



Short Paper

# SiniLoyal: Enhancing Marketing and Public Services Through Siniloan Market's Loyalty Card

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## Abstract

**Purpose** – The purpose of this study is to design and evaluate SiniLoyal, a digital loyalty card in enhancing marketing and local services within the public markets. Additionally, it applies predictive analytics and the assessment using Technology Acceptance Model (TAM) on the criteria of perceived usability.

**Method** – Descriptive and developmental method based on the Rapid Application Development (RAD) model, wherein information from LGU officials, Sangguniang Bayan, vendor associations, and related studies were integrated. Using TAM framework, 273 consumers and 241 vendors assessed the system. ARIMA and SARIMA forecasting enabled the predictive analysis of seasonal spend behaviors to improved market strategy.

**Results** – SiniLoyal earned high acceptability, consumers rating 4.23 and vendors 4.30. Grand mean 4.02 and 4.12 acceptable respectively. There are significant differences in perceived usefulness and ease of use, p-value less than 0.05, which indicates the need for engagement level. The forecasting module achieved over 85% accuracy, correctly predicting periodic demand. QR-based purchases gave tiered rewards instant points updates, while collected data highlighted trends that help sales optimization and marketing strategies.



*Conclusion* – Loyalty mechanisms driven by predictive analytics with QR based transaction and LGU participation would promote a more transparent, efficient, and engaging public market operation.

*Recommendations* – Improved system features, transactions and incentives would attract more users. Collaborate with key partners LGU-SB and DTI reinforce awareness and adoptability; limited sample size requires testing in other markets. Future improvements should focus on better rewards, working more with market group, improving mobile accessibility for broader adoption.

*Research Implications* – Sustainable utilization to public market of SiniLoyal application convert traditional market into digital loyalty consumer-vendors engagement while integrating local service governance. Its expansion can strengthen local economies, provide respondent-driven insights, and serve as national model for enhancing and refining public market operations.

*Keywords* – public markets, government services, e-commerce, digital loyalty, predictive analytics, Technology Acceptance Model

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## **INTRODUCTION**

Public markets, the commerce center of many towns and cities. They keep goods/foods within reach, help fishermen, farmers and small entrepreneur grow, and restore a community's togetherness. Digital technologies including hybrid retail setups, loyalty programs, and predictive analytics for making things run smoother and keeping consumers coming back. But most public markets, especially in developing nations, haven't taken them up yet (ASEAN Magazine, 2024). These markets demand innovation in digital loyalty programs to perform. They should assist vendors interact with consumers, compete for smarter, fairer data methods, and make sure everyone gets a fair share (ResearchAndMarkets, 2025).

The Philippines public market, rooted in pre-colonial trade practices (Velez, 2020), continue to be a vital in local economies and cultural identity (Zade, 2009; Carmen et al., 2020), keeping up fishermen, farmers, small retailers, and merchandiser. But right now, they're feeling of more competition from supermarkets, mini-malls, online shopping (Lazada, Shopee and etc..), and administrative challenges following the pandemic (Anabtawi & Bleibleh 2025, Debuque-Gonzales, 2021). However, persistent issues such as underfunded infrastructure, political bias, and inefficient management continue to hinder market performance despite LGU empowerment under the Local Government Code of 1991 (Republic Act 7160), underscoring the potential of digitalization to modernize operations and strengthen community participation (Brucal et al., 2024).

In line with the Philippine Development Plan (PDP) 2023–2028, the government’s market modernization efforts including DTI’s market digitalization projects and tools like the Electronic Price Watch Board, Scan Matrix System, and Paleng QR Ph Plus, underscore the push for digital transformation and strengthened MSME competitiveness. (NEDA, 2023; PIA, 2024). Siniloan, a second-class municipality, acts as both a historical and economic center reflecting its ongoing transformation toward urbanization. However, its public market experiences decreased consumer engagement due to the emergence of malls, foreign traders and online marketplaces like Lazada and Shopee. This problem was elaborated by the municipal mayor in one of the meetings with the researcher. This gap between traditional market operations and digital innovation points out the need for adaptable technology that improve local engagement and marketplace vibrancy.

These problems, the researcher came up with SiniLoyal, a digital loyalty card system that brings together LGU administration, vendors, consumers, and even local government agency services to encourage engagement. Guided by Technology Acceptance Model (TAM) and predictive analytics for suppliers use in forecasting. It introduces a system with data-driven loyalty programs into the public markets.

## **LITERATURE REVIEW**

### ***Related Literature***

Public markets were important for inclusive local economies, maintaining accessibility, sanitation, and order through coordinated governance between LGUs and vendor groups. (Isolana, 2021). While the 1991 Local Government Code empowers LGUs to manage infrastructure, vendors, and revenue (Ramos & Ocampo, 2021), many markets still rely on old management systems with minimal digital integration. The limited use of technologies like loyalty card programs demonstrates a greater gap in utilizing technology to promote transparency, efficiency, and citizen engagement (Conner Public Market, 2022).

Digital loyalty programs, long used in the private sector, are only beginning to influence government, evolving from simple punch cards into mobile platforms that track real-time activity, offer personalized rewards, and generate insights through CRM analytics (Algamdi et al., 2021; Haverila, et al., 2022). While these technologies can improve participation, concerns about privacy, security, and users’ weariness exist (Soni, 2024). Research on their application in public markets remains restricted, underscoring the need for inclusive, adaptive, data-driven strategies. Predictive analytics useful for demand forecasting and informed decision-making (Corpin et al., 2023; Kumar & Nayak, 2024) is often used within government operations but seldom incorporated into citizen-facing services (Khorana et al., 2024; Owens & Adeel, 2025). Systems that monitor vendor activity and consumer flow could thus encourage efficiency and contribute evidence-based governance.

Davis's (1989) Technology Acceptance Model (TAM) implies that people adopt new technology when it is easy to use and truly useful (Musa et al. 2024). While TAM is often applied in digital contexts (Abuhassna, 2023), it has been used significantly less to research AI or predictive analytics in public-sector technologies (Schorr, 2023). Applying it to public markets can link loyalty programs, analytics, and citizen participation for more responsive governance (Martin, 2022).

## **Related System**

Loyalty programs have evolved into data-driven systems leveraging personalization, predictive analytics, and gamification to boost consumer retention (Rakhmanita, 2023; James, 2024). Platforms like Starbucks Rewards, Amazon Prime, and Alibaba's 88VIP use AI to analyze behavior and deliver targeted rewards (Collins, 2021; Burugulla, 2024). In the Philippines, programs such as SMAC, SukiCard, PERKS, ACE Rewards, GrabRewards, and Shopee Coins combine practical, symbolic, and gamified benefits to enhance satisfaction and maintain loyalty (Chen et al., 2020; Zhang et al., 2025).

In contrast, operations within the public sector follow a distinct set of processes and governance structures. Projects like Paleng-QR Ph Plus and the Department of Trade and Industry's digital endeavors mainly focus on digital payments and enhancing transparency. They don't really use rewards or data-driven engagement (DTI, 2023; BSP, 2023). That leaves a large gap. Public efforts miss out the predictive analytics and loyalty means that might improve participation and help local vendors compete.

This is where the SiniLoyal application comes in, a multi-vendor, multi-market platform that blends analytics and a loyalty system with active LGU participation, combining incentives mechanisms with predictive modeling. Vendors and consumers interact in real time, while data analysis shapes incentives from participating agency.

## **METHODOLOGY**

### **Research Design**

The researchers choose descriptive developmental research design throughout the course of the study. Descriptive focus on understanding and acquiring respondents' data which has a direct influence as to how the system should be develop, test and examine the acceptability of Siniloyal application through an adapt instrument of TAM Software Quality Model (Venkatesh & Davis, 2000). TAM was use for five (6) criteria to investigate the effect of the developed Siniloyal system on public market environment. These are perceived usefulness, perceived ease of use, attitude towards use, behavioral intension and additional two (2) criteria attribute of usability and user satisfaction.

For developing the application itself, the researcher used the Rapid Application Development (RAD) approach as part of the standard Software Development Life Cycle. RAD stood apart due to its focus on quick prototyping and feedback loops, which is necessary when users' needs continually changing. A 2023 British Computer Society evaluation found that RAD's iterative prototyping and stakeholder involvement save time, adapt to change, and boost user satisfaction (Fauzi et al., 2023).

## System Framework

The Siniloyal system's framework connects five key users using a digital loyalty program as indicated in Figure 1. These are consumers and vendors who make use of a mobile app, the Siniloan Market Vendor Association (SMVA) as the administrator, the Local Government Unit (LGU) of Siniloan, and cooperating agencies supervised by the LGU. Consumers receive points from market purchases, which may be redeemed for discounts on goods with tiered rewards (silver, gold, titanium) based on spending. Vendors acquire points from consumer transactions and redeem them to earn business voucher incentives like business permit taxes, healthcare, and other public services that may benefits vendors, while also accessing knowledge about consumer behavior, sales forecasting and market analytics trends.

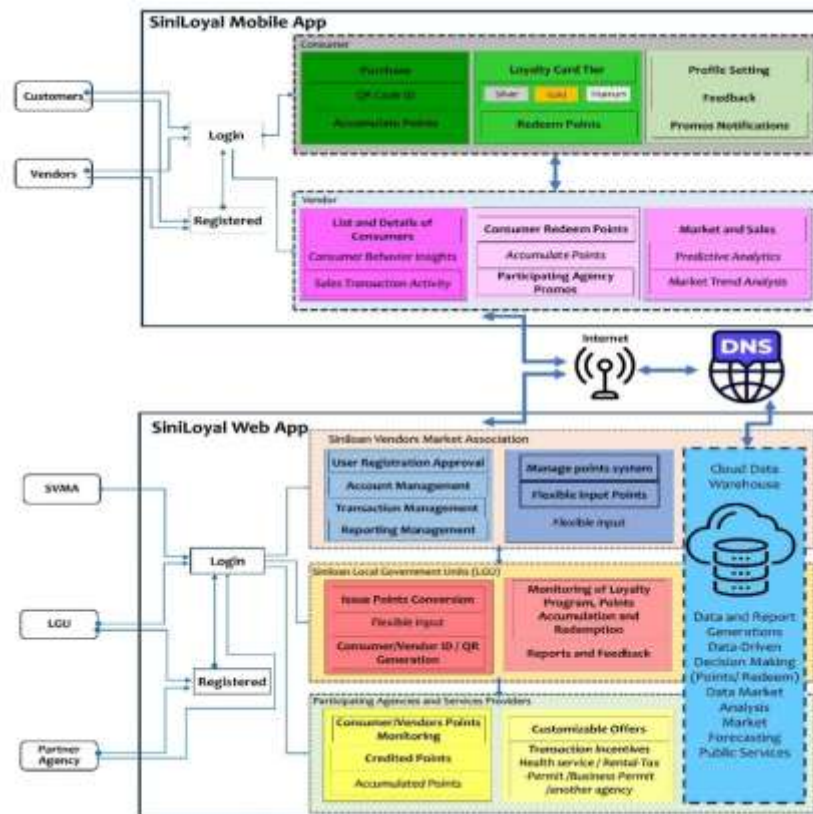


Figure 1. System Framework for SiniLoyal

On the administrative side, the LGU uses vendors transaction data for public services, set up promo policies. The agencies involved handle the perks stuff like tax breaks or healthcare discounts and they track how often people actually use them and whether they're making a real impact. SMVA runs registrations, keeps the system up and running. With a central data warehouse, they get to dive into analytics, sales trend and forecasting in public market operation.

### **Population of the Study**

The SiniLoyal evaluation targeted both vendors and consumers. A total of 603 vendors were identified from the market coordinator’s database, spanning both first and second floor and different section area of Siniloan Public Market. Consumers were also included as respondents, enabling assessment of program adoption, engagement, and practical impact on market participation.

### **Sampling Design**

Stratified sampling was used in vendors respondents. The researcher randomly selects samples from each stratum, ensuring that each subgroup was adequately represented in the overall sample. (Fowler, 2013). and convenience sampling were carried out to the consumers under the assumption that the researcher could identify elements that reflect a typical representation of the target population (Golzar et al, 2022). The Slovin formula was used to determine the appropriate sample size needed to accurately represent a population of the study with 5% margin of error the result target respondent for vendors was 241. See below table for stratified sampling. (Calculator Academy. (2025). Slovin’s formula calculator.).

Table 1 presents the distribution of vendor participants across market sections using stratified sampling to ensure proportional representation. The vegetable section had the highest number of vendors (169 or 28%), followed by the second floor (138 or 22.9%) and ground floor (117 or 19.4%), which also contributed the largest sample sizes of 68, 55, and 47, respectively. In total, 241 vendors were sampled from all key market areas, including the kiosk (26), fish (12), meat (12), fruit (10), chicken (7), and eatery (4) sections.

Table 1. Vendors sample size stratified per area

<b>Area</b>	<b>Count</b>	<b>%</b>	<b>Sample Size</b>
Ground Floor	117	19.4%	47
Second Floor	138	22.9%	55
Fish Section	30	5.0%	12
Meat Section	29	4.8%	12
Chicken Section	18	3.0%	7
Fruit Vendor	26	4.3%	10
Eatery Section	10	1.7%	4
Kiosks	66	10.9%	26
Vegetable	169	28.0%	68
<b>Total</b>	<b>603</b>	<b>100%</b>	<b>241</b>

Surveyed consumers at the public market, statistically a minimum of 100 respondents was necessary. However, the researcher aimed for a sample size between 200 and 300 to compensate for potential non-responses and to enhance the reliability and strength of the data collected (Cabanelas et al., 2024). The respondents of the study consisted of 273 consumers from the Siniloan Public Market, selected to represent diverse segments of people based on their purchasing behaviors and frequency of visits.

## **Data Collection Instruments**

This study used survey questionnaires as the primary tool for gathering data from four key user groups: consumers, vendors, LGU-SMVA, and partner agencies. The instruments were designed to support the study's goal of evaluating and improving market engagement and administrative decision-making for greater transparency and adaptability.

### **Pre-Survey**

The researcher obtained relevant information to conceptualize the study, problems from the background and existing issues within the public market. Inputs from LGU officials were also considered in developing the system through a consecutive meeting of the College of Computer Studies' extension projects. This collaborative effort suggested how they will serve better their constituents especially the market vendors because of some issues they encountered.

### **Observations**

The researcher's observations, informed when the Participatory Rural Appraisal (PRA) activity in the IS Corner e-Store Project 2023 (Adrias, 2023), highlighted declining vendor sales, a concern also raised to the mayor. The emergence of mini-malls, low-priced foreign stores, and the convenience of online shopping especially during the pandemic significantly changed consumer habits over the past three years. Although sales rose during holidays and major events, some vendors still experienced low sales even in peak periods. Traditional consumer loyalty, where buyers consistently returned to familiar stalls, has weakened, leading to reduced engagement and a continued drop in public market sales.

### **Questionnaires**

The researcher adapted the TAM questionnaire from Aztoveza (2021) for LSPU Siniloan and added two criteria User Satisfaction and Attribute of Usability based on studies by Peng and Yan (2022), and Buabeng-Andoh et al. (2018). A bilingual English-Filipino version was created, with translations validated by language experts, ensuring clarity and allowing respondents to choose their preferred version for accurate and comfortable participation.

Before administering the survey, the researcher submitted request letters to the Municipal Mayor, Vice Mayor, and SMVA officials. After receiving approval and collecting respondent consent, the survey was conducted, with the researcher clearly explaining the study's purpose, scope, capabilities, limitations, opportunities, and potential risks.

For evaluating the application's acceptability quantitatively, the study used a TAM-based Likert scale as shown in Table 2. Ratings ranged from highly acceptable (5) (Lubos na Katanggap-tanggap) to highly unacceptable (1) (Lubos na Hindi Katanggap-tanggap). Once the questionnaires were issued, the researcher provided respondents additional time to complete them if they wished to answer later.

Table 2. Qualitative Interpretation of 5-Point Likert Scale Measurement

Scale	Ratio	Verbal Interpretation
5	4.21 – 5.00	Highly Acceptable (Lubos na Katanggap-tanggap),
4	3.41 – 4.20	Acceptable (Katanggap-tanggap)
3	2.61 – 3.40	Moderately Acceptable (Katamtamang Katanggap-tanggap)
2	1.81 – 2.60	Unacceptable (Hindi Katanggap-tanggap)
1	1.00 – 1.80	Highly Unacceptable (Lubos na Hindi Katanggap-tanggap).

### Interviews

To get a more comprehensive picture of the study, the researcher performed interviews to the market administrators and president of SMVA as may include in the questionnaires and also their approval related to sensitive data but this was previously approved by Sanguniang Bayan to have access to information needed by the researcher (SB Decision No.121 series of 2025).

### Statistical Tools

Table 3 outlines statistical tools applied in the analysis, including descriptive statistics, TAM-based acceptability measures, and Mann-Whitney U tests, were used to assess SiniLoyal usability and compare user perceptions across groups.

Table 3. Statistical Tool

Variables	Tools
1. Consumer and Vendor Profiles: Examined demographics, loyalty program participation, and engagement within the public market.	Frequency Percentage
2. System Evaluation via TAM: Assessed SiniLoyal acceptability and user engagement using the Technology Acceptance Model (TAM). 2.1 Consumers 2.2 Vendors	Mean, Rank, Verbal Interpretation

3. Comparison of Acceptability: determine if there are significant difference in the acceptability of the system by the consumers and vendors.

Mann-Whitney U  
Test

## Project Design

The SiniLoyal application is a QR-code-based digital loyalty program designed to increase consumer involvement, vendor marketing, and public service at the Siniloan Public Market. The system was developed using the Rapid Application Development (RAD) model, enabling fast prototyping and continuous user feedback for more rapidly development and well alignment with user needs (Riadi et al., 2024; Kendall & Kendall, 2010). This iterative process reduces project risks and enhances usability (Avison & Fitzgerald, 2006; Murphy et al., 2022). Key features include consumer registration, QR-code loyalty cards, purchase tracking, a points-based rewards system, a vendor sales dashboard, and an admin panel for market management. Built in PHP with a MySQL database, the system also applies ARIMA and SARIMA forecasting for daily and seasonal market insights.

## Software Development Model

The Rapid Application Development (RAD) approach, represented in Figure 2, thrives on fast prototyping, regular improvements, and continuous user feedback (Pressman & Maxim, 2020). Development made it simple to gather requirements, establish the user interface, build multiple elements at the same time, and start testing early. Everything stayed in coordination with regard to both vendors and consumer's needs (Sommerville, 2019).

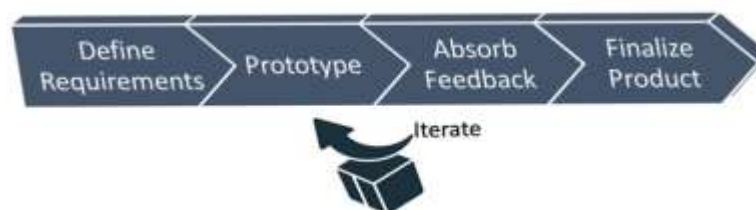


Figure 2. Rapid Application Development (RAD) Model

### Define Requirements

SiniLoyal system was loyalty application to vendors track sales and provide analytics, and consumers purchases earn and use points just by scanning QR codes. It used PHP (Laravel or CodeIgniter), MySQL, and Python. A secure admin panel, a dashboard for vendors, forecasting models so daily, weekly, monthly, and even seasonal trends covered. Certifying the system aligns with user, administrative, and public market goals, the development process emphasizes continuous stakeholders' engagement through regular consultations, prototype feedback sessions, and LGU participation thru SB meetings.

## **Prototype**

The SiniLoyal prototype is a fully mobile-responsive web-based digital loyalty card system with four dashboards for consumers, vendors, participating agencies, and administrators. Consumers earn and redeem points, vendors access sales and forecasting tools, agencies create promotions, and administrators manage system monitoring, user registration, and reports. The process begins with user registration, followed by QR code-based transaction logging, which stores purchase data in a central database. This data is then analysed using ARIMA(1,1,1) with drift and SARIMA (1,0,1)×(1,0,1)<sub>12</sub>, forecasting. The use of ARIMA and SARIMA models helping vendors daily and seasonal sales trends.

## **Absorb Feedback**

The SiniLoyal application incorporates continuous stakeholder feedback to stay aligned with its goals. Consultations with the LGU, Sangguniang Bayan, and SMVA were conducted twice helped refine system features, including rewards, tiers, promos, vouchers, data privacy measures, and integration with local government services, ensuring relevance and community responsiveness.

The LGU provides guidance on local services alignment, while the SMVA and vendors contribute feedback on usability and consumer retention. The Sangguniang Bayan ensures policy compliance and on allocate budgeting. Collectively, these stakeholders supported early data gathering and facilitated pilot surveys for vendors and consumers in the public market.

## **Iterate**

Feedback collected during early planning, development and testing guided for modifications in system simple interface, friendly layout, reward mechanics and business process flow. As progress continued based on collaboration and feedback, collecting data set was gathered for predictive analytics using ARIMA and SARIMA models to generate vendor sales forecasts, top products and accumulated redeem points. Each iteration merged process adjustments, policy alignment, and feedback to improve adoption and usefulness.

## **Finalize Product**

To finalize the product, SiniLoyal must successfully achieve all its defined objectives. A loyalty card system builds in web and mobile application that rewards consumers and vendors, integrates predictive analytics and forecasting for market insights. Before deployment, the system was tested for all it features and simplicity then using the Technology Acceptance Model evaluate significant difference in the acceptability of the system.

## **RESULTS**

## The Developed SiniLoyal System

The SiniLoyal application offers a fully operational digital loyalty system for the Siniloan Public Market. Its Consumer Module enables users to register, log in, and view a dashboard of earned and redeemed points (Figure 3). Each consumer generates a unique QR code for secure, contactless transactions, which vendors scan to validate purchases and award points (Figure 4). Users are grouped into Silver, Gold, and Titanium tiers with progressive discounts and exclusive rewards (Figures 5–6). Consumers can track point balances, accumulation, and redemptions in real time, explore deals, and monitor voucher expirations, ensuring transparency and usability (Figures 7–8).



Figure 3. Consumer Dashboard



Figure 4. Consumer QR code to scan by Vendors



Figure 5. Consumer Tier Level

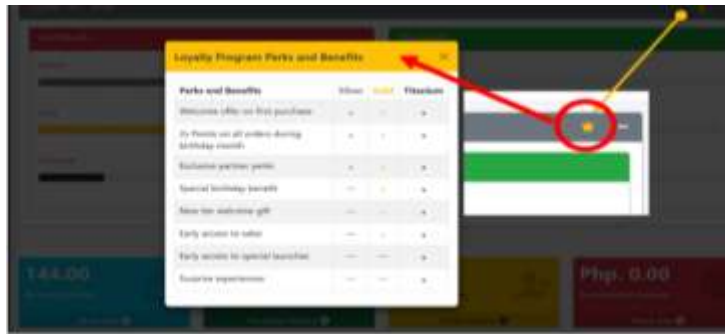


Figure 6. Tier grade levels (Perks and Benefits)

Promo Name	Promo Description	Start Date	Promo Start	Promo End	Expiration Date	Action
1. 10% Off Discount	Get 10% off on all purchases for only 10 days	2020	Monday 11/22/20	February 01, 2021	February 01, 2021	View
2. 15% Off Discount	Get 15% off on all purchases for only 15 days	2020	Monday 11/22/20	February 01, 2021	February 01, 2021	View
3. 20% Off Discount	Get 20% off on all purchases for only 20 days	2020	Monday 11/22/20	February 01, 2021	February 01, 2021	View
4. 25% Off Discount	Get 25% off on all purchases for only 25 days	2020	Monday 11/22/20	February 01, 2021	February 01, 2021	View

Figure 7. Available promos

Promo Name	Promo Code	Expiration Date	Status
1. 10% Off Discount	10OFF100	February 01, 2021	Expired
2. 15% Off Discount	15OFF100	February 01, 2021	Expired
3. 20% Off Discount	20OFF100	February 01, 2021	Expired
4. 25% Off Discount	25OFF100	February 01, 2021	Expired

Figure 8. Vouchers code and redemption date for available promos

The Vendor Module provided a complete dashboard for monitoring points, transactions, and award qualification shown in Figure 9. Vendors scanned consumer QR codes using the built-in scanner shown in Figure 10 to validate actions and obtained complete purchase forms in Figure 11. Daily and monthly sales trends, including seasonal peaks, were represented on the dashboard shown Figure 12. Vendors could also monitor available promotions shown Figure 13 and track issued vouchers, including redeemed and unused statuses shown Figure 14. The module enabled streamlined oversight of sales performance, customer interactions, and promotional activities in a single integrated interface.



Figure 9. Vendor Dashboard



Figure 10. QR Code Scanner

The screenshot shows a mobile application 'Purchase Form' for 'SiniLoyal'. The form includes the following fields and information:
 

- Name :** Jun Uraya
- Available Points :** 100.00
- Purchase Amount :** 3500
- 0 points**
- Redeem Amount :** (empty field)
- 1.00 points = 1 Pesos**
- Minimum of 100.00**
- Total Amount :** (empty field)

 A blue 'Save' button is located at the bottom of the form.

Figure 11. Purchase form from consumer information



Figure 12. Vendors sales monitoring

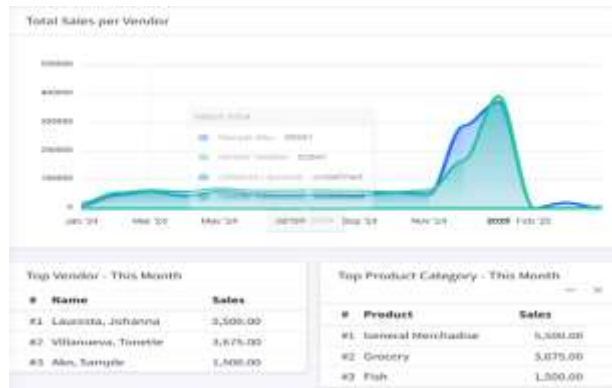


Figure 13. Top Vendor Sales Transaction and Top Products



Figure 14. Total Sales by each Vendors with accumulated points

### Predictive Analytics and Forecasting

The SiniLoyal system utilized predictive analytics to anticipate consumer and vendor behaviors. Consumer redemption patterns and top user activity appear in Figure 15, while vendor transaction histories enable demand forecasts with 1,888 entries (Figure 16). Administrators configure forecasts via the Point and Forecasting Settings form (Figure 17), selecting Autoregressive Integrated Moving Average (ARIMA) for daily trends and Seasonal Autoregressive Integrated Moving Average (SARIMA) for long-term seasonal projections. ARIMA outputs predicted daily sales moves (Figure 18), whereas SARIMA captured repeating monthly trends over a 120-month horizon (Figure 19).



Figure 15. consumer data transactions for predictive analytics

#	Date - Time	Name	Amount	Accumulated / Redeemed
1851	2024-02-07 10:05:14	Ako. Sample	Php. 982.00	0.00
1852	2024-02-07 10:05:14	Ako. Sample	Php. 54.00	0.00
1853	2024-02-07 10:05:14	Ako. Sample	Php. 586.00	0.00
1854	2024-02-06 10:05:14	Ako. Sample	Php. 980.00	0.00
1855	2024-02-06 10:05:14	Ako. Sample	Php. 664.00	0.00
1856	2024-02-05 10:05:14	Ako. Sample	Php. 583.00	0.00
1857	2024-02-05 10:05:14	Ako. Sample	Php. 780.00	0.00
1858	2024-02-05 10:05:14	Ako. Sample	Php. 20.00	0.00
1859	2024-02-05 10:05:14	Ako. Sample	Php. 408.00	0.00
1860	2024-02-05 10:05:14	Ako. Sample	Php. 357.00	0.00

Showing 1,851 to 1,860 of 1,888 entries.

Figure 16. Vendors data transactions for predictive analytics

Point and Forecasting Settings

**Consumer - Minimum purchased to earned points :**

**Consumer - Purchase price to earned 1 point :**

**Points equivalent to 1 Pesos Consumer -> Vendor :**

**Consumer - Minimum points before consumer can avail redeeming :**

**Vendor - Price sold to earn 1 point. :**

**ARIMA - Daily Forecasting :**

**SARIMA - Forecasting Monthly :**

Figure 17. Point and Forecasting Settings

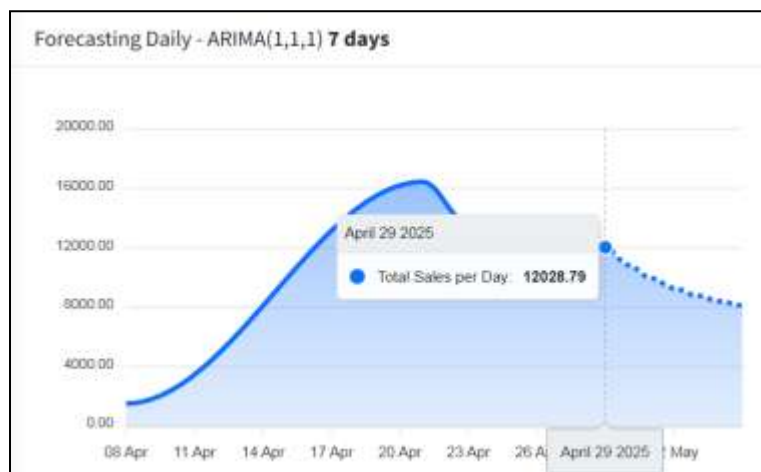


Figure 18. ARIMA Daily Forecasting

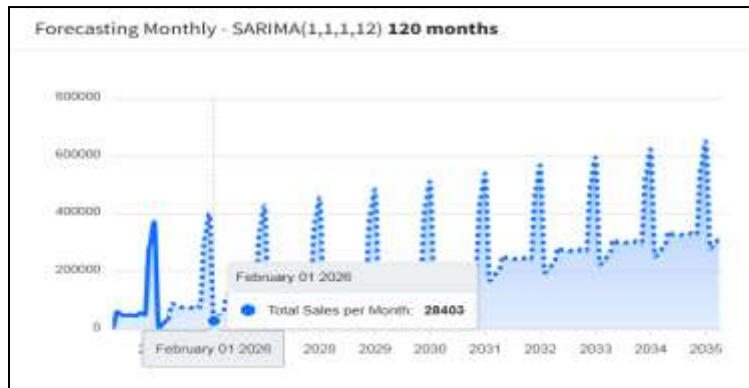


Figure 19. SARIMA Monthly Forecasting

### Forecasting Accuracy

The forecasting accuracy of the ARIMA and SARIMA models using two common metrics: Mean Absolute Error (MAE) and Mean Absolute Percentage Error (MAPE), following the approach laid out by Hyndman and Athanasopoulos (2021). Showing equations for MAE is computed by averaging the absolute differences between actual and forecasted values and MAPE computed by averaging the absolute percentage errors of all records.

$$MAE = \frac{1}{n} \sum |At - Ft| \tag{Equation 1}$$

$$MAPE = \frac{1}{n} \sum_{t=1}^n (|At - Ft| / AT) \times 100 \tag{Equation 2}$$

Where:

$At$  = Actual sales at time  $t$

$Ft$  = Forecasted sales at time  $t$

$n$  = Number of observations                      for MAPE the result is expressed in percentage.

$$ARIMA = 8970.00 - 7685.38 = 1284.62 \quad = 1284.64 / 8970 \times 100 = 14.32\%$$

$$SARIMA = 21167.00 - 18251.13 = 2915.87 \quad = 2915.87 / 211670 \times 100 = 13.78\%$$

For daily forecasts, ARIMA came in with a MAE of 1,284.62 and a MAPE of 14.32%. SARIMA, run on monthly data, had a higher MAE at 2,915.87 edged out ARIMA on MAPE with 13.78%. MAPE values between 10% and 20% are generally considered acceptable indicators of forecasting accuracy. Converting those MAPE values into accuracy gives ARIMA about 85.68% and SARIMA roughly 86.22%. Each model has over 85% accuracy, and while SARIMA has higher raw errors, it still delivers a marginally better result in percentage terms. ARIMA and SARIMA both have dependable projections work well for forecasting sales in this context.

## Assessment of Consumer and Vendor Demographic Profile

The data in Table 4 shows that consumers are mostly young adults aged 20–29, (41%) predominantly female (69%), single (52%), and college-educated (62%), with family sizes of 5–6 members (41%). They engage once in a while in loyalty programs (44%), mainly redeeming discounts, and regularly purchase groceries, rice, and meat at weekly markets, typically spending 151–300 pesos per visit. Vendor profiles in Table 5 show predominantly female (72%), aged 30–39 (30%), married (71%), and secondary-educated (52%) participants. While 63% of vendors claim rewards, most engage in loyalty programs only occasionally, indicating moderate participation while their public market activity centers on selling groceries, fish, fruits, household items, and rice, typically generating 1,000–1,500 pesos in sales (55%).

Table 4. Consumers Demographic, Loyalty Program Participation and Public Market Engagement

<b>Criteria</b>	<b>Response</b>	<b>Frequency</b>	<b>Percentage (%)</b>	
<b>Profile for Consumers</b>				
Age	20-29 yrs old	112	41	
Gender	Female/Babae	187	69	
Status	Single/ Walang Asawa	143	52	
Education	Tersiyaryo (College)	168	62	
Family Member	5-6 member	111	41	
<b>Loyalty Programs Participation</b>				
Participate	Sometimes	120	44	
Benefits	Discounts	61	22	
Claim Reward	Yes/Oo	166	61	
Reward Redeem	Discounts	57	23	
<b>Public Market Engagement</b>				
Market Buyer	Weekly/Lingo-lingo	128	47	
	Rice/Bigas	142	15	
Main Product Bought	Meat/Karne at Manok	131	14	
	Grocery/Sari-Sari Paninda	126	13	
	Vegetables/Gulay	112	12	
	Fish/Isda	98	10	
	Fruits/Prutas	91	10	
	Housewares /Mga kagamitan sa bahay	62	7	
	Personal Care/Personal na Pangangalaga	60	6	
	RTW at Tela	36	4	
	Purchase	151–300 Pesos	101	37

Table 5. Vendors Demographic, Loyalty Program Participation and Public Market Engagement

<i>Criteria</i>	<i>Response</i>	<i>Frequency</i>	<i>Percentage (%)</i>
<b>Profile for Consumers</b>			
Age Group	30-39 years old	72	30
Gender	Female/Babae	171	72
Marital Status	Married/May Asawa	170	71
Education Level	Secondary/High School	124	52
Family Member	3-4 member	117	49
<b>Loyalty Programs Participation</b>			
Participate	Sometimes	139	58
Benefits	Points/Rewards	64	27
Claim Reward	Yes	151	63
Reward Redeem	Discounts	64	27
<b>Public Market Engagements</b>			
Main Product Sell	Grocery/ Sari-Sari Paninda	31	13
	Fish/Isda	23	10
	Fruits/Prutas	22	9
	Household items	20	8
	Rice/Bigas	18	8
Sales	1000-1500 Pesos	132	55

### **Technology Acceptance Model (TAM) Evaluation**

Consumer acceptance of the SiniLoyal application was measured using the Technology Acceptance Model (TAM) shown in Table 6. User Satisfaction scored highest (4.25, Highly Acceptable), followed by Perceived Usefulness (4.13) and Usability Attributes (4.11), showing the system efficiently meets user needs. Perceived Ease of Use, Attitude Toward Use, and Behavioral Intention to Use all scored over 4.0, showing general acceptance and willingness to engage with the platform. The overall grand mean of 4.12 implies that SiniLoyal is universally accepted, encouraging practical application in improving loyalty and engagement in the public market.

Table 6. Consumer TAM Summary Evaluation

<i>TAM Factor</i>	<i>Mean Score</i>	<i>Verbal Interpretation</i>	<i>Rank</i>
Perceive Usefulness	4.13	Acceptable	2
Perceived Ease of Use	4.07	Acceptable	5
User Satisfaction	4.25	Highly Acceptable	1
Attribute of Usability	4.11	Acceptable	3
Attitude Toward Use	4.07	Acceptable	5
Behavioral Intention to Use	4.09	Acceptable	4
<b>Grand Weighted mean</b>	<b>4.12</b>	<b>Acceptable</b>	

Table 7 show the Vendors rated the SiniLoyal system with User Satisfaction highest at 4.30 (Highly Acceptable), indicating strong approval of the platform’s user satisfaction. Usability Attributes (4.02) and Perceived Usefulness (3.97) also scored favorably, while Perceived Ease of Use, Attitude Toward Use, and Behavioral Intention to Use ranged from 3.94, 3.97 respectively, reflecting general acceptance and moderate readiness to adopt. The overall grand mean of 4.02 shows the system is slightly appropriate for vendor use, determining areas for further training or interface changes to improve engagement and engagement.

Table 7. Vendor TAM Summary Evaluation

<b>TAM Factor</b>	<b>Mean Score</b>	<b>Verbal Interpretation</b>	<b>Rank</b>
Perceive Usefulness	3.97	Acceptable	3
Perceived Ease of Use	3.94	Acceptable	4
User Satisfaction	4.30	Highly Acceptable	1
Attribute of Usability	4.02	Acceptable	2
Attitude Toward Use	3.94	Acceptable	4
Behavioral Intention to Use	3.97	Acceptable	3
<b>Grand Weighted mean</b>	<b>4.02</b>	<b>Acceptable</b>	

Finally, in Table 8 show the comparison of acceptability between consumers and vendors using the Mann–Whitney U test as shown in Table 8, show significant differences between consumers and vendors in Perceived Usefulness ( $p = 0.00072$ ), Perceived Ease of Use ( $p = 0.0027$ ), Attitude Toward Use ( $p = 0.00126$ ), and Behavioral Intention to Use ( $p = 0.00121$ ), indicating differing perceptions and adoption readiness between the two groups and demonstrating shared approval of the system perceived usefulness and interface ease of use. No significant differences were identified in User Satisfaction ( $p = 0.829$ ) or Usability Attributes ( $p = 0.053$ ). These findings indicate the need for focused support or training for vendors to connect their involvement with consumer experiences and maximize loyalty program usability.

Table 8. Consumers vs. Vendors across the six criteria of TAM

<b>TAM Criteria</b>	<b>Mann-Whitney U Test</b>	<b>p-value</b>	<b>Hypothesis</b>	<b>Interpretation</b>
<b>Perceived Usefulness</b>	38446	0.00072	Reject	Significant
<b>Perceived Ease of Use</b>	37763.5	0.0027	Reject	Significant
<b>User Satisfaction</b>	33245.5	0.82906	Accept	Not significant
<b>Attribute of Usability</b>	36066	0.05262	Accept	Not significant
<b>Attitude Toward Use</b>	38058.5	0.00126	Reject	Significant
<b>Behavioral Intention to Use</b>	38057	0.00121	Reject	Significant

## **DISCUSSION**

The results revealed that the SiniLoyal application successfully developed a digital loyalty program that enhanced consumer engagement and supported vendor operations in the public market. Core features QR code transactions, tiered rewards, and voucher redemption effectively sustained user engagement through gamification and transparent tracking. Vendors' lower participation signaled the need for improved digital onboarding and stronger incentives, though they still benefited from a structured, manageable system for tracking and controlling reward points.

Predictive analytics was incorporated to add strategic benefit. Although their long-term dependability depended on the gathering of more consistent data, ARIMA and SARIMA models provided helpful projections of short-term sales trends and seasonal demand peaks. Although administrative decisions for forecasting and point setting showed system flexibility, more automated and user-friendly analytics tools will be required for future improvements.

Demographics demonstrated a younger, college-educated consumers adopted the system more easily, while vendors with lower education levels were more cautious. This matched TAM results showing consumers perceived clearer benefits, whereas vendors faced literacy and workload barriers, yet both groups reported equal satisfaction, confirming overall system functionality.

Moderate ratings for perceived ease of use and attitude toward use pointed to the need for a simpler interface, clearer instructions, and more appealing system interactions. Although satisfaction was high, it alone did not guarantee long-term adoption; users also needed to perceive lasting value and manageable complexity. Study limitations included variable digital literacy among vendors, divergent participation among user groups, and the early-stage nature of the forecasting component, which relied on limited datasets.

## **CONCLUSIONS AND RECOMMENDATIONS**

The development and evaluation of the SiniLoyal application demonstrate its effectiveness as a digital loyalty system for the Siniloan Public Market, successfully integrating consumer rewards, vendor incentives, and data-driven forecasting to enhance market engagement. The system's admin module ensures smooth operation, while the consumer and vendor dashboards facilitate point accumulation, redemption, and sales tracking, supported by QR-code transactions for seamless usability. The implementation of ARIMA and SARIMA forecasting models provides valuable insights for short-term and seasonal market trends, aiding vendors in inventory management and promotional planning. Evaluation using the Technology Acceptance Model (TAM) revealed that both consumers and vendors find the system acceptable, with high satisfaction scores, though opportunities remain to improve perceived ease of use and long-term adoption strategies. Significant differences in Perceived

Usefulness, Ease of Use, Attitude, and Behavioral Intention between consumers and vendors highlight the need for role-specific optimizations, while the shared satisfaction with usability confirms the system's foundational effectiveness. These findings suggest that SiniLoyal has successfully laid the groundwork for a sustainable digital loyalty ecosystem, promoting local commerce and public service integration. Future enhancements should focus on user experience refinements and expanded incentives to further drive engagement and long-term success.

To enhance the SiniLoyal application's effectiveness and adoption, key recommendations include improving core features like transaction speed and real-time updates, simplifying the user interface with intuitive navigation and onboarding guides, and strengthening incentives through enhanced rewards for frequent use. Further awareness via training and promotional campaigns led by market administrators and local government units will help drive engagement, while continuous feedback collection ensures iterative improvements aligned with user needs. Expanding collaborations with market stakeholders can secure official endorsement, and robust technical support will maintain user confidence. These measures will help create a sustainable digital loyalty ecosystem that benefits consumers, vendors, and market administrators alike. By focusing on usability, incentives and stakeholders' engagement, SiniLoyal can achieve its goals of increasing consumer retention, optimize vendor operations and enhance public service integration in the public market.

## **IMPLICATIONS**

Bringing SiniLoyal application into public markets will be a significant move toward digital governance and economic innovation. This is due to making all processes smoother and more transparent, with increased public participation through rewarding schemes (Morgeson et al., 2020). As a model for digital public service innovation. It will help local economies grow, encourages individuals to get involved, and supports stronger communities (Kim et al., 2021; Breugelmans et al., 2015). By blending traditional markets with digital tools, SiniLoyal seeks for inclusive economic growth, smarter market operations, and tighter connections between communities as an effective way for modernizing public market systems (Gochoco-Bautista, 2025).

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## DECLARATIONS

### ***Conflict of Interest***

The researcher declares no conflict of interest in this study.

### ***Informed Consent***

After being notice to conduct, and approved letter from the Municipal Mayor and Sangguniang Bayan and SMVA about the study's objectives, methodology, benefits, confidentiality measures, and respondents right to withdraw in answering questionnaire, each participant provided informed consent through documented signed forms.

### ***Ethics Approval***

The study was conducted ethically, protecting the rights, privacy, and well-being of vendors and consumers. Participants remained anonymous, and research integrity was maintained through established protocols. Authorization was obtained from the Municipal Mayor, SMVA, and the Market Administrator. Required consent forms were kept, and the rest were shredded. A plagiarism check was completed, and all sources were properly cited.

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