traditional single-channel retailing has gradually evolved into multichannel and, more recently, omnichannel retailing, in which customers interact with retailers through integrated physical and digital channels such as brick-and-mortar stores, websites, mobile applications, and social media platforms (Neslin et al., 2006; Rigby, 2011). In this environment, customers no longer rely on a single purchasing path; rather, they move dynamically across multiple channels during different stages of the buying journey, including information search, product evaluation, purchase execution, and post-purchase engagement (Gensler et al., 2012; Verhoef et al., 2007). As a result, understanding customer behavior in omnichannel settings has become one of the most important strategic priorities for retailers seeking sustainable competitive advantage.

The emergence of omnichannel retailing reflects a broader shift from product-centered business models toward customer-centered value creation systems. Unlike traditional retail systems, omnichannel retailing integrates multiple touchpoints into a unified and seamless experience in which customers can interact continuously with retailers across digital and physical environments (Gao & Jiang, 2025; Jalalzadeh et al., 2025). This integration enables customers to engage in behaviors such as showrooming, webrooming, mobile-assisted purchasing, online product comparison, and Buy Online Pick Up In Store (BOPIS) services (Halibas et al., 2023). Such behaviors illustrate that customers are no longer passive recipients of products and services but active participants in shaping their shopping experiences and contributing to organizational value creation processes.

The increasing importance of omnichannel retailing is closely associated with the concept of value co-creation. Value co-creation refers to the collaborative process through which customers and organizations jointly generate value through interaction, participation, knowledge exchange, and engagement (Bosisio, 2024). In modern retail ecosystems, customers create value not only through purchasing activities but also through behaviors such as sharing experiences, providing feedback, participating in brand communities, and contributing information that can improve organizational decision-making and service innovation (Dennis et al., 2017; Kesenduran et al., 2024). Consequently, retailers increasingly recognize that customer interaction quality and behavioral engagement are essential determinants of long-term organizational performance and customer loyalty.

Recent studies have emphasized that omnichannel technologies significantly enhance opportunities for value co-creation by facilitating seamless communication, personalized experiences, and interactive engagement between retailers and consumers (Dehghani Ghahnooiyeh et al., 2025; Maleki Minbash Razgah et al., 2025). Omnichannel systems provide customers with greater flexibility and control over the shopping process, thereby increasing their participation in value-generating activities. For instance, integrated mobile applications, digital payment systems, personalized recommendations, and synchronized inventory systems improve convenience and create opportunities for collaborative interactions between customers and retailers (Chamelian, 2024; Gao & Jiang, 2025). These developments suggest that omnichannel retailing extends beyond operational efficiency and functions as a strategic platform for customer engagement and shared value creation.

Despite the widespread adoption of omnichannel systems, customer behavior within these environments remains highly heterogeneous. Different customers exhibit varying levels of interaction, digital engagement, information sharing, and channel-switching behavior (Konus et al., 2008; Kumar & Venkatesan, 2005). Some customers actively participate in omnichannel ecosystems by utilizing multiple channels, engaging with brands on social media, and contributing feedback, whereas others maintain transactional and low-engagement relationships with retailers. This heterogeneity creates significant managerial challenges because retailers cannot effectively address all customer segments using uniform strategies. Consequently, identifying and classifying customer behavioral patterns has become critical for designing targeted marketing strategies and improving customer relationship management.

Consumer behavior research has long recognized that channel preferences and shopping motivations differ substantially across individuals. Early studies on multichannel consumer behavior demonstrated that customers select channels based on both product utility and process utility (Balasubramanian et al., 2005). Consumers evaluate not only the functional characteristics of products but also the convenience, enjoyment, and efficiency associated with different purchasing channels. Similarly, research has shown that internet experience, technological familiarity, and shopping goals significantly influence customer channel preferences and purchase intentions (Frambach et al., 2007; Ha & Stoel, 2009). These findings indicate that omnichannel shopping behavior is shaped by a complex interaction of psychological, technological, and situational factors.

The growth of digital retailing has also intensified the importance of customer experience management. Modern consumers expect consistency, personalization, and convenience across all retail channels (Rigby, 2011). When customers encounter fragmented or inconsistent experiences, satisfaction and loyalty decline significantly. Therefore, retailers increasingly focus on integrating channels into a unified customer journey that minimizes friction and facilitates smooth transitions between online and offline environments (Gao & Jiang, 2025; Jalalzadeh et al., 2025). Research suggests that effective omnichannel integration positively influences customer satisfaction, purchase intention, and customer return behavior (Chamelian, 2024;

Jalalzadeh et al., 2025). These outcomes further reinforce the strategic value of understanding how customers behave across different channels.

Another important dimension of omnichannel behavior involves the role of digital interaction in shaping customer engagement. Digital technologies have transformed customers from isolated purchasers into interconnected participants within broader retail ecosystems (Schibrowsky et al., 2007). Through social media platforms, online reviews, virtual communities, and interactive applications, customers actively exchange information, evaluate products, and influence other consumers' purchasing decisions. This interactive environment strengthens the role of customer engagement as a driver of value co-creation (Dennis et al., 2017). Customers who interact more frequently with brands and other consumers are more likely to contribute knowledge, provide feedback, and participate in collaborative innovation activities.

The concept of customer engagement has therefore become central to contemporary retail management. Customer engagement reflects the cognitive, emotional, and behavioral involvement of customers with brands and organizations (Dehghani Ghahnooiyeh et al., 2025). Highly engaged customers typically exhibit stronger loyalty, higher purchase frequency, and greater willingness to participate in value co-creation activities. Moreover, engaged customers often act as brand advocates who voluntarily promote products and services through word-of-mouth communication and social sharing. In omnichannel contexts, engagement is amplified by the availability of multiple interaction points that facilitate continuous communication between customers and retailers (Kesenduran et al., 2024).

The relationship between omnichannel behavior and value co-creation is particularly important because customers increasingly expect personalized and participatory shopping experiences. Studies indicate that customers who actively use multiple retail channels demonstrate stronger tendencies toward collaborative behavior and higher shopping frequency (Kesenduran et al., 2024). Similarly, research on omnichannel integration has shown that seamless customer experiences enhance both emotional attachment to brands and perceived value creation (Dehghani Ghahnooiyeh et al., 2025). These findings suggest that omnichannel systems do not merely facilitate transactions; rather, they establish environments in which customers and organizations jointly create meaningful experiences and shared benefits.

From a managerial perspective, identifying different types of omnichannel customers is essential for effective segmentation and strategic planning. Previous studies have proposed that multichannel customers differ significantly in terms of profitability, loyalty, technological adoption, and interaction intensity (Konus et al., 2008; Kumar & Venkatesan, 2005). Some customer groups generate substantially greater value for organizations because they purchase more frequently, use multiple channels, and participate actively in engagement activities. Conversely, less engaged customers may demonstrate lower loyalty and weaker relationships with brands. Therefore, customer segmentation based on behavioral patterns provides retailers with opportunities to allocate resources more effectively and design customized engagement strategies.

In addition to behavioral differences, environmental and experiential factors also influence customer interactions within omnichannel systems. Retail atmospherics, digital interfaces, and sensory experiences can affect emotional responses and purchasing behaviors (Morin et al., 2007). Likewise, assortment organization, promotional strategies, and product presentation influence customer perceptions of value and convenience (Lee & Ariely, 2006; Morales et al., 2005). These factors collectively shape how customers perceive and interact with retail environments across multiple channels.

The evolution of omnichannel retailing has also been supported by significant technological advancements. The development of e-commerce systems, mobile technologies, customer analytics platforms, and integrated databases has enabled retailers to collect and analyze extensive behavioral data (Imap, 2010; Insights, 2010). Such technologies allow organizations to track customer journeys, monitor channel-switching behaviors, and identify patterns of interaction that were previously difficult to observe. Consequently, data mining and machine learning techniques have become increasingly valuable for analyzing customer behavior in omnichannel contexts.

Data mining approaches provide retailers with powerful tools for identifying hidden behavioral patterns and predicting customer actions. Clustering algorithms, classification models, and predictive analytics techniques enable organizations to segment customers based on similarities in purchasing behavior, engagement levels, and interaction patterns. These analytical approaches support more accurate personalization, improved targeting strategies, and enhanced customer experience management. Previous research has highlighted the growing importance of customer analytics for managing multichannel

consumer behavior and improving organizational performance (Rangaswamy & Van Bruggen, 2005; Thomas & Sullivan, 2005).

Although substantial research has examined multichannel retailing and customer engagement, several important gaps remain in the literature. First, many previous studies have focused primarily on operational integration and customer satisfaction rather than behavioral heterogeneity in value co-creation processes. Second, limited attention has been devoted to identifying distinct behavioral clusters of omnichannel customers using data-driven analytical approaches. Third, existing research often investigates customer engagement and omnichannel behavior separately, despite their strong conceptual interconnections. Finally, relatively few studies have simultaneously examined customer interaction behaviors, channel-switching patterns, and value co-creation activities within a unified analytical framework (Bosisio, 2024; Kesenduran et al., 2024).

Furthermore, the rapid evolution of omnichannel technologies requires continuous reassessment of customer behavioral patterns. Consumer expectations and digital interaction habits are constantly changing as new technologies and retail platforms emerge (Gao & Jiang, 2025). Retailers must therefore understand not only how customers behave in omnichannel environments but also how different customer groups contribute to organizational value creation. Identifying these patterns can help organizations develop more effective customer relationship strategies, optimize omnichannel infrastructures, and enhance long-term competitiveness.

The theoretical importance of this topic is complemented by its substantial practical implications. Retailers operating in highly competitive markets face increasing pressure to deliver personalized experiences, maintain customer loyalty, and maximize customer lifetime value. Understanding customer co-creation behavior provides organizations with valuable insights into how customers contribute to innovation, service development, and brand reputation. Moreover, behavioral segmentation based on omnichannel interaction patterns can support more effective targeting, communication, and loyalty management strategies.

Given the growing importance of omnichannel retailing and the critical role of customer participation in value creation processes, analyzing behavioral patterns in omnichannel environments represents an essential area of research. Therefore, the present study aims to identify and classify customer behavioral patterns in omnichannel retailing and explain their role in value co-creation processes using data mining techniques.

2. Methods and Materials

This study is applied in terms of purpose and descriptive–analytical in terms of implementation method, employing a data mining approach to investigate customer behavior in omnichannel retailing and analyze value co-creation patterns. The study seeks to identify customer behavioral patterns and classify customers based on characteristics related to customer interaction, shopping experience, and participation in the value co-creation process. To achieve this objective, data analysis methods, including clustering and classification techniques, were used to extract hidden patterns from customer data.

The statistical population of the study consisted of 1,000 active customers operating within an omnichannel retail environment who utilized different purchasing channels such as physical stores, websites, and other online platforms. From the available data, a dataset containing customer behavioral variables associated with customer interaction, shopping experience, and value co-creation activities was selected as the population under investigation. The research sample consisted of recorded customer data obtained from an omnichannel retail store within a dataset related to customer behavior in omnichannel retailing, which was used for data mining analyses.

Table 1. Statistical Information Used in the Study

Variable Name	Definition
Customer_ID	Unique identifier assigned to each customer
Age	Customer age (between 18 and 80 years)
Gender	Customer gender
Income Level	Customer income level
Education	Educational attainment level
Online Purchase Frequency	Number of online purchases within a specified period
Offline Purchase Frequency	Number of in-store purchases from physical retail outlets
Mobile App Usage	Extent of mobile application usage (measured on a scale of 1–10)
Social Media Interaction	Degree of customer interaction with the brand's social media platforms (likes, comments, visits)

Channel Switching Frequency	Number of times the customer switched between channels during a purchasing process (e.g., viewed online and purchased in-store)
BOPIS Usage (Buy Online, Pick Up In Store)	Use of the online purchase and in-store pickup feature (1 = used, 0 = not used)
Customer Participation	Extent of the customer's practical participation in retail processes
Customer Engagement	Level of the customer's cognitive and emotional involvement with the brand
Information Sharing	Customer willingness to share personal and preference-related information with the retailer
Feedback Provision	Quantity and quality of feedback provided by the customer to the brand
Trust Level	Customer trust level toward the brand (1–10)
Perceived Value	Overall customer satisfaction level
Loyalty Score	Loyalty score calculated based on repeat purchases and willingness to recommend the brand to others
Co-Creation Score	A composite co-creation index derived from the weighted average of participation, engagement, information sharing, and feedback variables
Co-Creation Class	Co-creation category based on the co-creation score, classifying customers into three groups: Low for scores below 4, Medium for scores between 4 and 7, and High for scores above 7

The sampling method in this study was convenience sampling based on available data. Specifically, customer behavior datasets containing variables associated with customer interactions across different retail channels were selected as the research sample. These data included information regarding customer participation in value co-creation activities, digital interactions, shopping experience, and other indicators associated with customer behavior. The data collection instrument in this study was a customer behavior database in omnichannel retailing, consisting of a set of quantitative variables related to customer activities and interactions. After preparation, cleaning, and preprocessing, the collected data were used for data mining analyses. At this stage, the data were organized within the RapidMiner software environment and prepared for the implementation of analytical algorithms.

Table 2. Demographic Characteristics of the Research Sample

Characteristic	Category	Frequency	Percentage
Gender	Male	526	52.6
	Female	474	47.4
Income Level	Medium	508	50.8
	Low	297	29.7
	High	195	19.5
Education	Bachelor's Degree	402	40.2
	High School Diploma	352	35.2
	Master's Degree	187	18.7
	Doctoral Degree	59	5.9
Age Group	18–25	177	17.7
	26–35	192	19.2
	36–45	231	23.1
	46–55	223	22.3
	56–65	177	17.7
	66+	0	0.0

As observed, the sample composition was relatively balanced in terms of gender; however, the proportion of male participants was slightly higher than that of female participants. Regarding income level, the highest frequency belonged to the medium-income category. Among educational levels, the bachelor's degree category represented the largest proportion, followed by the high school diploma category. In terms of age distribution, the highest frequency was associated with the 36–45 age group.

To examine the validity of the instrument, content validity was employed. The indicators and variables used in the study were selected based on theoretical foundations and previous studies in the fields of customer behavior, omnichannel retailing, and value co-creation. Furthermore, to ensure data reliability, the consistency and stability of the recorded data were examined, and incomplete or inconsistent data were removed or corrected during the preprocessing stage.

Data analysis was conducted using data mining techniques. Initially, clustering methods were applied to identify customer behavioral patterns and group customers based on similar behavioral characteristics. Subsequently, classification algorithms were employed to predict and categorize customer behavior across different levels of value co-creation. Data analysis was performed within the RapidMiner software environment, and measures such as the confusion matrix and model accuracy were

used to evaluate the performance of classification models. These analyses enabled the identification of customer behavioral patterns and provided a deeper understanding of the role of customer interactions in the value co-creation process within the omnichannel retail environment.

3. Findings and Results

In this section, customer behavior clustering was conducted using the X-Means and K-Means algorithms in RapidMiner version 9.9. To evaluate the clusters generated by the clustering algorithms and identify the optimal clustering structure, the Davies–Bouldin (DB) Index, which is based on maximizing inter-cluster distance and minimizing intra-cluster distance, was employed. The first step in this procedure involved determining the optimal number of clusters. Accordingly, clustering techniques with different numbers of clusters were initially implemented on the input data, and the number of clusters with the most appropriate Davies–Bouldin criterion was identified. Cluster evaluation was performed for the specified K values in both clustering methods, and the method with the lowest DB value was selected as the optimal clustering approach.

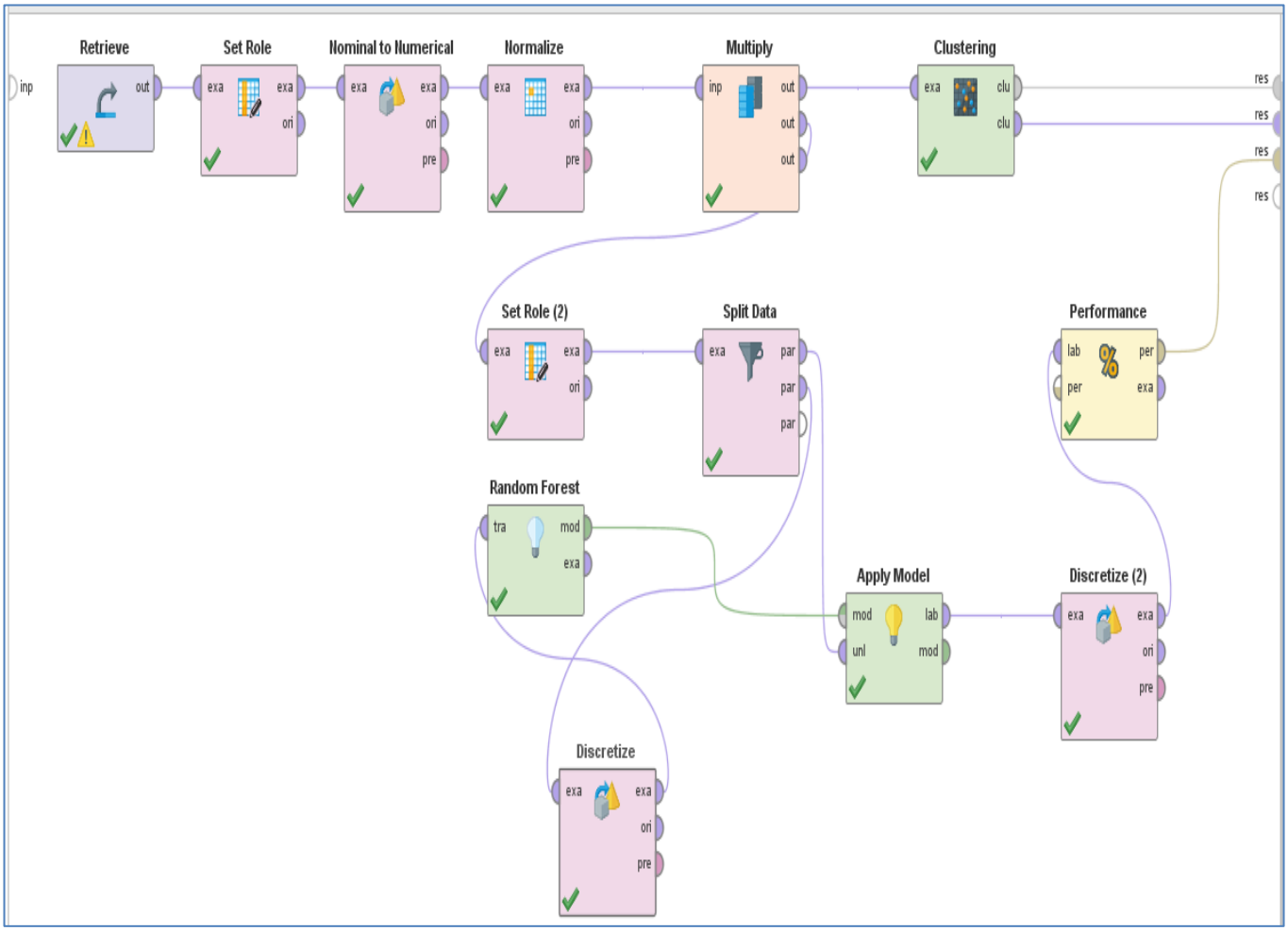

Figure 1. K-Means Clustering Operator in RapidMiner Software

Based on the obtained results, both the K-Means and X-Means methods identified three optimal clusters. According to the findings, Cluster 0 contained 687 customers, Cluster 1 contained 80 customers, and Cluster 2 consisted of 233 customers.

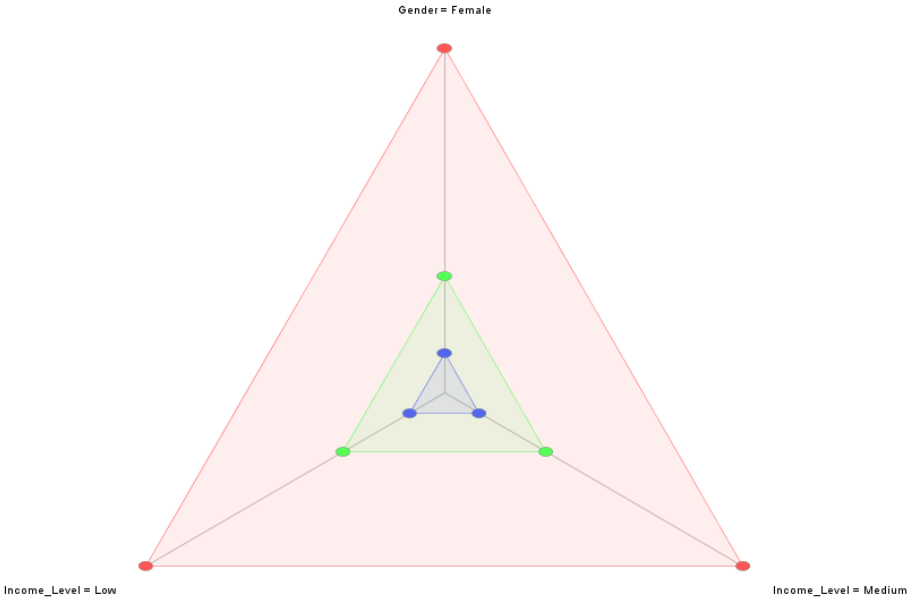

Figure 2. Members of Each Cluster (Cluster 0 = Red, Cluster 1 = Blue, Cluster 2 = Green)

At this stage, the K-Means clustering algorithm was used to identify customer behavioral patterns in the omnichannel retail industry. The optimal number of clusters was determined as three based on validation indices such as the Davies–Bouldin criterion. All variables were standardized using the Z-score method prior to analysis to prevent differences in scale from influencing the results. The following table presents the centroid of each cluster for the variables under investigation, which served as the primary basis for customer categorization and behavioral analysis.

Table 3. Customer Clustering Results

Behavioral / Demographic Variable	Cluster 0 (Mainstream / Typical Customers)	Cluster 1 (Active Value Co-Creators)	Cluster 2 (Passive Customers)
Number of Members (N = 1000)	687	80	233
Value Co-Creation Level	-0.29	3.38 (Very High)	-0.29
Information Sharing	0.09	1.04 (High)	-0.62
Customer Engagement / Participation	0.08	0.84 (High)	-0.53
BOPIS Usage	-0.03	0.12	0.07
Channel Switching	-0.02	0.16	0.01
High Income Level	-0.01	0.13	-0.01

Cluster 0: Mainstream Customers. This cluster, with 687 customers, represents the largest segment of the sample and can therefore be considered the "mainstream" customer group within the omnichannel retail environment. The behavioral indicators of this group are generally centered around the average and display minimal deviation from the midpoint. The level of value co-creation in this cluster is moderate, and the value of -0.29 indicates that customer participation is neither particularly high nor extremely low, but rather reflects the routine and typical behaviors of omnichannel customers.

Information sharing, BOPIS usage, and channel switching in this cluster were also reported to be slightly below the average. Customer engagement with the brand was only marginally lower than the average level. This pattern indicates that mainstream customers exhibit standardized and predictable behaviors and do not actively participate in co-creation processes, although they cannot be considered passive. Overall, this cluster represents the "typical and low-risk" customer behavior pattern within the omnichannel system.

Cluster 1: Active Value Co-Creators. This cluster, consisting of 80 customers, is the smallest in size; however, its members exhibit highly distinctive and valuable behaviors from the retailer's perspective. All behavioral indicators for this group are above the average, and in some cases, such as the value co-creation level (3.38), substantially exceed the levels observed in the other clusters.

These customers share more information with retailers, demonstrate higher levels of interaction and engagement with the brand, extensively utilize innovative services such as BOPIS, and show a higher degree of channel switching behavior. This pattern reflects customers who are engaged, informed, loyal, and technologically active.

Overall, Cluster 1 represents a group of customers for whom shared value creation constitutes an integral part of the omnichannel shopping experience. These customers are particularly valuable targets for loyalty programs, personalized content strategies, and participatory campaigns.

Cluster 2: Passive Customers. This cluster consists of 233 customers whose behaviors are clearly below the average level. All behavioral indicators, including information sharing, customer engagement, BOPIS usage, and channel switching, exhibit negative and below-average values.

The value co-creation level (-0.29) in this cluster is approximately similar to that of the mainstream cluster; however, other behaviors such as information sharing (-0.62) and customer participation (-0.53) indicate that these customers have the lowest level of interaction with the retailer. Their limited use of BOPIS and minimal channel switching further suggest that these customers are inactive, weakly engaged, and predominantly passive.

This cluster generally exhibits lower sensitivity toward technological changes and limited involvement in value creation processes. Therefore, retailers should consider tangible incentives, trust-building mechanisms, and simplification of the omnichannel experience to activate and engage this customer segment. The results indicate that omnichannel behaviors, such as BOPIS usage and channel switching, are directly correlated with value co-creation. Customers who combine multiple retail tools, including applications, websites, and physical stores (Cluster 1), demonstrate a stronger tendency to participate in co-creation processes such as providing feedback and sharing knowledge. This finding highlights the importance of developing omnichannel infrastructures to enhance customer value.

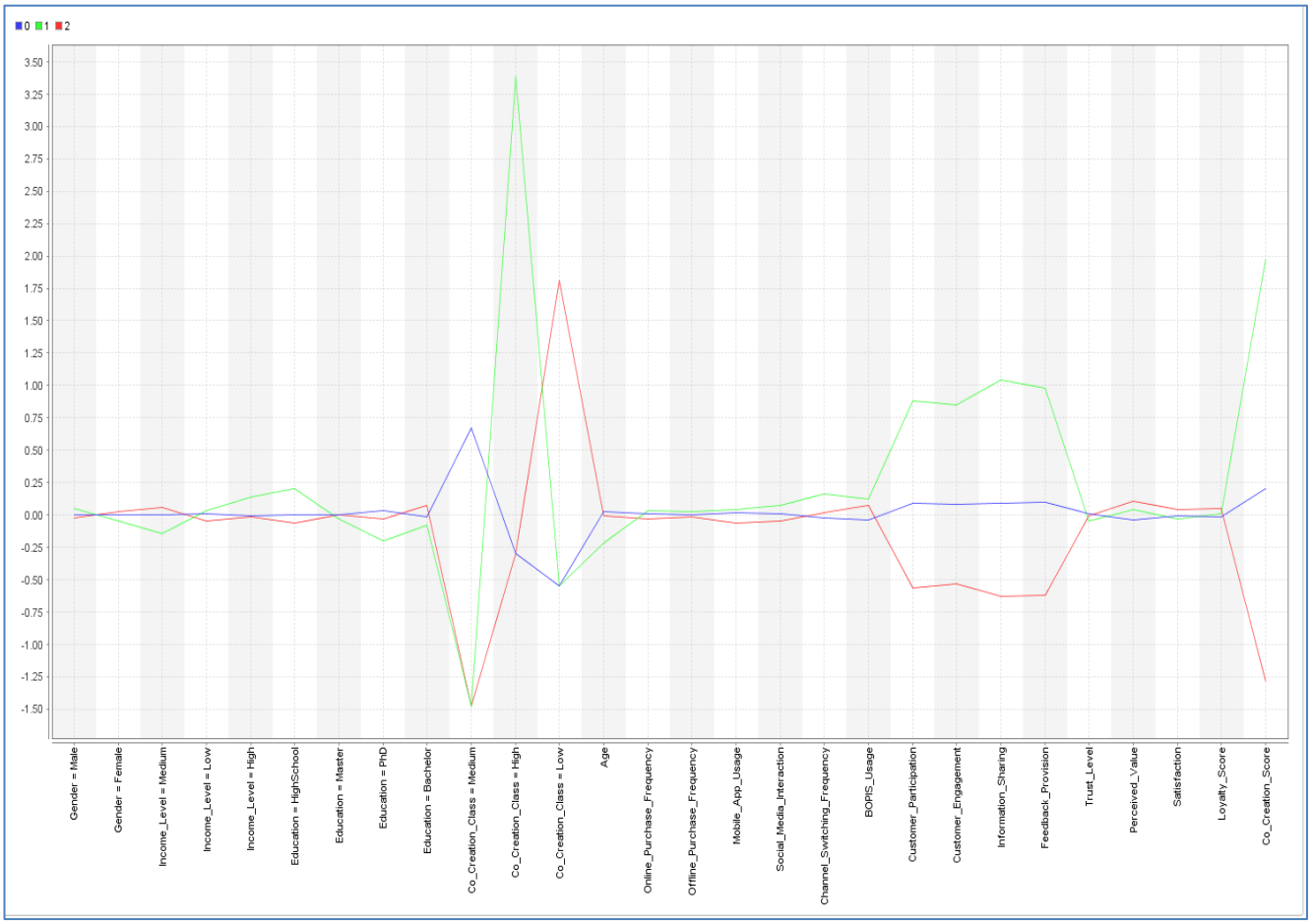

Figure 3. Customer Clustering Results

The line chart above illustrates the variation patterns of the three clusters across all research variables. Since the data were standardized, values above zero indicate above-average performance, whereas values below zero represent below-average performance. Based on the chart, the three clusters are clearly distinguishable.

Cluster 1: Leading Omnichannel Co-Creators consists of customers who exhibit the highest level of engagement and interaction with the brand. These individuals achieved exceptionally high scores on the primary value co-creation indicators, including participation, knowledge sharing, and feedback provision. In addition, they are pioneers in utilizing omnichannel retail capabilities such as online shopping, mobile applications, and BOPIS systems. Despite their smaller population size, this group serves as brand ambassadors and represents the primary source of innovation and value creation for the organization.

Cluster 2: Passive and Transaction-Oriented Customers exhibit the lowest tendency toward participation in co-creation processes and social interactions with the brand. Negative and low scores on information sharing and omnichannel interaction dimensions indicate that their relationship with the organization is primarily transactional and focused on satisfying basic purchasing needs. This group demonstrates limited sensitivity to changes in retail channels and, due to their lack of emotional and cognitive engagement, possesses low loyalty potential, thereby representing a major challenge for customer retention strategies.

Cluster 0: Balanced Majority with Co-Creation Potential represents the largest segment of the statistical population and demonstrates behaviors close to the overall sample average. The level of value co-creation in this group is moderate, and their behavioral fluctuations across different sales channels, both online and offline, remain balanced. These customers constitute the organization's primary source of revenue, and although they are not currently as active as Cluster 1, they possess considerable potential to evolve into active co-creators through marketing stimuli and improvements in the omnichannel experience.

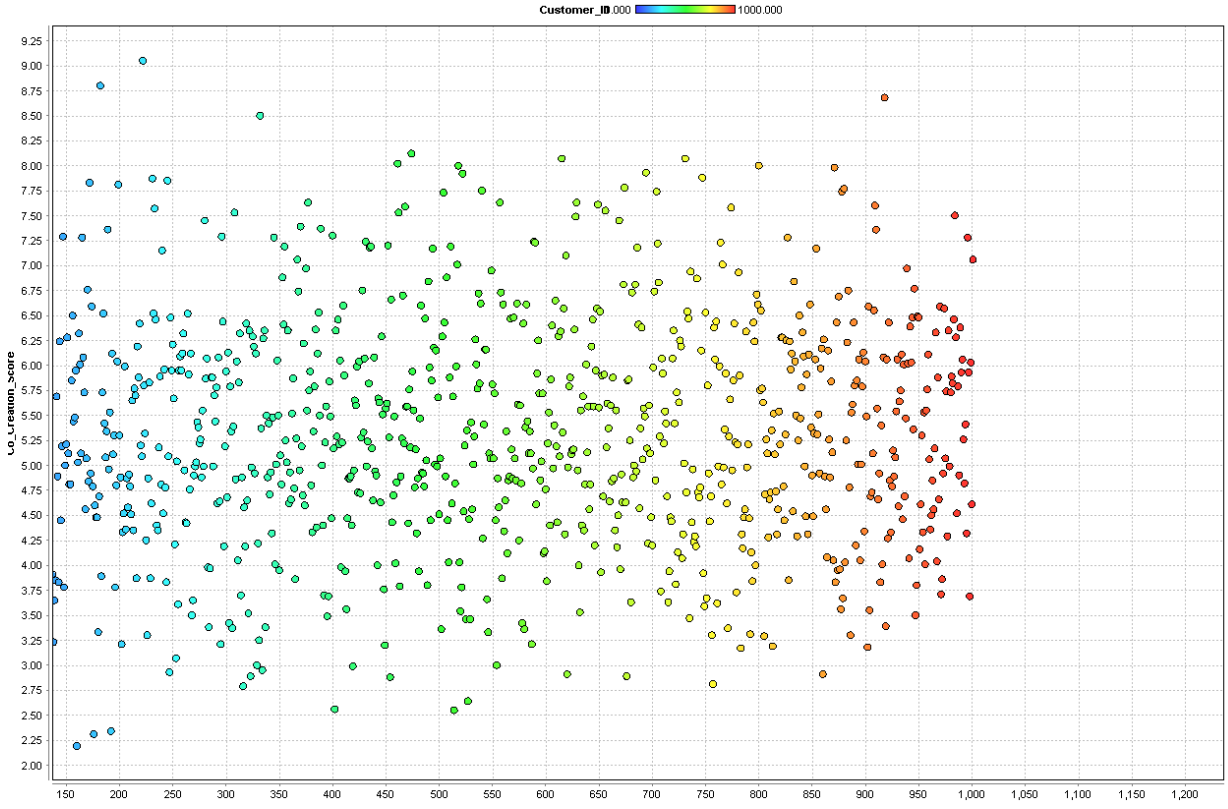

Figure 4. Scatter Plot of Value Co-Creation Scores for All 1,000 Customers

The vertical axis (Y-axis) represents the value co-creation score, which ranges approximately between 2 and 9.25. This broad dispersion indicates that customers in the studied retail industry exhibit highly diverse behaviors in the value co-creation process. The existence of such substantial variance confirms the necessity of clustering and classification models implemented in the previous stages.

The highest concentration of data points is observed within the score range of 4.5 to 7.0, indicating that the majority of customers operate at a moderate level of interaction and co-creation. At the same time, points located at the upper section of the chart (scores above 8) correspond to the leading co-creators identified as the "golden cluster" in the clustering analysis. Points located at the lowest level (near 2) and highest level (above 9) represent outliers or customers with highly distinctive behavioral patterns.

In the context of an ISI-indexed article, it can be argued that clustering models such as K-Means successfully identified these subtle differences and segmented customers into homogeneous groups based on this distribution. The color of the points changes gradually from blue (customers at the beginning of the list) to red (customers at the end of the list), corresponding to Customer_ID values. Since the color transitions appear horizontally and systematically, this suggests that the original dataset did not contain any specific bias related to time or customer registration order, and that the distribution of scores throughout the dataset was random and approximately normal.

At this stage, a classification model was employed to predict the level of customer value co-creation. The evaluation results demonstrated that the implemented algorithm achieved an overall accuracy of 67.86%, indicating acceptable performance in predicting customer co-creation behavior. Considering the behavioral and multidimensional nature of customer data in the omnichannel retail industry, this level of accuracy is considered satisfactory and consistent with previous studies in this field.

Table 4. **Customer Classification Results**

	Actual: range1 (≈ 0–0.403)	Actual: range2 (≥ 0.403–∞)	Precision
Predicted: range1	1	0	100%
Predicted: range2	225	474	67.81%
Recall	0.44%	100%	

Analysis of the confusion matrix indicates that the model performs very effectively in identifying customers with higher levels of value co-creation (range2), with the Recall value for this group reported as 100%. This result demonstrates that the model is capable of correctly identifying all customers with high levels of value co-creation. From a managerial perspective, this finding is highly significant because these customers play a critical role in shared value creation, innovation, and sustainable interaction with the brand.

In contrast, the model's performance in identifying customers with lower levels of value co-creation (range1) was considerably weaker, with the Recall value for this class reported as only 0.44%. This imbalance indicates that the model has a greater tendency to predict the dominant class and faces challenges in accurately distinguishing low-engagement customers. Such patterns are commonly observed in imbalanced behavioral datasets, where behavioral differences among less engaged customers are more difficult to detect.

Overall, the classification analysis demonstrates that the prediction model performs adequately in identifying customers with high value co-creation potential; however, improving the differentiation of lower co-creation levels requires further optimization of input variables, feature engineering, and potentially the use of multiclass classification methods (Low / Medium / High). These findings confirm that omnichannel behaviors and customer interaction indicators can serve as effective predictors of value co-creation in the retail industry.

At this stage, the relative importance of each behavioral and interactive customer variable in predicting the level of value co-creation was examined using the Random Forest model. The purpose of this analysis was to identify the features that play the most significant role in predicting customer co-creation behavior. Feature importance not only explains the model's predictive accuracy but also possesses substantial managerial value, as it reveals which customer behaviors contribute most strongly to shared value creation.

The results of the feature importance analysis demonstrated that indicators associated with active customer interactions are the most influential determinants of co-creation levels. Variables such as Customer Engagement, Customer Participation, Information Sharing, and Feedback Provision generally ranked among the most important features. This finding indicates that the more actively customers participate in interactive engagements with the brand, the greater the likelihood that they will belong to higher levels of value co-creation.

In addition to interaction-related factors, several omnichannel behaviors also played a meaningful role in customer classification. Variables such as Channel Switching and App Usage generally occupied intermediate levels of importance. This suggests that customers who experience greater diversity across multiple purchasing channels exhibit stronger tendencies to

participate in shared value creation processes. Such findings emphasize that designing an integrated omnichannel experience can serve as an important driver of customer co-creation.

Conversely, variables such as demographic characteristics and basic information (e.g., Age, Gender, and Income) generally appeared at the lowest levels of importance. Consistent with many recent studies, this result indicates that actual customer behaviors possess substantially greater explanatory power than demographic characteristics. Therefore, organizational investment in behavioral and interactional data is likely to generate higher managerial returns compared with demographic data.

Overall, the feature importance analysis demonstrates that the model primarily relies on interactive and omnichannel variables, thereby emphasizing the critical role of customer interaction in shaping value co-creation behaviors. These findings can be directly applied to the development of marketing strategies based on personalization, loyalty management, and customer experience design.

Table 5. Customer Classification Results

Cluster	Cluster 0	Cluster 1	Cluster 2
	Mainstream / Typical Customers	Active Value Co-Creators	Passive Customers
Key Behavioral Characteristics	All behavioral variables around the average level; moderate channel activity; low to moderate information sharing	Very high value co-creation level (3.38); high information sharing; strong brand engagement; frequent BOPIS usage; active channel switching	Low co-creation; lowest information sharing (-0.62); lowest customer participation (-0.53); lowest BOPIS usage; lowest channel switching
Psychological Customer Profile	Routine customers with stable and low-risk behavior; neither highly participative nor passive	Informed, participation-oriented, interaction-seeking, loyal, and technologically adaptive customers	Low-interaction, cautious customers with low trust or limited familiarity with digital channels
Omnichannel Participation Level	Moderate; customers use channels without strong enthusiasm or exceptional participation	Very high; customers intelligently utilize all channels	Low; single-channel and habit-dependent behavior
Value Creation for Retailer	Moderate; stable contribution but not exceptional	Very high; greatest contribution to service development and digital interactions	Low; minimal participation and lowest customer lifetime value
Final Behavioral Interpretation	This group exhibits stable and predictable behavior. Retaining these customers is essential, and their participation can be enhanced through minor incentives.	This group represents the retailer's most valuable customers; their behavior drives innovation and digital channel development. They are the primary target of interaction-oriented campaigns.	This group requires education, simplification of the purchasing process, trust-building, and motivational incentives. They can be activated through improved experiences and reduced complexity.

This table demonstrates that omnichannel retail customers can be categorized into three distinct clusters based on their interaction patterns and levels of value co-creation. Cluster 0 includes mainstream or typical customers whose behaviors are relatively balanced, stable, and close to the average level. Although these customers utilize multiple channels, their levels of participation and information sharing remain moderate; therefore, this group represents a stable source for maintaining sales and gradually expanding participation.

Cluster 1 represents active value co-creators who exhibit the highest levels of participation, brand engagement, information sharing, utilization of services such as BOPIS, and channel switching behavior. Consequently, this group constitutes the most valuable customer segment and plays a critical role in innovation, digital service development, and enhancement of customer lifetime value.

In contrast, Cluster 2 consists of passive customers who display the lowest levels of interaction, participation, information sharing, and use of multiple channels, relying primarily on habitual and single-channel purchasing behaviors.

Overall, this clustering pattern demonstrates that customers are heterogeneous in terms of interaction intensity and value creation for retailers. Therefore, marketing strategies and customer relationship management practices should be tailored according to the characteristics of each cluster. Specifically, strategies for the mainstream cluster should focus on retention and gradual enhancement, strategies for the active cluster should emphasize loyalty reinforcement and co-creation development, and strategies for the passive cluster should prioritize education, trust-building, and simplification of the purchasing experience.

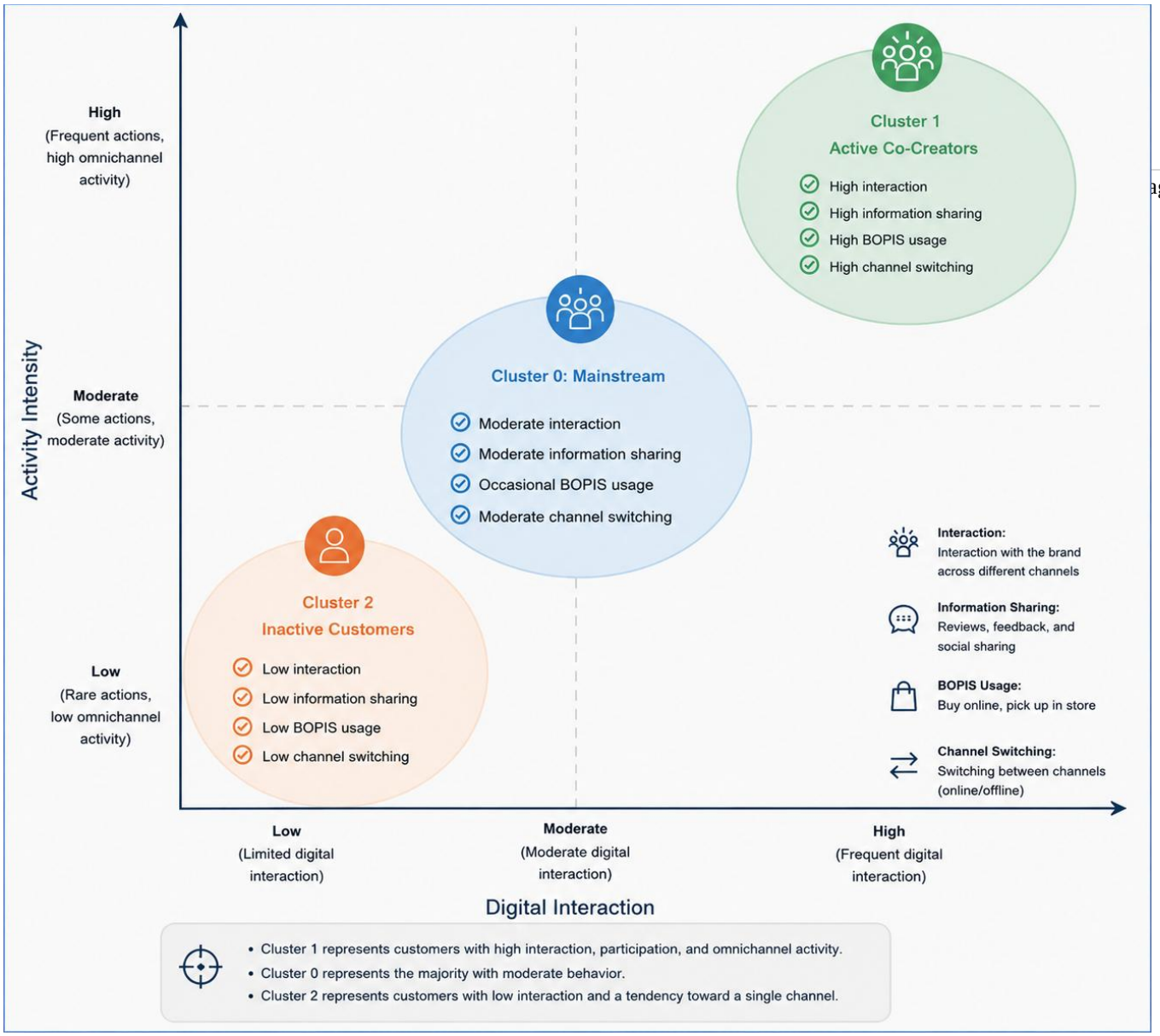

Figure 5. Customer Clusters in Omnichannel Retailing

4. Discussion and Conclusion

The present study aimed to identify and classify customer behavioral patterns in omnichannel retailing and explain their role in value co-creation processes using data mining techniques. The findings demonstrated that customer behaviors in omnichannel retail environments are highly heterogeneous and can be classified into three distinct clusters: mainstream customers, active value co-creators, and passive customers. The clustering analysis further revealed that customers differ significantly in terms of engagement, information sharing, omnichannel participation, BOPIS usage, and channel-switching behavior. These findings confirm that omnichannel retailing creates differentiated interaction environments in which customers exhibit varying levels of participation and contribution to organizational value creation.

One of the most important findings of the study was the identification of the “active value co-creators” cluster as the most strategically valuable customer segment. This group demonstrated the highest levels of engagement, interaction, information sharing, and omnichannel participation. Their behavioral profile indicates that they actively utilize multiple retail channels, frequently switch between online and offline platforms, and participate in collaborative activities such as feedback provision and knowledge sharing. This finding aligns closely with previous research emphasizing that omnichannel integration

strengthens customer participation and enhances value co-creation behaviors (Dehghani Ghahnooiyeh et al., 2025; Kesenduran et al., 2024). Customers who interact across multiple channels tend to perceive greater convenience, personalization, and flexibility, which in turn increases their emotional attachment to the retailer and their willingness to contribute to value-generating activities.

The strong role of omnichannel participation in predicting value co-creation also supports the argument that omnichannel retailing functions as more than a distribution mechanism. Rather, it represents an integrated interaction ecosystem in which customers become active contributors to organizational performance (Dennis et al., 2017; Gao & Jiang, 2025). The active co-creator cluster in the present study demonstrated high levels of channel switching and BOPIS usage, indicating that customers who use multiple channels in a complementary manner are more likely to engage in co-creation processes. This result is consistent with earlier findings showing that multichannel shoppers exhibit stronger behavioral loyalty, higher purchase frequency, and greater profitability compared with single-channel customers (Konus et al., 2008; Kumar & Venkatesan, 2005).

Another important finding concerns the relationship between customer engagement and value co-creation. The results showed that variables such as customer engagement, customer participation, information sharing, and feedback provision were among the most important predictors of value co-creation behavior. These findings reinforce the theoretical perspective that customer engagement represents a critical driver of collaborative value creation in retail ecosystems (Bosisio, 2024). Customers who are cognitively and emotionally connected to brands are more likely to interact with retailers, share experiences, provide constructive feedback, and contribute to service improvement processes. This finding is also supported by research suggesting that engaged customers frequently become voluntary brand advocates who contribute to innovation and digital interaction development (Dennis et al., 2017; Kesenduran et al., 2024).

The findings also revealed that omnichannel behavioral indicators such as app usage and channel switching significantly contributed to the classification of customers. This suggests that customers who actively navigate across multiple touchpoints are more inclined toward collaborative behaviors and interactive participation. Such results align with the work of (Gensler et al., 2012) and (Verhoef et al., 2007), who emphasized that modern consumers increasingly rely on multiple channels during different stages of the shopping journey. Customers may search for information online, evaluate products through social media, compare alternatives using mobile applications, and complete purchases in physical stores. These integrated behaviors create richer interaction opportunities and increase the probability of value co-creation between customers and retailers.

The identification of mainstream customers as the largest cluster also provides important insights into omnichannel customer behavior. Although this group exhibited moderate levels of engagement and omnichannel participation, their behavior remained relatively balanced and predictable. These customers neither displayed highly active co-creation behavior nor complete passivity. Such findings correspond with previous studies indicating that many omnichannel customers occupy intermediate behavioral positions and may gradually transition toward higher levels of engagement when appropriate incentives and experiences are provided (Rangaswamy & Van Bruggen, 2005; Thomas & Sullivan, 2005). From a strategic perspective, this segment represents a stable revenue source and possesses considerable potential for future development through personalization strategies, loyalty programs, and enhanced customer experiences.

The behavioral characteristics of mainstream customers also support earlier findings related to process utility and channel convenience. Research has demonstrated that customers select channels not only for product acquisition but also for convenience, simplicity, and efficiency during the shopping process (Balasubramanian et al., 2005). The moderate omnichannel participation observed in this cluster may therefore reflect functional and pragmatic motivations rather than emotional attachment or collaborative orientation. Nevertheless, because this segment constitutes the majority of the customer base, improving their engagement levels could significantly increase overall organizational value creation.

In contrast, the passive customer cluster exhibited the lowest levels of engagement, information sharing, and omnichannel participation. These customers relied heavily on habitual and limited purchasing behaviors and demonstrated weak interaction with retail systems. Their low BOPIS usage and minimal channel switching suggest that they either lack technological familiarity or perceive limited value in omnichannel experiences. This finding is consistent with prior research indicating that technological acceptance and digital familiarity strongly influence online shopping behavior and channel adoption (Ha & Stoel,

2009; O'Cass & Fenech, 2003). Customers with lower technological confidence often demonstrate reduced willingness to interact with digital retail platforms and are less likely to participate in collaborative value creation activities.

The presence of passive customers also highlights the importance of trust-building and experience simplification in omnichannel retail systems. Previous studies have shown that customers may avoid digital channels when they perceive complexity, uncertainty, or insufficient value in omnichannel interactions (Frambach et al., 2007; Keen et al., 2004). Therefore, retailers must design intuitive and seamless shopping experiences that reduce cognitive effort and encourage gradual engagement with digital services. Simplifying omnichannel interfaces, improving navigation systems, and offering customer education initiatives may increase participation among passive customer segments.

Another important contribution of the study relates to the predictive classification model used for identifying customer co-creation levels. The classification results demonstrated that omnichannel behavioral variables could predict value co-creation behavior with acceptable accuracy. The model performed especially well in identifying customers with high co-creation potential, suggesting that customer interaction patterns provide strong indicators of collaborative behavior. This finding supports previous literature emphasizing the growing importance of behavioral analytics and data mining techniques in retail management (Imap, 2010; Insights, 2010). Retailers increasingly rely on customer data to optimize personalization strategies, improve targeting mechanisms, and identify high-value customer segments.

The feature importance analysis also provided valuable theoretical and managerial insights. The findings demonstrated that interaction-related variables possessed substantially greater predictive power than demographic characteristics such as age, gender, and income level. This result aligns with many contemporary consumer behavior studies suggesting that actual behavioral data provide more accurate explanations of customer actions than static demographic profiles (Konus et al., 2008; Kumar & Venkatesan, 2005). In modern omnichannel environments, customers are differentiated less by demographic characteristics and more by their interaction intensity, technological engagement, and collaborative participation patterns.

The relatively low importance of demographic variables may also indicate that omnichannel retailing has reduced traditional segmentation boundaries. Because digital technologies are widely accessible across different demographic groups, behavioral engagement has become a more meaningful determinant of customer value creation than demographic identity. This interpretation is consistent with findings showing that customer experience and interaction quality increasingly shape retail outcomes in integrated channel environments (Chamelian, 2024; Jalalzadeh et al., 2025).

The study also contributes to the broader literature on omnichannel customer experience. Previous research has argued that seamless integration across channels enhances satisfaction, loyalty, and shopping convenience (Gao & Jiang, 2025; Rigby, 2011). The present findings extend this perspective by demonstrating that integrated omnichannel experiences also encourage collaborative customer behaviors and increase value co-creation participation. Customers who move comfortably between channels are not only more active shoppers but also more likely to engage in knowledge sharing, feedback provision, and brand interaction.

Furthermore, the findings support theoretical arguments regarding the transition from transactional retailing to relationship-oriented retail ecosystems. Traditional retail models viewed customers primarily as buyers, whereas contemporary omnichannel systems position customers as active participants in organizational processes (Neslin et al., 2006; Sanchez-Perez et al., 2014). The identification of active co-creators in the present study illustrates how customers increasingly contribute to service development, innovation, and organizational reputation through interactive behaviors. This shift has important implications for marketing strategy because organizations must focus not only on sales generation but also on fostering sustainable customer relationships and collaborative engagement.

The importance of omnichannel integration identified in this study is also consistent with research emphasizing the strategic role of synchronized customer journeys. Consumers increasingly expect consistency across digital and physical environments, and fragmented experiences often reduce satisfaction and loyalty (Gensler et al., 2012; Rigby, 2011). Therefore, retailers that successfully integrate online and offline touchpoints may create stronger emotional connections with customers and facilitate greater participation in co-creation activities.

The findings additionally reinforce the role of interactive technologies in modern retail systems. Digital applications, social media platforms, and integrated customer management systems provide customers with opportunities to participate actively in

retail processes (Schibrowsky et al., 2007; Subramanian et al., 2007). Such technologies not only improve convenience but also transform the nature of customer–retailer relationships by enabling continuous communication and collaborative interaction. Consequently, retailers that invest in advanced omnichannel infrastructures may strengthen customer engagement and increase long-term value creation potential.

Overall, the study demonstrates that customer behavior in omnichannel retailing is multidimensional and behaviorally diverse. Customers differ substantially in terms of interaction intensity, technological participation, and collaborative orientation, and these differences strongly influence their contribution to value co-creation processes. The findings therefore highlight the importance of behavioral segmentation, customer engagement strategies, and omnichannel integration in developing sustainable retail systems and improving organizational competitiveness.

One limitation of the present study is that the dataset was derived from a specific omnichannel retail environment, which may limit the generalizability of the findings to other retail sectors or geographic contexts. Additionally, the study relied primarily on behavioral and transactional variables and did not include psychological constructs such as motivation, perceived risk, or emotional attachment that may further explain customer participation in value co-creation. Another limitation concerns the cross-sectional nature of the data, which restricts the ability to examine behavioral changes over time. Finally, although the predictive model achieved acceptable performance, the imbalance between customer classes reduced the accuracy of identifying low-engagement customers.

Future research should investigate customer value co-creation behavior across different retail industries and cultural environments to improve the generalizability of findings. Longitudinal studies may also provide deeper insights into how omnichannel customer behavior evolves over time and how customers transition between behavioral clusters. Future studies could additionally incorporate psychological, emotional, and social variables to develop more comprehensive behavioral models. The application of advanced machine learning approaches such as deep learning, ensemble learning, and hybrid clustering techniques may further improve predictive accuracy and customer classification performance.

From a managerial perspective, retailers should design differentiated strategies tailored to each customer cluster. For active co-creators, organizations should focus on strengthening loyalty programs, personalized communication, and participatory campaigns to maximize engagement and innovation potential. For mainstream customers, retailers should provide incentives and seamless experiences that gradually increase interaction and omnichannel participation. For passive customers, simplifying digital interfaces, enhancing trust, and providing educational support may encourage greater adoption of omnichannel services. In addition, retailers should prioritize investment in integrated omnichannel infrastructures and behavioral analytics systems to better understand customer interaction patterns and optimize value co-creation strategies.

Ethical Considerations

All procedures performed in this study were under the ethical standards.

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Conflict of Interest

The authors report no conflict of interest.

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