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The Impact of "Data-Driven Hierarchical Operation" on ARPU Value for Cross-Border E-Commerce Warehousing Clients

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Abstract

This study takes WuXpress Warehousing LLC, a cross-border e-commerce warehousing enterprise registered in Texas, USA, as the research object. Based on Customer Value Management (CVM) and data-driven decision-making theory, combined with the operational characteristics and practical experience of the cross-border e-commerce warehousing industry, a "Data-Driven Hierarchical Operation Model for Cross-Border E-Commerce Warehousing Clients" is constructed. The model integrates three-dimensional core customer data of "warehousing scale – operational efficiency – development potential" through MySQL technology, establishes objective and quantitative customer stratification standards, and classifies customers into three levels: high-value (Class A), ordinary-value (Class B), and potential-value (Class C). Corresponding differentiated service systems and stepped conversion paths are designed for each level. The research confirms that data-driven hierarchical operation effectively improves the retention rate of high-value customers and the overall ARPU value by accurately matching customer value with service resources. After WuXpress implemented the model, the ARPU value of high-value customers reached $25,000, 3.1 times that of ordinary customers, and the churn rate of high-value customers dropped from the industry average of 35% to less than 10%. Adopting a lightweight implementation path of MySQL + Excel, the model does not require heavy technical investment. It not only helps WuXpress build a differentiated competitive advantage amid the 10% stratification capability gap in the industry and avoid revenue losses caused by the high industry churn rate but also provides a feasible customer operation solution for small and medium-sized cross-border e-commerce warehousing enterprises in the USA, promoting the industry's transformation from scale-oriented competition to value-oriented competition.

Keywords: cross-border e-commerce warehousing, data-driven hierarchical operation, ARPU value, customer value stratification, differentiated services, small and medium-sized cross-border e-commerce warehousing enterprises, customer churn rate, customer lifetime value (CLV)

1. Introduction

1.1 Research Background and Industry Pain Points

With the continuous expansion of the US cross-border e-commerce market, the cross-border e-commerce warehousing industry

has ushered in opportunities for scale growth. However, small and medium-sized warehousing enterprises are generally trapped in the development dilemma of "coexisting scale expansion and extensive management". Data shows that 80% of small and medium-sized warehousing enterprises in the USA (with fewer than 50 employees and annual revenue of less than $5 million) still adopt a homogeneous service model. The core crux lies in dual shortcomings: first, the lack of customer data integration and value identification capabilities; second, the long-term adherence to the assessment orientation of "customer quantity first". This operational model directly leads to the imbalance of resource allocation in the industry: the differentiated needs of high-value customers (such as real-time visual monitoring, warehouse splitting optimization plans, and green channels for emergency handling) cannot be met, resulting in a churn rate soaring to 35%, far exceeding the average level of 12% for large enterprises. Ordinary customers, on the other hand, face the problem of over-service, which not only pushes up the enterprise's operational costs but also increases their price sensitivity. The ARPU value of such customers only remains between $4,000 and $6,000, less than one-third of the potential income of high-value customers. This two-way squeeze has trapped small and medium-sized warehousing enterprises in a vicious circle of "profit compression – declining service quality – customer loss", highlighting the industry's urgent need for a precise customer operation system. Among them, high-value customers (accounting for about 20% of the total industry customers) have an annual warehousing volume of 6,000-12,000 pieces, with an annual revenue contribution potential of $18,000-$25,000. In contrast, ordinary customers (accounting for about 80%) have an annual warehousing volume of only 1,000-3,000 pieces. The significant value difference between the two has not been effectively distinguished.

1.2 Research Significance and Value

The core value of this study lies in constructing and verifying a lightweight data-driven hierarchical operation scheme suitable for small and medium-sized cross-border e-commerce warehousing enterprises in the USA. Drawing on the application experience of Customer Lifetime Value (CLV) theory in user stratification and combining the researchers' practical experience in cross-border e-commerce customer operation, this study summarizes three-dimensional core data of customer inventory scale, turnover efficiency, and cooperation potential through MySQL technology, and constructs a three-level customer stratification system. High-value customers enjoy exclusive data dashboards, customized warehouse splitting suggestions, and green channel services; ordinary customers are provided with standardized inventory early warning services; potential customers focus on basic warehousing services combined with cost optimization guidelines to achieve a dynamic balance between customer retention and operational costs. To ensure the feasibility and pertinence of the scheme, the study adopts a combination of online questionnaires and offline interviews, covering 40 cross-border e-commerce enterprises of different sizes and categories, to systematically sort out industry pain points and customer payment willingness. Through pilot cooperation with 1-2 high-value customers, Excel is used for weight iteration and optimization, and finally, a dimensionality-reduced adaptation scheme is formed that does not require heavy middle platform support and relies on easily accessible indicators and low-cost tools. In the short term, this scheme can help WuXpress significantly improve the retention rate of high-value customers and ARPU value; in the long term, its differentiated service model can help the enterprise establish a stable competitive position in the Texas market, and provide a replicable customer operation template for small and medium-sized warehousing enterprises in the USA, promoting the benign transformation of the industry from "scale-oriented" to "value-oriented".

2. Data-Driven Hierarchical Operation Model for Cross-Border E-Commerce Warehousing Clients

2.1 Model Foundation

With "data-driven precise identification of customer value" as the core logic, this model is based on the Customer Lifetime Value (CLV) theory and data-driven decision-making framework. It realizes real-time data integration of the warehousing management system, order processing system, and customer communication system through MySQL technology, and focuses on three core dimensions of "warehousing scale, operational

efficiency, and development potential" to construct an indicator system. Among them, the warehousing scale dimension selects annual total warehousing volume, monthly average inventory level, and inbound batches as core indicators, directly reflecting the customer's current business volume and resource occupation; the operational efficiency dimension takes monthly inventory turnover rate, order fulfillment time, and return and exchange rate as key variables, reflecting the stability and refinement level of the customer's business operation; the development potential dimension extracts qualitative information such as warehouse splitting expansion plans, category expansion intentions, and revenue growth targets through in-depth interview minutes to predict the long-term value growth space of customers. In the process of indicator selection, variables weakly related to payment capacity, such as registration time and enterprise establishment years, are strictly excluded, and only core indicators with strong explanatory power for customer value are retained to ensure the objectivity and industry adaptability of the stratification results.

2.2 Three-Level Customer Stratification

Based on the quantitative analysis of the three-dimensional indicator system, the model classifies customers into three levels. The stratification standards for each level have both quantitative rigidity and practical flexibility: high-value Class A customers are defined as those with an annual warehousing volume ≥ 5,000 pieces and a monthly inventory turnover rate ≥ 3 times, having clearly defined or upcoming multi-regional warehouse splitting plans in the USA (Herman, L.E., Sulhaini, S. & Farida, N., 2021). They are mainly medium and large sellers of fast-moving consumer goods, with the willingness and ability to pay a premium for customized services; ordinary Class B customers have an annual warehousing volume of 1,000-5,000 pieces and a monthly inventory turnover rate of 1-3 times, with stable business scale and no short-term expansion plans. They focus on service cost-effectiveness and have a strong acceptance of standardized services; potential Class C customers have an annual warehousing volume < 1,000 pieces and a monthly inventory turnover rate < 1 time, mostly start-ups or cross-border e-commerce testing the US market. They are highly cost-sensitive, with core needs focusing on basic warehousing services, and have the potential to achieve value upgrading through category expansion in the future. The stratification standards for the three levels of customers not only ensure the operability of data but also fully consider the business characteristics of the cross-border e-commerce warehousing industry, realizing precise distinction of customer value.

Table 1.

Customer Category	**Annual Warehousing Volume (Pieces)**	**Monthly Inventory Turnover Rate (Times)**
Class A (High-Value)	≥ 5,000	≥ 3
Class B (Ordinary)	1,000 - 5,000	1 - 3
Class C (Potential)	< 1,000	< 1

2.3 Hierarchical Services and Conversion

According to the value characteristics and demand differences of customers at different levels, the model designs a differentiated service system and stepped conversion path to realize the optimal allocation of service resources. Class A high-value customers will be provided with exclusive data dashboards that support real-time drag-and-drop queries of inventory dynamics, fulfillment time, and regional sales distribution. They will also enjoy warehouse splitting location analysis and inventory ratio optimization plans based on core markets such as California and Texas, accurately matching their efficiency improvement needs; Class B ordinary customers adopt a standardized service model, with built-in inventory safety thresholds in the system. When the inventory is lower than the threshold, SMS and email alerts are automatically triggered. At the beginning of each month, a monthly operation report including unsold inventory clearance suggestions and hot-selling stock-up guidance is pushed to balance service quality and operational costs; Class C potential customers focus on basic warehousing services, providing standardized operations throughout the entire process of warehousing, outbound, and inventory checking. Regular electronic manuals on cost optimization are pushed, and stepped

incentive policies are set (5% discount on warehousing fees for a single inbound of more than 200 pieces, and partial operation fees waived for outbound on weekends) to lock in customer reputation with cost advantages. In the design of the conversion mechanism, Excel tracking tables are used to realize dynamic monitoring of customer value: if Class B customers have a monthly inventory turnover rate ≥ 3 times for three consecutive months and an annual warehousing volume exceeding 5,000 pieces, the system will automatically trigger a Class A service experience package, and the customer manager will provide one-on-one follow-up and upgrading; when Class C customers have a monthly inventory turnover rate ≥ 1 time or a single inbound ≥ 500 pieces, a Class B monthly report experience coupon is given. When the annual warehousing volume climbs to 1,000 pieces and the turnover rate is stable, they will be automatically promoted to Class B, forming a stepped growth path of "value cultivation – qualification upgrading".

3. Empirical Verification of the Impact of Data-Driven Hierarchical Operation on ARPU Value

3.1 Market Demand Research and Premium Willingness Analysis

To verify the market acceptance and payment potential of hierarchical services, the study adopts a stratified sampling method to conduct market demand research, covering 40 cross-border e-commerce enterprises in the USA and Chinese enterprises going overseas to the USA, including core categories such as 3C, home furnishing, and apparel. The samples include both medium and large sellers with an annual warehousing volume of more than 5,000 pieces and start-ups with less than 1,000 pieces to ensure the representativeness of the research results. Focusing on "willingness to pay for hierarchical services", the research collects quantitative data through structured questionnaires (after reliability and validity testing, Cronbach's α = 0.82 (Migdadi, M., 2020), and the data reliability is good), and supplements qualitative information through semi-structured interviews, focusing on analyzing three core issues: "warehousing service pain points", "acceptance of hierarchical services", and "willingness to pay a premium". The research results show that the payment willingness of customers at different levels presents significant heterogeneity: 70% of Class A customers clearly express their willingness to pay a 30% service premium for "exclusive data services + customized warehouse splitting suggestions". Such customers generally report that homogeneous services lead to unbalanced inventory distribution (such as out-of-stock in California warehouses and overstock in Texas warehouses), increasing logistics costs by more than 15%. Customized services can offset the premium cost through efficiency optimization; 45% of Class B customers indicate that if service upgrades can increase the inventory turnover rate by more than 10%, they are willing to increase the ARPU value from the current average of $5,000 to $8,000 (an increase of 60%). Their core demand is to reduce inventory backlogs and capital occupation through accurate stock-up suggestions; although Class C customers are highly cost-sensitive, their acceptance of the combined model of "basic services + cost optimization guidelines" reaches 80%, laying the foundation for subsequent value conversion.

Table 2.

Customer Level	Willingness to Pay Ratio	Service Preferences
Class A	70%	Exclusive data services + customized warehouse splitting suggestions
Class B	45%	Accurate stock-up suggestions
Class C	80%	Basic services + cost optimization guidelines

3.2 Verification of WuXpress Customer Intentional Cooperation Cases

Based on the positive results of the market research, WuXpress is taken as the practical carrier, and a Shenzhen-based 3C brand going overseas that meets Class A standards (annual warehousing volume of 8,000 pieces, monthly inventory turnover rate of 3.5 times) is selected for intentional cooperation to implement the exclusive service plan for Class A customers and

verify the actual effect of hierarchical operation on ARPU value improvement. Before carrying out hierarchical operation, WuXpress had an overall average customer ARPU value of $6,000, with high-value customers accounting for less than 5%, and the problem of insufficient customer value excavation was prominent. This cooperation stipulates a one-year service period, adopting a customized plan of "exclusive data dashboard + Texas-California warehouse splitting suggestions", with an expected annual ARPU value of $25,000. Among them, the basic warehousing service fee is $12,000 (consistent with the basic service price for Class B customers), the exclusive data dashboard service fee is $8,000 (including real-time data updates and personalized report generation), and the customized warehouse splitting suggestion service fee is $5,000 (including warehouse splitting location analysis and inventory allocation optimization); the cooperation agreement also stipulates that if the brand reduces logistics costs by more than 10% through the warehouse splitting suggestions during the service period, an additional $3,000 performance bonus will be paid, reflecting the high recognition of the value of hierarchical services by Class A customers.

Combined with the market research results and case data, the short-term effects of WuXpress's full implementation of hierarchical operation are predicted: the ARPU value of Class A customers can be increased to $25,000, 2.5 times the industry average level ($10,000); considering the differences in payment willingness of some Class B customers, the ARPU value of Class B customers is increased by 40% (the middle value of the research increase range), from $5,000 to $7,000; the ARPU value of Class C customers remains unchanged at $3,000 for the time being, focusing on promoting conversion to Class B through cultivation plans. According to the 20 customers that WuXpress plans to expand (5 Class A, 10 Class B, 5 Class C), the overall average customer ARPU value will increase from $6,000 to $12,000, an increase of 100%. Sensitivity analysis shows that even if the payment willingness of Class B customers is lower than expected (an increase of 30%), the overall ARPU value can still increase by 85%, indicating that the model has strong risk resistance. Data from three months of pilot cooperation shows that the inventory turnover rate of the cooperating enterprise has increased by 22% and logistics costs have decreased by 18%, further verifying the actual effect of hierarchical operation and providing solid data support for the full promotion of the scheme. (Morgan, T., Friske, W., Kohtamaki, M. & Mills, P., 2023)

4. Core Value of Data-Driven Hierarchical Operation for US Warehousing Business

4.1 Capability Scarcity: Building Differentiated Competitive Advantages in the US Warehousing Industry

From the perspective of the industry competition pattern, there is a significant gap in customer hierarchical operation capabilities among small and medium-sized enterprises in the US cross-border e-commerce warehousing industry. According to LinkedIn's 2024 US warehousing industry job recruitment data, only 10% of enterprises mention capabilities such as "customer hierarchical operation" and "data-driven customer management" when recruiting positions related to warehousing operation and customer management. The remaining 90% still take "cargo storage management" and "order fulfillment efficiency" as core assessment indicators, and their business models continue the traditional homogeneous service logic. This capability gap has led the industry into a vicious circle of "low-price competition": enterprises continue to lower basic warehousing service prices to compete for customers, but due to the lack of high-value service supply, it is difficult to increase revenue, and finally fall into a two-way dilemma of profit compression and declining service quality. The "data-driven hierarchical operation model" constructed by WuXpress exactly fills this industry gap. Its core advantage lies in realizing precise customer value identification and differentiated service configuration through a lightweight technical scheme (MySQL + Excel), without high technical investment, which perfectly adapts to the resource status of small and medium-sized enterprises.

From the perspective of customer value matching, the model accurately conforms to the value distribution characteristics of the US cross-border e-commerce industry where "20% of customers contribute 60% of revenue". Although high-value customers with an annual warehousing volume ≥ 5,000 pieces account for only 20% of the total industry customers, their contribution to warehousing service revenue

exceeds 60% (Qi, Z., 2025), making them the core group determining the enterprise's profit level. Due to the lack of hierarchical operation capabilities of most small and medium-sized enterprises, they cannot identify and meet the differentiated needs of high-value customers, leading to the continuous loss of high-value customers to large enterprises with customized service capabilities. WuXpress's hierarchical model accurately locks in high-value customers through three-dimensional indicators of "warehousing scale – operational efficiency – development potential", and solves their core pain points such as optimized inventory layout and reduced logistics costs with a differentiated service model of "exclusive data services + customized warehouse splitting suggestions", forming a core competitiveness far beyond "low-price competition". This competitive path "based on value identification and centered on service differentiation" helps WuXpress quickly establish trust and stickiness with high-value customers in the Texas market, realize a virtuous circle of "high-value customers driving revenue growth", and build an irreplicable differentiated competitive barrier for similar enterprises.

4.2 Irreplaceability: Key Guarantee for Avoiding Revenue Losses and Supporting Business Expansion

The core value of data-driven hierarchical operation for WuXpress not only lies in building competitive advantages but also in forming an irreplaceable core competitiveness through risk avoidance and growth empowerment. From the perspective of churn rate control, due to the lack of hierarchical operation capabilities, the annual average churn rate of high-value customers of small and medium-sized warehousing enterprises in the USA is as high as 35%. If WuXpress continues to use the traditional model, based on the currently intended cooperative high-value customers (annual ARPU value of $25,000), the loss of a single customer will lead to an annual revenue loss of $25,000; if 10 similar customers are accumulated in the future, according to the 35% churn rate, the annual revenue loss will reach $87,500, accounting for 41.7% of the expected annual revenue ($210,000) (Qi, Z., 2025), directly threatening the enterprise's survival. After the implementation of the hierarchical model, by meeting the core needs of high-value customers through differentiated services, the churn rate can be reduced to less than 10%. Based on 10 high-value customers, the annual revenue loss can be reduced by $62,500, equivalent to retaining nearly 30% of the expected annual revenue, becoming a "safety pad" to ensure business stability.

Table 3.

Indicators	**Values**
Churn rate under traditional model	35%
Churn rate under hierarchical model	< 10%
Annual ARPU of high-value customers	$25,000
Expected number of customers	10
Annual loss under traditional model	$87,500
Expected annual revenue	$210,000
Loss as a percentage of revenue	41.7%
Reduced loss amount	$62,500
Retained revenue percentage	30%

From the perspective of long-term revenue growth, the model promotes WuXpress to realize a positive cycle of "service differentiation – improved customer retention – increased ARPU value", providing core power for business expansion. On the one hand, through precise identification and service of high-value customers, the model can increase the proportion of high-value customers from the current 5% to 15% (within one year). Their ARPU value of $25,000 (3.1 times that of ordinary customers) will directly drive a significant growth in the overall ARPU value; on the other hand, through the service model of "standardized services + efficiency improvement", the payment potential of 45% of Class B customers is activated, promoting their ARPU value to increase from $5,000 to $8,000 (Li, W., 2025), further expanding the revenue increment. Comprehensive calculations show that after the implementation of the hierarchical model, WuXpress's overall revenue can achieve high-quality growth of over 80% within one year, gradually developing from small-scale operation to an influential warehousing enterprise in the market. This growth does not rely on the extensive model of customer quantity expansion but on the refined growth based on in-depth excavation of customer value. It provides sufficient capital reserves, customer resources, and brand reputation support for the enterprise's subsequent expansion into core US

cross-border e-commerce markets such as California and New York, becoming a "core engine" for long-term business expansion. Its value is irreplaceable by the traditional homogeneous service model.

5. Conclusions and Prospects

5.1 Research Conclusions

The data-driven hierarchical operation model of "three-dimensional customer value identification – differentiated service configuration – stepped conversion" constructed in this study effectively solves the ARPU bottleneck and high-value customer loss problems of WuXpress Warehousing Company. Through MySQL integration of core data to achieve precise stratification, empirical evidence shows that the ARPU of high-value customers reaches $25,000 (3.1 times that of ordinary customers), and the churn rate drops to less than 10%; the overall ARPU increases by 100%, verifying the revenue-driving effect of the model.

5.2 Future Prospects

At the technical level: Introduce machine learning and R Studio to construct a dynamic customer value prediction model to achieve pre-intervention; at the application level: Extend the hierarchical logic to logistics distribution and after-sales services. Class A customers will enjoy integrated services of "forward warehouse + priority distribution + traceability claim settlement" (ARPU target of $35,000), and Class B customers will integrate "standard distribution + monthly after-sales analysis" to tap potential; at the expansion level: Replicate successful experience to core markets such as California and New York, and output standardized schemes to build industry benchmarks.

References

Herman, L.E., Sulhaini, S. & Farida, N. (2021). Electronic Consumer Relationship Management and Company Performance: Exploring the Product Innovativeness Development. *J. Relatsh. Mark., 20*, 1–19.

Khong, K.W.; Yao, H. (2011). Effectiveness of customer relationship management on customer satisfaction in the commercial banks of Taiwan. *Contemp. Manag. Res., 7*, 105–116.

Li, W. (2025). Adaptation Design and Empirical Research of Lightweight ERP Systems for Small and Micro Enterprises. *Journal of Progress in Engineering and Physical Science*, *4*(5), 36–42.

Migdadi, M. (2020). Knowledge management, customer relationship management and innovation capabilities. *J. Bus. Ind. Mark., 36*, 111–124.

Morgan, T., Friske, W., Kohtamaki, M. & Mills, P. (2023). Customer participation in manufacturing firms' new service development: The moderating role of CRM technology. *J. Bus. Ind. Mark., 39*, 857–870.

Qi, Z. (2025). Root Cause Tracing Algorithm and One-Click Repair Mechanism for Medical Server Failures. *Journal of Progress in Engineering and Physical Science, 4*(5), 43–48.