

Applying design science research to develop an integrated digital marketing communication application for increasing the economic value of recycled waste products

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Abstract

Waste banks play an important role in supporting the circular economy by transforming recyclable waste into products with economic value. However, the Kebumen Gemilang Sejahtera (KGS) Waste Bank in Palembang faces challenges in marketing recycled products due to limited digital promotion, fragmented marketing channels, manual customer data management, and the absence of marketing performance analytics. This study aims to apply the Design Science Research (DSR) method to develop an Integrated Digital Marketing Communication (IDMC) application to improve the effectiveness of digital marketing and the economic value of recycled waste products. The research follows six DSR phases: Problem Identification and Motivation, Define the Objectives for a Solution, Design and Development, Demonstration, Evaluation, and Communication. The resulting web-based IDMC application integrates digital branding, product catalog management, social media and marketplace integration, Customer Relationship Management (CRM), digital promotion, sales management, and marketing analytics. The application also integrates the product catalog with Meta Commerce Manager to support product synchronization across Facebook Shop and Instagram Shopping. Evaluation using Black Box Testing showed that the implemented functions operated according to the specified requirements. Usability testing using the System Usability Scale (SUS) resulted in a score of 82.5, categorized as Excellent, indicating good usability and user acceptance. The study demonstrates that the DSR-based IDMC artifact provides an integrated digital solution for improving marketing management, expanding market reach, strengthening customer engagement, and supporting the economic value of recycled products at the KGS Waste Bank.

Keywords

Design science research, integrated digital marketing communication, digital marketing, waste bank, recycled products

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Introduction

Waste management is one of the main challenges in sustainable development. Population growth, urbanization, and changes in people's consumption patterns have led to a significant increase in waste volume every year. One of the main strategies in addressing environmental problems while creating sustainable economic growth is the implementation of the circular economy concept. This approach emphasizes the reuse of resources through reduction, reuse, recycling, and recovery activities, thereby reducing waste while increasing the added value of products. One form of circular economy implementation in Indonesia that encourages community participation in economy-based waste management is the Waste Bank (Geissdoerfer et al., 2018). The Kebumen Gemilang Sejahtera (KGS) Waste Bank in Palembang City has acted as a community-based waste management institution tasked with reducing the volume of waste disposed of in the waste bank environment while producing various recycled products with economic value. The main problem faced by the KGS Waste Bank is the low competitiveness of its products in the market, caused by limited marketing strategies, branding, and technology utilization. The existence of a waste bank through a mechanism of waste collection, sorting, and processing is able to produce various recycled waste products with economic value. In addition to providing environmental benefits, they also contribute to community empowerment and increased household income. However, most waste banks still face challenges in marketing their recycled products because promotions are still conducted conventionally and do not utilize digital technology optimally (Astoria & Heruman, 2016).

Current developments in information technology have shifted the marketing paradigm towards more integrated digital marketing communications. Integrated Digital Marketing Communication (IDMC) is an approach that integrates various digital communication channels, such as websites, social media, marketplaces, email marketing, content marketing, and customer relationship management (CRM), thereby increasing the effectiveness of communication with customers, expanding market reach, and building sustainable customer relationships. Various studies have shown that the use of social media, online marketplaces, and other digital platforms can significantly increase market reach and consumer interaction (Nnanna-Ohuonu et al., 2025). Furthermore, the concept of Integrated Marketing Communication (IMC), which has evolved into Integrated Digital Marketing Communication (IDMC), offers a comprehensive marketing approach by integrating various digital channels to deliver consistent and effective messages (Mulhern, 2009).

Various studies have developed digital marketing and e-commerce systems for micro, small, and medium enterprises (MSMEs). However, most studies only implement one or two digital marketing channels and have not provided a platform that comprehensively integrates all digital marketing communication activities, particularly in the management of recycled products in waste banks. In addition, previous studies have focused more on system implementation without explaining the process of systematically developing artifacts using information systems research methodology (Hevner et al., 2004). In the field of information systems, Design Science Research (DSR) is a methodology oriented towards developing artifacts to solve real organizational problems through a systematic process starting from problem identification to solution evaluation. DSR not only produces applications but also provides scientific contributions in the form of validated artifacts that can be replicated in

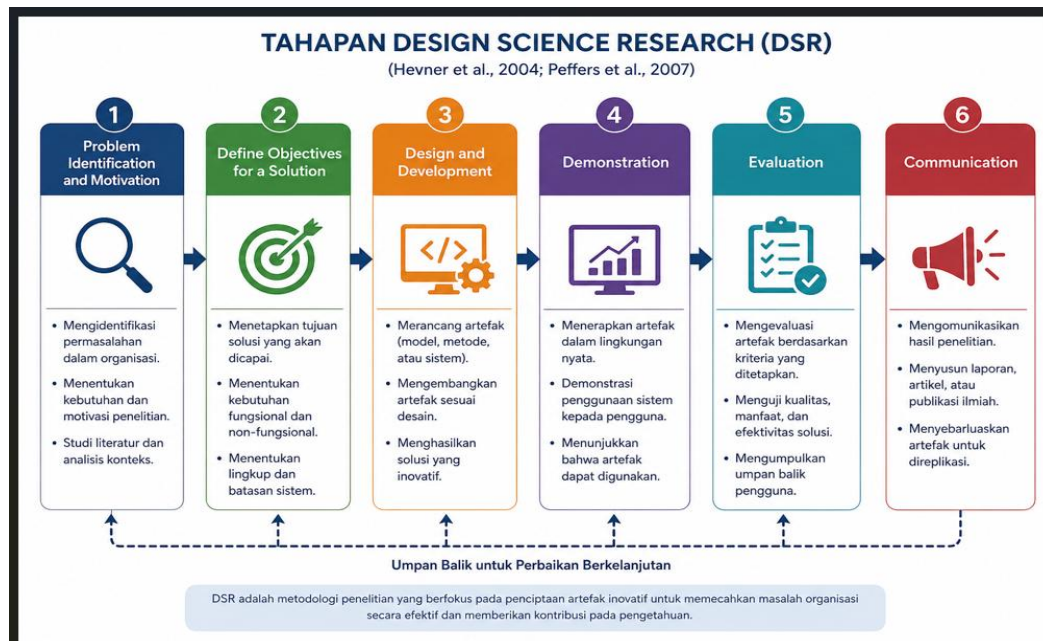
similar contexts (Hevner et al., 2004). DSR aims to create concrete solutions to practical problems faced by organizations, resulting in new technological artifacts as well as new knowledge. In the field of information systems, this approach is used to build systems that align with organizational needs and can directly solve problems. In general, the DSR framework is based on two main sources, namely (a) the organizational environment such as user needs, work culture, and the technology used, and (b) the knowledge base, such as theories of technology and user behavior (e.g., TAM, TRI, and others). The uniqueness of DSR compared to professional development methods such as Waterfall, Agile, or Scrum lies in its orientation which is directly aimed at solving specific problems in the organizational context (Zebua et al., 2025). Based on these problems, this study aims to apply the Design Science Research method to develop an Integrated Digital Marketing Communication (IDMC) application at the Kebumen Gemilang Sejahtera Waste Bank as an effort to increase the effectiveness of digital marketing and the economic value of recycled waste products.

Research Methodology

This study uses the DSR method because it focuses on developing an artifact in the form of an IDMC application capable of solving real-world problems in the marketing process of recycled products at the Kebumen Gemilang Sejahtera Waste Bank. DSR was chosen because it provides a systematic framework for identifying problems, designing technology-based solutions, developing artifacts, and evaluating their effectiveness in a real-world setting.

The research stages refer to the six phases of DSR, namely Problem Identification and Motivation, Define the Objectives for a Solution, Design and Development, Demonstration, Evaluation, and Communication (Peffer et al., 2007).

Figure 1. *Stages of DSR (in Indonesian)*



Problem identification and motivation

At this stage, the problems faced by the KGS Waste Bank were identified through observation, interviews with KGS Waste Bank managers, and documentation studies. The identification results revealed several key issues: product marketing is still conducted conventionally; promotions only utilize social media to a limited extent; there is no integration between social media, marketplaces, and the website; customer data is not centrally documented; there is no analysis of the effectiveness of digital promotions; and sales reports are still compiled manually.

Define the objectives for a solution

At this stage, the system development objectives are determined. The objectives of system/application development are as follows:

- a. Develop a web-based Integrated Digital Marketing Communication application.
- b. Integrate all digital marketing media into a single platform.
- c. Simplify product and customer management.
- d. Provide a marketing analytics dashboard.
- e. Support increased sales and the economic value of recycled products.

Design and development

At this stage, the IDMC application artifact is designed and developed, starting with requirements analysis (functional and non-functional); system design; demonstration; evaluation; and implementation. The following functional and non-functional requirements can be seen in Table 1.

Table 1. *Needs analysis*

No	Functional Requirements	Non-Functional Requirements
1.	Customer data management;	System security
2.	Recycled product management	Ease of use
3.	Digital product catalog	Web-based access
4.	Digital branding	Responsiveness across devices
5.	Social media management	Ease of system maintenance
6.	Marketplace integration	
7.	Customer relationship management (CRM)	
8.	Digital promotions	
9.	Analytics dashboard	
10.	Sales reporting	

This subsection presents the proposed prototype of the digital marketing application designed to support the implementation of IDMC. The prototype has been designed to illustrate the overall concept, user interface, and core functionalities of the application. The detailed prototype screens and descriptions can be found in this section, providing an overview

of how the proposed system is intended to support digital marketing activities within the IDMC framework. Here is a prototype of the application:

Landing page, Figure 2 presents the landing page interface of the proposed Bank *Sampah* KGS application

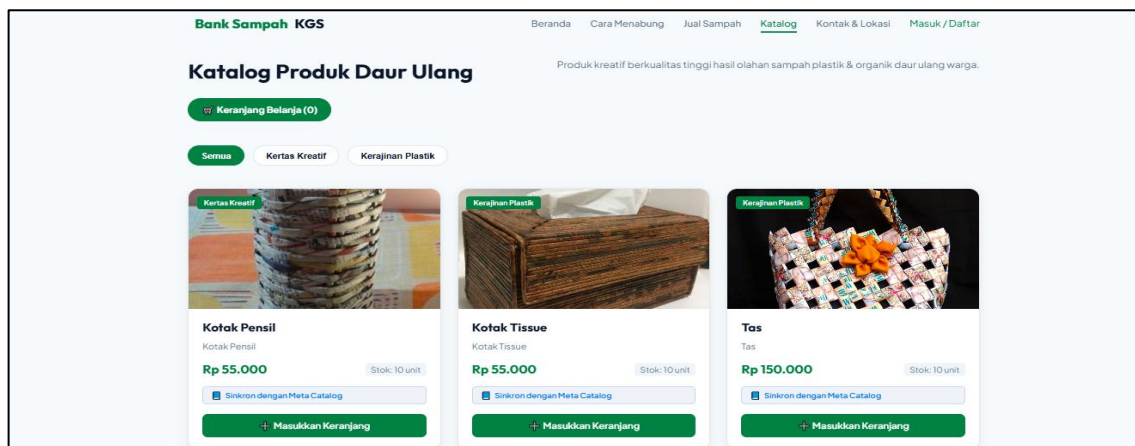
Figure 2. *Landing page (in Indonesian)*



The *Landing Page* serves as the main entry point of the Bank Sampah KGS digital marketing application. It is designed to introduce visitors to the platform by presenting the organization's value proposition, namely transforming household waste into economic benefits through digital waste banking services

Catalog product, figure 3 illustrates the product catalog interface of the proposed Bank Sampah KGS application.

Figure 3. *Catalog product (in Indonesian)*



The product catalog interface displays recycled products organized by category, accompanied by product images, prices, stock availability, and shopping cart functionality, enabling users

to conveniently browse, select, and purchase environmentally friendly products while supporting the digital marketing and e-commerce objectives of the proposed system.

Selling waste, figure 4 illustrates the waste selling interface of the proposed Bank Sampah KGS application.

Figure 4. *Selling waste (in Indonesian)*

The waste selling interface enables users to submit waste deposit requests by selecting the waste category, entering the estimated weight and additional information, while also displaying the current purchase prices for each waste type and the estimated balance to provide a transparent, convenient, and efficient transaction process.

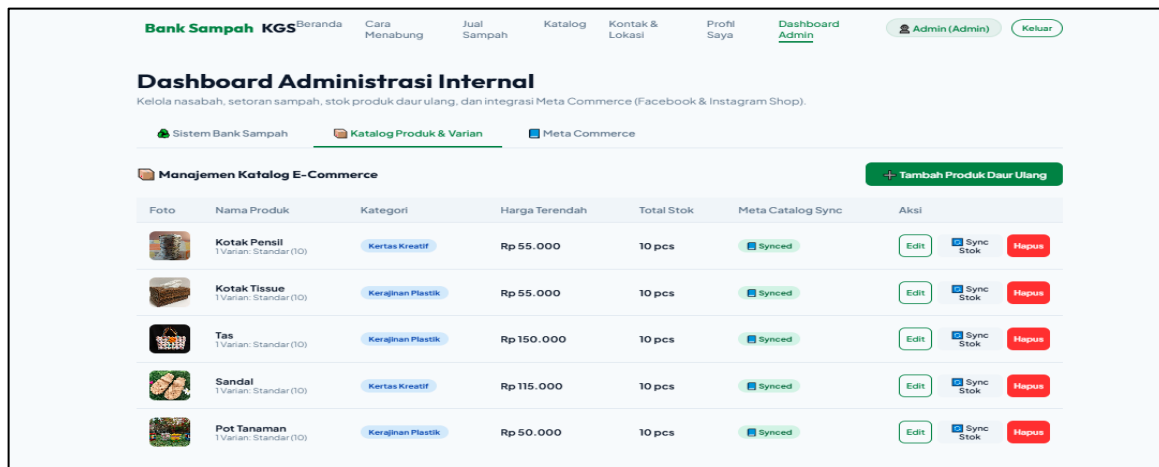
Waste management system, figure 5 illustrates the administrator dashboard interface of the proposed Bank Sampah KGS application.

Figure 5. *Waste management system (in Indonesian)*

The administrator dashboard provides a centralized interface for managing waste deposits, registering new customers, monitoring recyclable material inventory, and tracking customer balances, enabling administrators to efficiently oversee operational activities and maintain accurate records within the Bank Sampah KGS system.

E-commerce catalog management, figure 6 illustrates the product catalog management interface of the administrator dashboard in the proposed Bank Sampah KGS application.

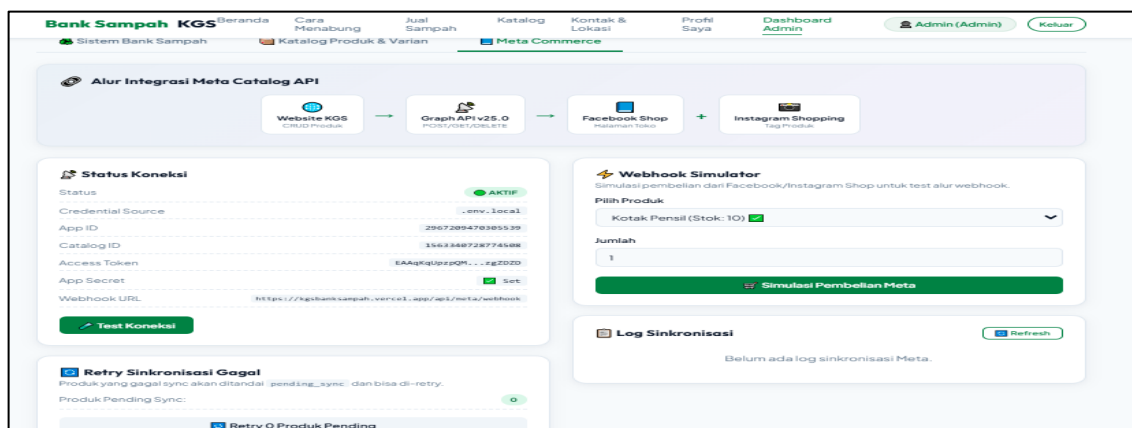
Figure 6. *E-commerce catalog management (in Indonesian)*



The product catalog management interface enables administrators to add, edit, and delete recycled products, manage product categories, prices, and stock availability, as well as synchronize product information with the Meta Catalog to support efficient inventory management and integrated digital marketing across e-commerce and social media platforms.

Meta commerce management, figure 7 illustrates the Meta Commerce integration interface of the administrator dashboard in the proposed Bank Sampah KGS application.

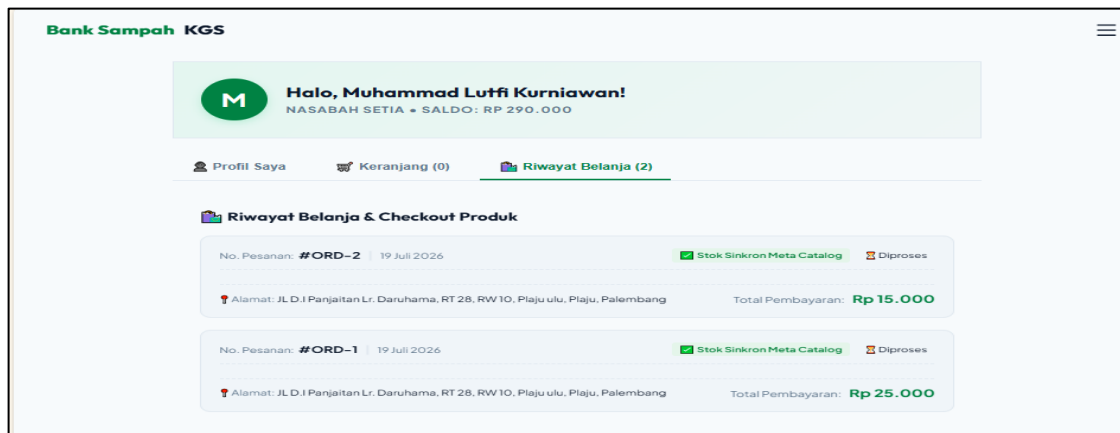
Figure 7. *Meta commerce management (in Indonesian)*



The Meta Commerce integration interface enables administrators to configure and monitor the connection between the application and the Meta Catalog API, manage synchronization settings, simulate product purchases through webhooks, and review synchronization logs to ensure that product information remains consistent across the website, Facebook Shop, and Instagram Shopping platforms.

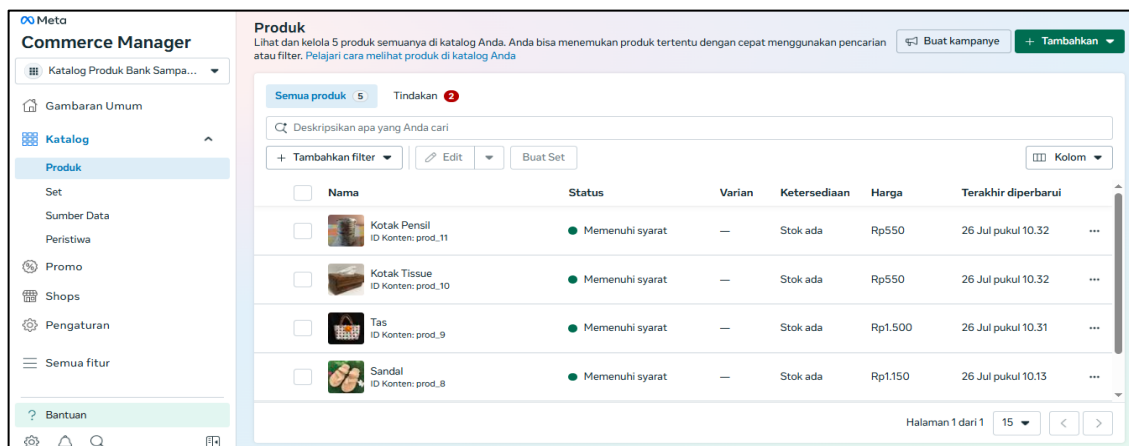
Purchase transaction ledger, figure 8 illustrates the user profile interface of the proposed Bank Sampah KGS application.

Figure 8. *Purchase transaction ledger (in Indonesian)*



Product catalog integrated into meta commerce, figure 9 presents the Meta Commerce Manager dashboard displaying the synchronized product catalog from the proposed Bank Sampah KGS application.

Figure 9. *Product catalog integrated into meta commerce (in Indonesian)*



The Meta Commerce Manager dashboard confirms that the recycled products from the Bank Sampah KGS application have been successfully synchronized with the Meta Catalog, allowing administrators to manage product availability, pricing, inventory, and product status centrally

while enabling seamless integration with Facebook Shop, Instagram Shopping, and other Meta Commerce services for digital marketing and online sales.

Description of each feature

As shown in the figure above, the product catalog feature has been integrated with Meta Commerce Manager, allowing the recycled products of the partner waste bank to be listed and managed directly through the Facebook/Instagram Shop. As of the reporting period, five products have been uploaded to the catalog, including Pencil Case (Kotak Pensil), Tissue Box (Kotak Tissue), Bag (Tas), and Sandals (Sandal), each recorded with its stock availability, price, and eligibility status ("Memenuhi syarat"/meets requirements). This feature supports the Horizontal Integration dimension of the IDMC model by enabling consistent product information across digital marketing channels.

RESULTS AND DISCUSSION

Implementation of the design science research method

The application of Design Science Research (DSR) in this study provides a systematic approach to developing an artifact in the form of an Integrated Digital Marketing Communication (IDMC) application. Unlike software development methods that focus on the implementation process, DSR emphasizes the creation of artifacts that can solve real-world problems while simultaneously making scientific contributions (Hevner et al., 2004). The Problem Identification and Motivation phase successfully identified various obstacles faced by the Kebumen Gemilang Sejahtera Waste Bank, including limited promotional media, a lack of integration between digital marketing channels, manual customer data management, and the absence of an analytical system to evaluate promotional effectiveness. These issues have resulted in limited marketing reach and a suboptimal economic value for recycled products.

Based on the identification results, the Define the Objectives for a Solution stage generates system requirements that focus on integrating various digital marketing communication media into a single platform. This approach aligns with the primary goal of DSR, which is to produce technology-based solutions that effectively address organizational needs (Peppers et al., 2007).

During the Design and Development phase, the IDMC application was developed as a research artifact that integrates modules for digital branding, product management, social media, marketplaces, customer relationship management (CRM), digital promotions, analytics dashboards, and sales reports. The integration of all these modules results in a system that not only supports marketing activities but also provides the information necessary for data-driven decision-making.

The Demonstration phase demonstrated that the application could be used by the managers of the Kebumen Gemilang Sejahtera Waste Bank in carrying out daily digital marketing activities. Furthermore, the Evaluation phase, through functional and usability testing, demonstrated that the system met user needs and achieved a good level of acceptance. Thus, the DSR implementation successfully produced relevant artifacts, usable in real-world environments, and has the potential to be replicated in similar organizations.

Implementation of integrated digital marketing communication

The Integrated Digital Marketing Communication (IDMC) concept is implemented by integrating various digital communication channels into a single web-based application. This approach enables waste bank managers to consistently convey product information to customers through various digital media, thereby increasing the effectiveness of marketing communications.

The developed application consists of several main modules: Digital Branding, Product Catalog, Marketplace Integration, Social Media Management, Customer Relationship Management (CRM), Campaign Promotion, Sales Management, and a Marketing Analytics Dashboard. Integration between these modules makes it easy to manage all marketing activities without having to use multiple separate applications.

Digital branding helps build the identity and image of recycled products, making them more recognizable to the public. Social media integration allows product information to be published more quickly and reach a wider audience of potential customers. Meanwhile, marketplace integration supports online transactions, expanding market access. A CRM module is used to document customer data, purchase history, and communication activities, allowing for more effective customer relationship management.

The analytics dashboard provides information on the number of products marketed, sales levels, promotional effectiveness, and transaction trends. This information serves as a basis for managers to evaluate marketing strategies and determine more appropriate policies. These results align with the concept of digital marketing, which emphasizes the use of data as a basis for marketing decision-making (Chaffey & Ellis-Chadwick, 2022).

Application contribution to increasing the economic value of recycled products

One of the main objectives of this research is to increase the economic value of recycled products through the use of information technology. The implementation of the IDMC application provides several contributions to the economic aspects. First, the application expands marketing reach through website, social media, and marketplace integration, allowing recycled products to be promoted to a wider consumer base than conventional marketing methods. This opens up opportunities for increased customer numbers and sales transactions. Second, the system assists waste bank managers in developing more targeted promotional strategies by providing analytical data on marketing performance. This information enables managers to identify products with high demand and the most effective promotional strategies. Third, integrated customer data management through CRM improves the quality of service and communication with customers. Improved customer relationships have the potential to increase customer loyalty and repeat purchases, positively impacting revenue.

Beyond the economic benefits, the app also supports the implementation of a circular economy by increasing the added value of recycled products. The broader the market reach, the greater the opportunity for recycled products to compete with other commercial products. Thus, the app not only supports marketing but also contributes to environmental sustainability by increasing the use of recycled products.

System evaluation

The evaluation was conducted using Black Box Testing and the System Usability Scale (SUS). Functional testing results indicated that all application features functioned according to user needs, from authentication and product management to digital promotions and marketplace integration, to sales reporting.

Usability testing using the SUS instrument demonstrated that the application achieved an Excellent score (e.g., a SUS score of 82.5). This score indicates that the application is easy to use, has an intuitive interface, and effectively supports digital marketing activities. These results align with research by Bangor et al. (2009), which stated that a SUS score above 80 indicates excellent user acceptance. In addition to quantitative evaluation, user interviews indicated that the application helped reduce time spent managing promotions, simplify the preparation of sales reports, and increase the efficiency of customer data management. These findings demonstrate that the resulting artifact not only meets technical requirements but also provides practical benefits for waste bank managers.

Conclusion

This study successfully applied the Design Science Research (DSR) method to develop an Integrated Digital Marketing Communication (IDMC) application for the Kebumen Gemilang Sejahtera Waste Bank. The implementation of the six DSR phases—Problem Identification and Motivation, Define the Objectives for a Solution, Design and Development, Demonstration, Evaluation, and Communication—provided a systematic approach for identifying organizational problems, defining solution objectives, developing the application artifact, and evaluating its applicability in a real-world environment. The developed web-based IDMC application integrates several digital marketing functions, including digital branding, product catalog management, social media and marketplace integration, Customer Relationship Management (CRM), digital promotion, sales management, and marketing analytics. The integration with Meta Commerce Manager also enables recycled product information to be synchronized with digital commerce channels such as Facebook Shop and Instagram Shopping. This integration reduces the fragmentation of marketing activities and provides a centralized platform for managing products, customers, promotions, and sales information. The evaluation results indicate that the application successfully meets the identified functional requirements based on Black Box Testing. Furthermore, the System Usability Scale (SUS) evaluation produced a score of 82.5, categorized as Excellent, demonstrating that the application has good usability and is well accepted by users. User feedback also indicates that the system can simplify promotional management, customer data management, and sales reporting.

Overall, the developed IDMC application contributes not only to the digital transformation of marketing activities at the KGS Waste Bank but also to the broader effort to increase the market reach and economic value of recycled products. By integrating digital marketing channels and supporting data-driven decision-making, the proposed artifact has potential for adoption by other community-based waste management organizations with similar marketing challenges. Future research can focus on measuring the application's long-term impact on sales growth, customer engagement, and revenue, as well as integrating

advanced analytics, automated digital marketing, and AI-based recommendation features to further optimize marketing strategies.

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