



Enhancing Marketing Performance Through Digital Business Control Systems: An Extended RFM Approach

Mustafa Fadhil Zuhwar 

Department of Computer Engineering, Urmia University, Urmia, Iran.

*Correspondence: Mustafakhan4study@gmail.com



Abstract: Digital transformation has revolutionized the marketing sector through the installation of complex business control systems that maximize decision-making, business effectiveness, and customer experience. This article explains how the systems enable electronic records, networked automation systems, and intelligent systems to improve marketing performance. Electronic records abolish paper records, and automation systems enable integrated data processing for supporting decisions, and intelligent systems predict customers' behavior and perform real-time supply adjustments. The study employs an extended RFM approach, covering Customer Loyalty Age (CLA) and Customer Need Rate (CNR), in assessing renewal probability at the point-of-sale (POS) for supply chains. Findings show that aligning digital business control systems with extended RFM analysis enables POS operators and suppliers to predict customer renewal behavior, reduce lost sales risks, optimize inventory, ensure timely product availability, faster inventory turnover, and reduced costs. Lastly, the integration of digital control systems with advanced analytics offers real-time performance improvement as well as long-term strategic advantage in contestable markets.

Keywords: Digital business systems; Marketing performance; Intelligent systems; Customer retention; Sales optimization.

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1. Introduction

In today's rapidly evolving and extremely competitive business environment, digital technologies have become drivers of marketing success and organizational performance. Traditional forms of marketing, depending on human efforts, separate data sources and non-related communication channels, are no longer effective in developing consumer behavior and market dynamics. Companies are facing a double volume today: staying competitive together to make fact-based decisions, as well as respond to customers' needs quickly. It has created an immediate need for strong systems that are able to track, analyze and direct marketing measures with accuracy and speed [1–3].

Digital Business Control System Marketing and Action Driver Business Insights builds over an interstice to present a powerful solution. By combining sophisticated data management, process automation and intelligent analysis, these systems organizations make better decisions, increase operating efficiency and respond to market trends immediately. They make the spread information into useful insights, which run strategies, so that companies can provide the right product and service to the right customer at the right time and price. These skills become more valuable in the customer markets that are sensitive to speed, accuracy and adaptation [4–6]. Electronic business management system plays a role in marketing and can be seen in three broad categories. Electronic documents provide accurate, well-structured and easily recyclable documentation, reduce errors and increase efficiency [7]. The integrated automation system brings together various commercial processes and enables real-time coordination, monitoring and resource allocation. Intelligent systems pursue this capacity through the use of advanced analysis, machine learning and advance modeling so that customers can be given taste findings, forecasts and strategic decision facilities [8–11]. In total, these systems increase operational control, make costs more efficient, promote innovation and provide permanent growth.

The Recency–Frequency–Monetary (RFM) model has been widely used as a tool for improving customer division and improvement of marketing. However, researchers have emphasized that classic RFM structure, although simple and explanatory, cannot occupy the complete complexity of customer behavior. To solve this, several extensions have been proposed. Ho et al [12] introduced an extended RFMD model that integrates behavior and demographic variables. Five different customer groups were identified and validated with the performance matrix, using K-Means and K-Prototype algorithms. The model improves customers' understanding, supports storage analysis and enables companies to design more efficient marketing strategies. Similarly, Zalaghi and Abbasnejad Varzi [13] proposed an extended RFM model through the integration of loyalty-related attributes. The findings illustrated that applying the extended RFM in combination with clustering algorithms such as K-means enhanced customer classification accuracy. Digitalization transforms management control (MC) with profound implications for tasks, instruments, organization, and behavioral dimensions. Fährdrich examined [14] 116 articles (2000–2022) across top-tier accounting journals, sorted based on Guenther's MC framework. Findings report intensified MC tasks, new and adapted instruments, behavioural implications, and changing organizational forms. Methodological tendencies, research gaps, and avenues for future MC research are also disclosed. Changes business activities through digital marketing platforms, focusing consumer needs. Yang et al. [15] Discovered a blockchain-based digital marketing control system that integrates customer and business resources. Experimental results from two stores show significant improvements in sales and customer engagement after using Blockchain technology. The study concludes that the combination of digital marketing blockchain increases data transfer, online publicity and business service efficiency [16].

Therefore, there is a clear difference in literature: While the expanded RFM approach gives rich customers insight and the digital business control system provides powerful mechanisms for automation and decision -making in real time, little research has been evaluated in common to assess both of these flows in common how RFM can be increased in the digital business control system. It is necessary to show this difference to show how customer analysis can be performed in digital control infrastructure to achieve the average improvement in marketing efficiency.

Aside from these three categorizations, this study incorporates an extended RFM model—CLA and CNR—to assess renewal opportunity at point of sale (POS). Blending RFM analysis with electronic business control systems provides a stronger method for predicting customer demand, optimizing inventory distribution, and maximizing marketing reach. This practice provides immediate performance improvement along with long-term strategic advantage, enabling companies to excel in more data-driven and customer-focused markets.

2. Methods

The study adopts a quantitative and analytical approach to check the role of smart systems and extended RFM models to prevent lost sales points within supply chains. The function consists of four main steps: data collection, variable formulation, and analytical modeling.

2.1. Data Collection

Data was collected from business-to-business (B2B) and business-to-customer (B2C) transactions within a selected supply chain industry. The data include:

- History of customer purchases, such as date, quantity, and price.
- Supplier sales reports, which capture product flow to points of sale.
- Inventory movement records, tracking product inflows, outflows, and holding times.

These sources were collated to provide a holistic view of sales behavior, inventory control, and sales performance.

2.2. Variable Formulation

Based on the extended RFM framework, the following variables were defined and computed:

- Recency (R): The number of days since the customer's last purchase.
- Frequency (F): The total number of purchases within a defined observation period.
- Monetary Value (M): The aggregated amount spent by the customer over the same period.
- First Purchase Date (FP): The date marking the beginning of the customer's purchase history.

- Customer Loyalty Age (CLA): The time interval between FP and the current date.

$$CLA = Current\ Date - FP$$

- Customer Need Rate (CNR): is introduced as an extension to the classical RFM framework. It reflects the customer’s purchase behavior relative to their loyalty age. In this study, CNR is defined as:

$$CNR = \frac{CLA}{Number\ of\ Purchases}$$

- Purchase Renewal Potential (PRP): PRP is a derived measure that compares the CNR (Customer Need Rate) with Recency (R). It predicts the likelihood of a customer making a repeat purchase.

$$PRP = CNR - R$$

A high PRP indicates the high probability of repeating the procurement, which means that the customer has made relatively frequent purchases in the short term. A low PRP has suggested reducing the possibility of repeating the purchase, which means that the customer has either reduced the purchase rate or experienced a long difference after the final purchase.

2.3. Analytical Modeling

The extended RFM structure was operated as follows:

- Segmentation: Customers were segmented into groups based on R, F, M, CLA, and CNR values.
- Priority: The segment was ranked to identify high PRP customers, which reflects the needs of immediate or estimated consumption.
- Survey of inventory: Product categories were mapped in customer segments to adjust the distribution of goods with demand pattern.
- Post-flow adaptation: When using smart system data, the supply current was adjusted to ensure that high diverse products reached sales on time, reducing the risk of lost sales.

3. Results

Expanded RFM analysis was used on five points (POS) to evaluate the purchase behavior and predict renewal ability. Table 1 presents the computed variables, including Recency (R), Frequency (F), Monetary value (M), Customer Loyalty Age (CLA), Customer Need Rate (CNR), and the resulting prediction of purchase renewal.

Table 1. Extended RFM analysis results for selected POS.

Seq.	P.S_ Id	P.S_ Name	FP	LR	F	M/\$	Dif_ Days(R)	CLA	CNR	PRP	prediction
1	PS1	PSNAME1	1/3/2023	14/6/2024	2	1000	443	914	457	14	TRUE
2	PS2	PSNAME2	11/4/2025	11/8/2025	4	2400	20	142	35	15	TRUE
3	PS3	PSNAME3	4/1/2024	16/4/2024	1	500	502	605	605	103	TRUE
4	PS4	PSNAME4	8/6/2024	25/3/2025	6	3600	159	449	74	-85	FALSE
5	PS5	PSNAME5	1/2/2024	12/3/2025	8	4200	172	577	72	-100	FALSE

3.1. High Renewal Potential

Three POS (PS1, PS2, and PS3) were classified with a **TRUE** prediction, indicating a strong likelihood of purchase renewal.

- **PS1** shows moderate purchase frequency (F = 2) but a high CNR (457) compared to Dif_days (443), producing a positive “PRP” value (14). This suggests that although purchases are not frequent, the relative need indicates imminent renewal.

- **PS2** demonstrates stronger purchasing behavior with $F = 4$ and the highest Monetary value among the TRUE group ($M = 2400$). Its *Dif_days* (20) is very low, and CNR (35) closely matches the expected renewal pattern, leading to a TO Need of 15.
- **PS3**, despite having the lowest purchase frequency ($F = 1$) and relatively low spending ($M = 500$), shows a very high CNR (605) relative to *Dif_days* (502), with $TO\ Need(PR\ P) = 103$. This implies strong renewal potential due to irregular but urgent consumption needs.

3.2. Low Renewal Potential

Two POS (PS4 and PS5) were classified with a **FALSE** prediction, indicating low or negative renewal potential.

- **PS4** has the highest frequency ($F = 6$) and strong monetary value ($M = 3600$), but the CNR (74) is insufficient compared to *Dif_days* (159), resulting in a negative PRP (-85). This suggests past high activity but a declining likelihood of renewal.
- **PS5** shows the strongest frequency ($F = 8$) and the highest monetary contribution ($M = 4200$). However, the CNR (72) remains well below *Dif_days* (172), producing a PRP of -100. Despite strong historical loyalty, the model predicts saturation and reduced renewal.

3.3. Comparative Insights

- **CNR and *Dif_days*** were the most decisive indicators for renewal prediction. High CNR values exceeding *Dif_days* consistently led to positive PRP scores and TRUE predictions.
- **Frequency (F) alone was not sufficient** to determine renewal potential. For example, PS5 recorded the highest frequency yet was predicted FALSE due to mismatch with current consumption need rates.
- **Monetary Value (M)** influenced the relative importance of POS but did not directly determine renewal potential. High-value POS (PS4 and PS5) were predicted FALSE when CNR failed to align with expected renewal.

3.4. Visual Representation

The relationship between PRP values and the corresponding predictions is presented in Figure 1. Positive PRP (TO Need) scores (green bars) correspond to TRUE predictions, while negative values (red bars) correspond to FALSE predictions. The chart highlights that renewal potential depends less on frequency or monetary value and more on the balance between CNR and Recency.

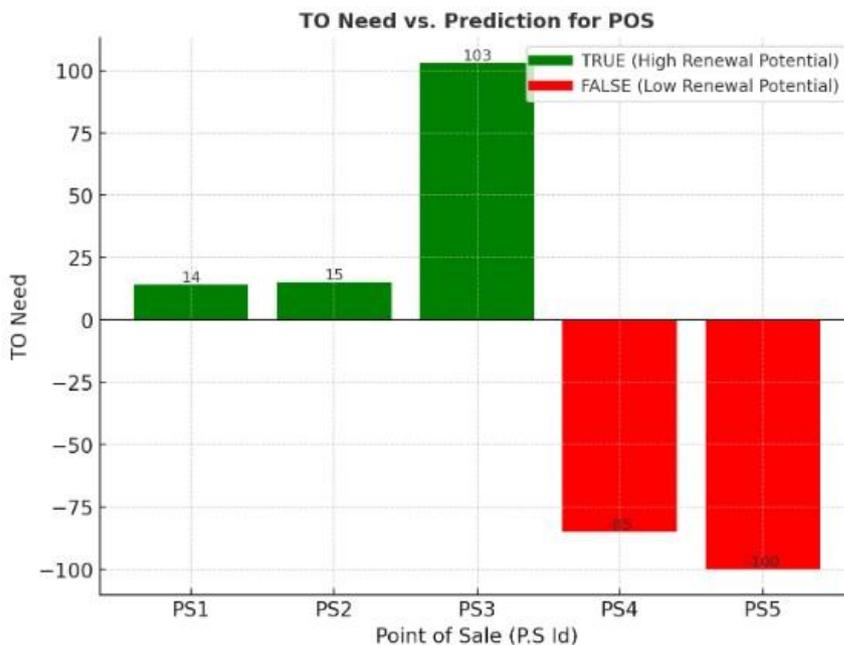


Figure 1. To need vs. Prediction for Points of Sale.

4. Implications

The results highlight that consumption dynamics (CNR vs. Recency) provide a more accurate measure of renewal likelihood than frequency or monetary value alone. This reinforces the utility of extending the RFM framework with CLA and CNR for supply chain applications, ensuring smarter inventory allocation and reducing risks of lost POS.

4.4 Discussion

This study used whether the online business control system would increase marketing performance when implemented with extended RFM analysis. With customer loyal age (CLA) and customer requirement rate (CNR), added to it, the model described buying deep behavior compared to RFM. The result of this was that the renewal capacity would be more adjustment with CNR and Recency (DIF_DAYS) interactions than the frequency or monetary value alone. For example, low CNR and high expenses were pos (PS4, PS5) predicted as low renewal and low costs, but high CNR mobility (PS1 - PS3) was labeled as high capacity. Applying this approach in electronic control systems strengthens the demand forecast, warehouse treatment is streamlined, and the risk of lost sales is reduced. Electronic documents provide accurate data, automation facilitates real-time processing, and intelligent systems benefit from advanced RFM models for decision-making. Together, these digital technologies protect market opportunities, maximize customers' satisfaction and reduce holding costs.

The study contributes to the principle to increase RFM with consumption and time-based measures and to practice through a prediction model for supply chain and market managers. However, the findings are based on small data and ignore external market parameters. Further research should use models on large data sets and detect integration with advanced machine learning algorithms.

In short, expanded RFM analysis-supported digital business control system is an effective way to strengthen marketing performance and maintain competition in uncertain markets.

5. Conclusion and Future Works

This study reflects the important role of digital business control systems to improve operating efficiency, improve operating efficiency and improve marketing performance to increase customers' satisfaction. By integrating electronic records, interconnected automation systems and intelligent systems, the company can provide better prediction of customer behavior and optimize inventory management using extended RFM frameworks. The results suggest that this integration reduces lost sales risk, reduces costs and strengthens competitive status. Future research discovered further integration with machine learning and artificial intelligence for the possibilities of expected predictions and investigated the scalability of these systems in different industries and assessed their long-term impact on customer loyalty and flexibility in the supply chain. In addition, it will be important for future studies that you address the security decisions and moral implications of the customer person in digital changes.

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