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CONSUMER-BASED PRODUCT ASSORTMENT AND VENDING MACHINE BUSINESS FEASIBILITY: A LEARNING FACTORY PROJECT

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Abstract

This study presents a Learning Factory project that developed an e-Warung business concept combining vending machines for daily necessities with a hygienic booth-container concept for internship participants. The project applied a consumer-oriented planning process consisting of questionnaire-based needs identification, product preference analysis, inventory estimation, vending-machine slot allocation, financial feasibility analysis, and marketing and customer-experience design. A total of 722 questionnaire responses were analyzed, comprising 569 respondents from Site A and 152 respondents from Site B, with one additional discrepancy in the reported aggregate gender count in the source report. The analysis identified strong demand for personal-care and daily-use products, including toothpaste, body soap, shampoo, snacks, beverages, and other essential items. The proposed vending-machine capacity was 240 slots per unit, with four layouts designed for Site A and three for Site B. Product allocation was determined proportionally from estimated stock requirements, while higher-priority products were positioned in more accessible areas. Financial projections indicated monthly post-tax income of approximately IDR 25.2 million for Site A and IDR 17.2 million for Site B. The project also proposed a digital loyalty program, QR-code interaction, responsive interfaces, digital payments, routine maintenance, and a booth-container concept supported by hygiene and operational standards. The project demonstrates how consumer information can be translated into assortment, service, and investment decisions in an automated retail setting. The findings are presented as a feasibility and design exercise rather than realized post-launch performance.

Keywords:
Vending Machine; Consumer Behavior; Product Assortment; Customer Experience; Marketing Communication; Learning Factory; Investment Feasibility

1. INTRODUCTION

Internship programs require participants to maintain daily routines and access essential goods and food while adapting to a work-oriented environment. The e-Warung Learning Factory project was developed from the practical problem identified in the project report: limited access to convenient and hygienic food facilities and daily necessities around internship activities. The proposed solution combined automated retail through vending machines with a booth-container concept intended to support a cleaner and more organized food environment.

From a management perspective, the project is relevant because vending machines operate with limited physical capacity. Product assortment therefore needs to be planned carefully rather than treated as a simple list of available products. Nemoto and Hiraishi (2024) describe vending-machine assortment as a distinct optimization problem because retailers face constrained capacity, stochastic consumer behavior, limited replenishment opportunities, and environmental variation. This makes consumer information and assortment decisions important components of vending-machine business design.

The importance of physical product arrangement is also supported by Marinelli et al. (2021), who found that planned product organization in automatic vending environments can influence purchasing activity and reduce shopping time. In the present project, this perspective is reflected in the use of questionnaire results to determine stock priorities and the placement of selected products in accessible slots. The project therefore connects consumer preference analysis with physical assortment and layout decisions.

Product portfolio decisions can also be viewed from a strategic portfolio-management perspective. García-Vidal et al. (2023) argue that product portfolio analysis helps firms evaluate offerings, identify products requiring improvement, and decide which products should be retained, discontinued, or added. More specifically for vending-machine operations, Kumoro et al. (2026) demonstrate the relevance of data-driven portfolio optimization by adapting portfolio analysis to SKU-level vending-machine decisions. Their Modified BCG Matrix uses internal sales indicators and supports operational actions such as facing allocation, replenishment priority, product rotation, replacement, and delisting. The present Learning Factory project differs in purpose and data maturity: it was conducted before operational transaction data were available and therefore relied on questionnaire-based demand estimates and financial projections rather than observed sales performance.

The project also integrates marketing communication and customer experience into the business design. Rather than considering vending machines solely as a distribution channel, the project proposes a loyalty mechanism, QR-code interaction, digital payment options, intuitive interfaces, strategic product placement, and routine maintenance. These components are intended to make the purchasing process convenient while supporting repeat purchasing and customer engagement.

Accordingly, the objective of this article is to document how consumer needs were translated into a vending-machine assortment, slot allocation, business feasibility model, and customer-experience strategy within a Learning Factory setting. The article also identifies the operational constraints and limitations of the project so that the proposed business model can be evaluated realistically before implementation.

2. RESEARCH METHOD

This study used a descriptive, project-based approach within a Learning Factory setting. The unit of analysis was the e-Warung business design developed by the student project team. The analysis combined primary questionnaire data collected from internship participants with secondary information used for product, cost, investment, and operational planning. The project report states that 722 respondents completed the questionnaire, consisting of 569 respondents from Site A and 152 respondents from Site B. The report also presents a separate aggregate gender count of 482 males and 239 females, which totals 721; this inconsistency is retained here as a documented source-data discrepancy rather than being silently corrected.

The project was conducted through several stages: (1) preliminary problem identification; (2) questionnaire distribution; (3) categorization of product needs and preferences; (4) estimation of stock requirements; (5) proportional slot allocation and layout development; (6) operating-cost, revenue, cash-flow, NPV, IRR, and payback-period calculations; and (7) development of marketing communication, customer-experience, and booth-container concepts.

Product demand was grouped into categories such as body soap, shampoo, toothpaste, body lotion, deodorant, facial cleanser, toothbrushes, detergent and fragrance products, light health products, vitamins, beverages, snacks, and seasonings. Stock levels were then estimated from the reported purchase-frequency patterns. The project used proportional allocation to convert estimated stock into vending-machine capacity. The reported formula was: Proportion (%) = product stock / total category stock × 100%, followed by Slot allocation = proportion × vending-machine capacity. The project specified a capacity of 240 slots per unit and used four layouts for Site A and three layouts for Site B.

Financial feasibility was assessed through projected revenue, variable costs, fixed costs, cash flow, Present Value, Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PBP), using a 10% WACC in the reported cash-flow analysis. Because the report contains different investment bases for machine procurement and the subsequent site-level cash-flow schedules, the financial figures in this article are treated explicitly as project assumptions and projections, not audited operating results.

For marketing and customer experience, the project proposed a loyalty mechanism in which a transaction of at least IDR 50,000 generates one point, while five points can be exchanged for a IDR 10,000 voucher. QR codes were proposed for point tracking and customer interaction. The project also proposed digital payments, responsive touchscreen interfaces, strategic placement of popular products, routine machine maintenance, and regular stock replenishment.

3. RESULTS AND DISCUSSION

3.1 Consumer Need Identification and Product Assortment

The questionnaire provided the main basis for deciding what products should be offered. The analysis identified personal-care and daily-use products as important demand categories, with toothpaste, body soap, shampoo, snacks, beverages, deodorant, facial-care products, detergent, vitamins, and light health products appearing in the proposed assortment. The two sites showed different respondent compositions and preference patterns. Site A was dominated by male respondents, whereas Site B was dominated by female respondents. This difference was reflected in the reported product preferences and became a consideration in designing the assortment for each location.

For Site A, the report highlighted products such as body soap, shampoo, toothpaste, deodorant, facial cleanser, toothbrushes, detergent, light health products, snacks, and seasonings, with several categories assigned relatively high minimum stock levels. For Site B, the same broad categories were retained, but the stock requirements were lower because the respondent base was smaller. The result shows a practical segmentation logic: assortment planning was not based only on general product availability but on the estimated needs of the specific user population.

Table 1 Respondent Composition and Site-Specific Planning Basis

Site	Reported respondents	Dominant respondent group	Planning implication
Site A	569	Male respondents	Higher stock requirements for high-frequency daily-use products
Site B	152	Female respondents	Lower total stock requirement with site-specific product preferences
Overall	722 reported	Source report also reports 482 male and 239 female	Gender totals contain a one-person discrepancy and are retained as reported

The product-selection process is consistent with the logic of assortment optimization in automated retail. Nemoto and Hiraishi (2024) emphasize that vending machines require decisions under constrained capacity, while García-Vidal et al. (2023) highlight the role of portfolio analysis in deciding which products should remain in an offering. In this project, the constraint was addressed through demand-based prioritization before the machine was deployed. However, unlike Kumoro et al. (2026), the project did not have transaction histories that could support SKU-level sales-growth analysis. The resulting assortment should therefore be understood as a pre-launch demand model that requires validation after implementation.

3.2 Demand Estimation, Slot Allocation, and Layout

The project translated questionnaire frequencies into minimum stock targets. For Site A, reported minimum stocks included approximately 500 units for body soap, 400 for shampoo, 450 for toothpaste, 300 for deodorant, 250 for facial cleanser, 200 for toothbrushes, 350 for detergent, 200 for light health products, 300 for snacks, and 250 for seasonings. For Site B, the corresponding minimum stock estimates were approximately 150, 120, 100, 80, 70, 60, 90, 50, 80, and 70 units. These values were then used to construct the vending-machine layouts.

The project specified 240 slots per vending-machine unit. Four layouts were prepared for Site A and three for Site B. Products with stronger estimated demand were positioned in more accessible locations, while product allocation was adjusted according to proportional stock requirements. This approach is important because physical assortment and product visibility can influence purchasing behavior in vending environments. Marinelli et al. (2021) found that planned product organization in automatic vending machines can positively affect purchases and help streamline the shopping process.

Table 2 Illustrative Stock Priorities Used in the Vending-Machine Design

Category	Site A minimum stock	Site B minimum stock	Planning interpretation
Body soap	500	150	High-priority daily-use item
Shampoo	400	120	High-priority personal-care item
Toothpaste	450	100	High-priority daily-use item
Deodorant	300	80	Regular personal-care demand
Facial cleanser	250	70	Site-specific personal-care demand
Toothbrush	200	60	Essential replacement item
Detergent	350	90	Household/daily-use requirement
Snacks	300	80	Convenience and impulse-purchase category

The layout design therefore functions as an operational translation of consumer information. It connects demand estimation to physical capacity, which is particularly relevant in vending machines because every slot represents a limited opportunity for inventory and sales. The project also proposed replenishment twice per week, indicating that slot allocation should not be separated from the replenishment process.

3.3 Financial Feasibility and Investment Planning

The financial model indicates a positive projected outcome under the assumptions used in the project. The reported monthly turnover was IDR 204.13 million for Site A and IDR 140.23 million for Site B. After variable and fixed costs and a reported 12% tax assumption, projected monthly post-tax income was approximately IDR 25.21 million for Site A and IDR 17.23 million for Site B. The project therefore estimated combined post-tax monthly income of approximately IDR 42.44 million.

Table 3 Projected Financial Performance by Vending-Machine Site

Indicator	Site A	Site B
Vending machines	4 units	3 units
Machine procurement cost	IDR 140,000,000	IDR 105,000,000
Projected monthly turnover	IDR 204,129,412	IDR 140,234,118
Variable cost	IDR 173,510,000	IDR 119,199,000
Fixed cost	IDR 1,969,982	IDR 1,452,286
Projected post-tax income/month	IDR 25,211,499	IDR 17,232,892
NPV	IDR 122,391,080	IDR 33,341,483
IRR	23%	15%
PBP	0.67 year	0.59 year
WACC used	10%	10%

The reported NPV values are positive and the IRR values exceed the 10% WACC used in the model. The reported PBP values are below one year, indicating rapid recovery under the project's assumptions. These results provide an initial feasibility signal, but they should not be interpreted as evidence of realized profitability because the project was still at the design and planning stage.

An important point for future implementation is the distinction between procurement cost and total investment used in the cash-flow schedules. The report states a combined machine procurement cost of IDR 245 million, while the site-level cash-flow schedules use initial capital of IDR 312.47 million for Site A and IDR 222.459 million for Site B. The difference suggests that the broader investment base includes additional components beyond the machine purchase. For publication purposes, the figures are therefore retained as reported and treated as separate planning assumptions rather than reconciled through unsupported adjustments.

3.4 Marketing Communication and Customer Experience

The project did not position the vending machine only as a self-service sales device. It designed a simple loyalty mechanism intended to encourage repeat transactions. A customer spending at least IDR 50,000 would receive one point, while five accumulated points could be exchanged for a IDR 10,000 voucher. QR codes were proposed for checking points and accessing the loyalty system. The project also proposed promotional communication, including monthly offers such as buy-two-get-one promotions for selected products.

The customer-experience design focused on five practical elements: strategic machine location, intuitive touchscreen navigation, multiple payment options including digital payment, easy access to popular products, and routine cleanliness and maintenance. These design choices are consistent with the vending-machine literature, where convenience, limited shopping time, product visibility, and physical organization are important components of the purchasing environment (Marinelli et al., 2021). The project consequently treated customer experience as an operational issue rather than solely a promotional issue.

Table 4 Customer-Experience and Marketing Design Components

Component	Proposed design	Operational purpose
Loyalty program	1 point for ≥ IDR 50,000; 5 points = IDR 10,000 voucher	Encourage repeat purchasing
QR-code interaction	Digital access to points and customer information	Reduce friction and support engagement
Digital payment	QRIS and other digital payment options	Improve transaction convenience

Product placement	Popular/impulse products in accessible positions	Improve visibility and ease of selection
Maintenance	Routine cleaning, servicing, and stock control	Protect service quality and availability

The marketing design can be strengthened by moving from a purely rule-based loyalty program toward a data-driven retention system after transactions become available. This is where the project can develop further in line with Kumoro et al. (2026), which demonstrates how transaction-level data can support portfolio decisions and operational actions in vending-machine networks. Once actual transaction histories are collected, the business could compare predicted demand with realized sales, revise slot allocation, identify slow-moving products, and eventually apply SKU-level portfolio classification.

3.5 Booth-Container Concept and Operational Standards

The booth-container concept complemented the vending-machine business by addressing the food-service side of the e-Warung proposal. The proposed booth measured approximately 120 × 180 × 200 cm and was designed with weather-resistant materials. Supporting facilities included clean water, electricity, additional lighting, a sink, CCTV, electrical outlets, and separate waste containers. The project also proposed standards for permitted products, hygiene, employee health, personal protective equipment, and periodic evaluation of tenants.

The concept included operational restrictions intended to maintain a healthier food environment, such as avoiding alcohol, cigarettes, illegal goods, and non-halal ingredients, together with requirements concerning food handling and cleanliness. The project further proposed six-month performance evaluations covering product quality, cleanliness, and customer satisfaction. These elements show that the e-Warung model was designed as a small retail ecosystem rather than an isolated vending-machine installation.

3.6 Supporting Factors, Constraints, and Learning Implications

Several factors supported the project: a structured timeline, questionnaire data, demand-based stock planning, a defined vending-machine capacity, a loyalty concept, and a financial feasibility model. The project also integrated marketing communication, consumer behavior, customer experience, and investment analysis, allowing the student to translate classroom concepts into a practical business-design exercise.

The main constraints were the high initial investment requirement, the technical complexity of digital-payment integration, and the need for coordinated replenishment. The report proposed replenishment twice a week and highlighted the need to distribute stock to strategic locations. These operational requirements mean that the financial feasibility of the concept depends not only on consumer demand but also on logistics, machine uptime, stock availability, and the accuracy of the demand assumptions.

A major methodological limitation is that the project relied on questionnaire-based preferences and projected financial data rather than actual vending-machine transactions. Consequently, statements about loyalty, purchase frequency, or profitability should be interpreted as intended outcomes or projections rather than measured effects. This limitation also defines the logical next step for the project: collect transaction-level data after implementation and compare actual sales, product availability, and customer behavior with the original demand model.

4. CONCLUSION

The Learning Factory e-Warung project demonstrates a structured approach to designing a consumer-oriented vending-machine business. Questionnaire results were translated into product categories, minimum stock requirements, vending-machine layouts, and site-specific assortment decisions. The proposed 240-slot capacity per unit and the use of multiple layouts allowed the project to connect consumer demand with the physical constraints of automated retail.

The financial model produced positive projected NPV and IRR values above the assumed 10% WACC for both sites, with reported payback periods below one year. The project also incorporated a loyalty program, QR-code interaction, digital payments, strategic product placement, maintenance routines, and a booth-container concept with hygiene and operational standards. However, these results remain feasibility projections because the project did not yet evaluate post-launch transaction data.

The most important direction for further development is to move from questionnaire-based planning to transaction-based optimization. After implementation, actual sales data should be used to revise stock levels, replenishment schedules, product placement, promotions, and the product portfolio. This direction is particularly relevant to the findings of Kumoro et al. (2026), which show how transaction-level portfolio optimization can support SKU-level decisions in vending-machine operations. Future research can therefore

examine whether the demand assumptions in this Learning Factory project are consistent with actual purchasing behavior and whether data-driven assortment changes improve sales and service performance

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