

การประยุกต์ใช้กระบวนการคิดเชิงนวัตกรรมการออกแบบเพื่อพัฒนาดิจิทัลแพลตฟอร์มธุรกิจ
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APPLYING DESIGN THINKING TO DEVELOP A DIGITAL RECYCLING PLATFORM
FOR THA PHO COMMUNITIES, PHITSANULOK

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บทคัดย่อ

งานวิจัยนี้ได้ประยุกต์ใช้กระบวนการคิดเชิงออกแบบ (Design Thinking) เพื่อพัฒนาแพลตฟอร์มดิจิทัลสำหรับการรีไซเคิลที่ปรับให้เหมาะสมกับชุมชนท่าโพธิ์ อำเภอเมือง จังหวัดพิษณุโลก โดยมีเป้าหมายเพื่อแก้ไขปัญหาความท้าทายในการจัดการขยะดิจิทัล และการขาดการออกแบบที่เน้นผู้ใช้งานเป็นศูนย์กลาง (User-centered design) ในโครงการริเริ่มด้านการรีไซเคิลที่มีอยู่เดิม ผ่านการสร้างสรรค์แพลตฟอร์มที่ใช้งานง่ายและสร้างผลกระทบเชิงบวก กระบวนการคิดเชิงออกแบบในงานวิจัยนี้ประกอบด้วย 5 ขั้นตอน ได้แก่ การทำความเข้าใจ (Empathize) การระบุปัญหา (Define) การระดมความคิด (Ideate) การสร้างต้นแบบ (Prototype) และการทดสอบ (Test)

ผู้วิจัยได้ลงพื้นที่พูดคุยกับชุมชนในท้องถิ่นเพื่อทำความเข้าใจความต้องการและปัญหา (Pain points) ของพวกเขา ขั้นตอนการระบุปัญหาได้นำข้อมูลเชิงลึกเหล่านี้มาสังเคราะห์เพื่อระบุขอบเขตของปัญหาที่สำคัญ และกำหนดความต้องการเฉพาะของผู้ใช้งานสำหรับชุมชนท่าโพธิ์ ขั้นตอนการระดมความคิดได้ส่งเสริมให้เกิดการพัฒนาแนวคิดเชิงนวัตกรรม โดยคำนึงถึงบริบทของท้องถิ่น บรรทัดฐานทางวัฒนธรรม และโครงสร้างพื้นฐานทางเทคโนโลยี ในระหว่างขั้นตอนการสร้างต้นแบบ แนวคิดเหล่านี้ได้ถูกนำมาแปลงสภาพเป็นประสบการณ์ทางดิจิทัลที่จับต้องได้ ซึ่งเอื้อให้เกิดการรับข้อเสนอแนะและการปรับปรุงอย่างต่อเนื่อง ท้ายที่สุด ขั้นตอนการทดสอบเป็นการนำต้นแบบไปประเมินผลร่วมกับชุมชนเพื่อวัดความสามารถในการใช้งานและประสิทธิภาพ ด้วยการมุ่งเน้นไปที่ความต้องการและแรงจูงใจของชุมชนท่าโพธิ์ กระบวนการคิดเชิงออกแบบได้ช่วยอำนวยความสะดวกในการสร้างแพลตฟอร์มดิจิทัลที่ช่วยส่งเสริมการมีส่วนร่วมอย่างกระตือรือร้น ความร่วมมือ และการนำแนวปฏิบัติด้านดิจิทัลที่ยั่งยืนมาใช้ แนวทางดังกล่าวนี้ได้แสดงให้เห็นถึงศักยภาพในการสร้างโซลูชันที่สร้างผลกระทบเชิงบวก ซึ่งตอบสนองต่อความต้องการของชุมชนและสนับสนุนความสำเร็จในระยะยาว

คำสำคัญ: กระบวนการคิดเชิงออกแบบ, แพลตฟอร์มดิจิทัล, ธุรกิจรีไซเคิล, ชุมชนตำบลท่าโพธิ์

ABSTRACT

This research applied the Design Thinking process to develop a digital recycling platform tailored to the Tha Pho community in Mueang District, Phitsanulok Province. The aim was to address the challenges of digital waste management and the lack of user-centered design in existing recycling initiatives by creating a user-friendly platform with positive impact.

The Design Thinking process in this study consisted of five stages: Empathize, Define, Ideate, Prototype, and Test.

The researchers engaged with the local community to understand their needs and pain points. In the Define stage, these insights were synthesized to identify key problem areas and establish specific user requirements for the Tha Pho community. The Ideate stage encouraged the development of innovative ideas by taking into account the local context, cultural norms, and technological infrastructure. During the Prototype stage, these ideas were transformed into tangible digital experiences, allowing iterative feedback and continuous refinement. Finally, in the Test stage, the prototypes were evaluated with the community to assess their usability and effectiveness. By focusing on the needs and motivations of the Tha Pho community, the Design Thinking process facilitated the development of a digital platform that promotes active participation, collaboration, and the adoption of sustainable digital practices. This approach demonstrates the potential for creating impactful solutions that respond to community needs and support long-term success.

Keywords: Design thinking, Digital platform, Recycling Business, Tha Pho District Communities

Introduction

The recycling business plays a crucial role in the global economy, contributing to environmental sustainability and the conservation of natural resources (EPA, 2020; Animascorp, 2024). It encompasses a range of processes, including the collection, sorting, processing, and marketing of recyclable materials. By offering practical solutions for waste management, recycling reduces carbon footprints, decreases the amount of waste sent to landfills, and minimizes the need for extracting raw materials (Rogoff, 2013). This industry covers a wide array of materials, such as paper, plastics, metals, electronics, glass, textiles, and hazardous waste (Nandy et al., 2021). Each material requires specific techniques and equipment for processing, making the recycling business complex and dynamic. Despite these challenges, the rewards are substantial.

Not only does recycling provide environmental benefits, but it also presents significant economic opportunities (Singh et al., 2014; Ferreira et al., 2008). Local jobs can be created, economic growth can be stimulated, and entrepreneurs and investors can find a reliable source of income. The increasing global focus on sustainability has further boosted the growth potential of the recycling industry. With the rise of new markets for recycled materials, there are expanded opportunities for businesses and individuals involved in the recycling sector (Veleva, & Bodkin, 2018). Overall, the recycling business plays a vital role in promoting a circular economy, reducing waste, and creating economic opportunities while contributing to environmental conservation efforts. Digital platforms have become a fundamental element of

the recycling business, utilizing advanced technologies to enhance effectiveness and productivity. Through AI-powered sorting machines (Arputharaj et al., 2024) and innovative methods for material recovery and reuse (Ginga et al., 2020), these platforms are shaping the future of recycling. Just as digital platforms have transformed other industries, they are now revolutionizing the recycling sector.

In recent times, digital platforms have emerged as influential tools for improving efficiency, transparency, and stakeholder engagement within the recycling industry. By harnessing technology, these platforms connect various stakeholders, streamline operations, and generate positive outcomes in waste management and resource conservation. They enable effective communication between recyclers, waste collectors, manufacturers, and consumers, facilitating the smooth flow of recyclable materials throughout the value chain. Additionally, these digital platforms provide valuable data insights, enabling businesses to optimize their operations and make informed decisions.

Therefore, the researcher is interested in studying the application of digital platforms to the recycling business to enable it to work smoothly and to be a system that promotes sustainable business that meets SDG 13.

Recycling business in Thailand.

Thailand, a country known for its natural beauty and rich cultural heritage, is also facing significant challenges in waste management and environmental sustainability. In recent years, there has been a growing emphasis on recycling and promoting a circular economy in the country. The recycling business in Thailand has gained momentum, with various initiatives and efforts aimed at improving waste management practices and maximizing resource recovery (The Thailand Board of Investment, 2023). The Thai government has implemented several policies and regulations to promote recycling and waste reduction. The Ministry of Natural Resources and Environment, along with other government agencies, has launched initiatives such as the National Roadmap on Plastic Waste Management and the 3Rs (Reduce, Reuse, Recycle) (Das et al., 2019). These initiatives aim to enhance waste management infrastructure, encourage recycling activities, and create a more sustainable waste management system in the country (Kumari and Raghubanshi, 2023).

Municipalities in particular generate a very high volume of solid waste, with plastic waste being a major problem. Many municipalities have implemented waste separation programs and set up Material Recovery Facilities (MRFs) to separate and process recyclable materials. These efforts have resulted in the establishment of local recycling industries focused on the processing of materials such as plastics, paper, and metals. This includes the involvement of the informal sector with waste pickers and waste pickers collecting and selling recyclable materials, which contributes to the overall waste management system. However,

there are ongoing efforts to improve working conditions and integrate the informal sector into the formal waste management framework. However, there are also opportunities for growth and innovation, including the development of advanced recycling technologies, the creation of new markets for recycled products, and the integration of circular economy principles across various sectors.

Therefore, the adoption of technology in the business sector is consistent with Thailand's circular economy project, which recognizes the need for a more sustainable approach. The researcher has therefore adopted the circular economy concept, which focuses on minimizing waste and maximizing resource utilization. In addition, Thailand promotes various circular economy projects to transition to a closed-loop system, where materials are continuously reused or recycled, reducing dependence on natural resources and minimizing environmental impacts.

In conclusion, the recycling business in Thailand is experiencing a significant upswing as the country intensifies its efforts to improve waste management practices and transition towards a circular economy model. Driven by a combination of government initiatives, heightened public awareness campaigns, and the development of dedicated recycling infrastructure, the recycling industry in Thailand is poised for substantial growth.

Design thinking process

Brown (2008) concludes Design thinking has emerged as a popular and effective approach for problem-solving and driving innovation across various fields. At its core, design thinking is a human-centered and iterative process that emphasizes empathy, collaboration, and creativity. This literature review provides an overview of the key concepts, applications, and benefits associated with this powerful methodology. Design thinking is rooted in the mindset and practices employed by designers, which involve deeply understanding the needs, behaviors, and motivations of end-users. By adopting an empathetic mindset, design thinkers can gain valuable insights and contextualize challenges from the user's perspective, leading to more effective and user-centric solutions. The design thinking process typically involves several stages, including empathizing with users, defining the problem statement, ideating potential solutions, prototyping, and testing. This iterative cycle allows for continuous refinement and improvement, as user feedback is incorporated throughout the process. Collaboration and cross-functional teamwork are vital, as they foster diverse perspectives and enable the integration of multidisciplinary expertise. Design thinking has been successfully applied in various domains, ranging from product and service design to organizational transformation and social innovation. In the business world, companies have embraced design thinking to develop customer-centric offerings, enhance user experiences, and foster a culture of innovation. Design thinking has also been instrumental in tackling complex social and environmental challenges,

leading to innovative solutions that address the needs of underserved communities and promote sustainable practices.

Overall, design thinking offers a powerful approach to problem-solving and innovation by combining human-centered design principles, creativity, and an iterative mindset. Its emphasis on empathy, collaboration, and user-centricity has made it a valuable methodology for organizations seeking to develop impactful and user-friendly solutions across various domains.

Importance of web applications for recycling businesses

Sotnik et al. (2023) imply web applications have become essential tools for recycling businesses, offering a range of benefits that enhance efficiency, improve customer experience, and increase market reach. These digital platforms enable centralized data management, allowing businesses to better track and analyze key metrics related to waste streams, recycling rates, and operational performance. This data-driven approach leads to informed decision-making and facilitates continuous improvement in processes and services.

Moreover, web applications automate various processes, streamlining operations and reducing manual effort. This automation improves response times, increases productivity, and minimizes the risk of errors associated with manual data entry and management.

Importantly, web applications provide a user-friendly platform for customers to access information, manage their accounts, and provide valuable feedback. This enhanced customer experience fosters engagement, builds loyalty, and ensures that the recycling services meet the evolving needs and preferences of the community.

Additionally, web applications expand a recycling business's market reach by creating an online presence that attracts new customers and facilitates partnerships. By showcasing their sustainability initiatives, unique value propositions, and commitment to environmental stewardship, businesses can increase their visibility, differentiate themselves from competitors, and drive growth in their customer base.

Furthermore, web applications offer recycling businesses the ability to gather and analyze valuable data, providing insights into customer behaviors, waste patterns, and market trends. This data facilitates evidence-based decision-making, process optimization, and service improvements aligned with the evolving needs of the community.

Research objectives

Based on the information provided, here are the potential research objectives for the study on developing a recycling business platform using an innovative design thinking process to leverage the Tha Pho District communities:

1. To apply the innovative design thinking process to develop a digital recycling platform for context of Tha Pho communities, Amphur Mueang, Phitsanulok.

Material and methods

Applying design thinking principles to web application development requires a deep understanding of user needs, desires, and expectations. This research is qualitative and uses document study, observation, and in-depth interviews to gather insights and inform the design process. The following research approaches were used:

1. User interviews: Potential users from the Tha Pho community were engaged in in-depth interviews to uncover their goals, challenges, and preferences related to the recycling platform. By exploring user behaviors, motivations, and pain points, valuable insights into their needs and expectations were gained.

2. User testing: Usability testing sessions were conducted, where users interacted with prototypes or iterations of the web application. Their feedback and observations during these sessions highlighted usability issues and areas for improvement, ensuring a user-centered design approach.

3. User feedback collection: Feedback forms, and customer support channels were utilized to continuously gather user feedback. Analyzing this feedback allowed for addressing user needs and facilitating continuous improvement throughout the design and development process.

The researchers employed a qualitative research methodology to conduct a descriptive study in the Tha Pho community, Phitsanulok. Tha Pho district was selected as the study area due to its status as the largest community in the region, with an average daily waste volume of 25 tons. Additionally, each community in Phitsanulok has shops that purchase recyclable waste, and a significant amount of waste is generated daily. Moreover, the province serves as a central hub for recyclable waste from the southern region. Hence, the researchers opted to focus on studying waste management and recycling practices in Phitsanulok.

By employing these research methods and conducting a thorough study in the Tha Pho community, the researchers aimed to gather comprehensive insights and apply design thinking principles effectively in developing a user-centric web application for the recycling platform.

Data Collection

To develop an effective recycling platform for the Tha Pho community, the researcher conducted meticulous data collection, including conducting documentary research to find theoretical concepts to apply and observing participants' behaviors. The participants were then selected based on their direct participation in recycling activities in in-depth interviews to

ensure that the collected data were relevant and useful. The group consisted of four entrepreneurs running a recycling business, two employees from a recycling shop, and ten customers who regularly sell recycled products. This selection was crucial to align the data collection with the research objectives and capture diverse experiences and perspectives. The data collection phase employed two primary research methods: interviews and observations.

- Interviews: Semi-structured interviews were conducted with the selected participants. This format provided a balance between structured questioning and the flexibility to explore new topics as they emerged. The interviews aimed to gather in-depth insights into participants' perspectives on recycling practices, the challenges they faced, and areas where improvements could be made. Interviews were recorded with participant consent to ensure accuracy in data capture.

- Observations: On-site observations were performed at various recycling facilities, stores, and collection points within Tha Pho. These observations allowed researchers to witness firsthand the recycling processes, stakeholder interactions, and operational challenges encountered daily. This method complemented the interview data by providing practical, real-world context.

By integrating interviews with observations, researchers aimed to capture both subjective experiences and objective realities of recycling within the community. This comprehensive approach ensured a robust understanding of the current recycling landscape, which was crucial for applying design thinking principles effectively in developing a user-centric recycling platform.

Research Tools and Analysis

The researchers chose semi-structured in-depth interviews as the primary method for data collection, following best practices established in previous research. This approach fostered an engaging environment where participants could freely discuss their experiences and challenges. Observations further enriched the data by providing insights into participants' behaviors, attitudes, and needs.

Interview questions were meticulously crafted to align with research objectives, ensuring that they were clear and relevant. Researchers probed deeper into participants' responses to uncover underlying reasons and provide a thorough exploration of the subject matter. This method enabled rich data collection and a deeper understanding of the issues faced.

Through analysis of the data collected via open-ended questionnaires, several key challenges were identified in the context of web applications for waste trading. These challenges included:

- The need for a scheduling system to manage queues for selling recyclables.

- The introduction of a points accumulation feature to encourage user engagement.
- Providing information on locations and timings for waste purchases.
- Implementing unique QR codes for user accounts.
- Allowing direct scheduling of recyclables exchange from the homepage.
- Creating an account page to display the user's transaction balance.

These insights guided the development of the NU Zero Waste Application, addressing the identified needs and improving the overall user experience.

The collected data was analyzed to define user requirements and establish the system's scope. The user groups were categorized into four main roles: System Administrators, Users, Volunteers, and Waste Trading Entrepreneurs. This categorization helped in tailoring the platform's features to meet the specific needs of each group.

Prototype Development: NU Zero Waste Application

The conceptual framework for the NU Zero Waste Application was designed to facilitate waste trading by promoting sustainable practices through the reuse and recycling of waste materials. The framework outlined key operational procedures:

- System Administration: System administrators are responsible for managing the platform's data, including adding new waste item categories, managing user accounts, and assigning permissions.

- User Registration and Features: Users must register and log in to access the platform. Registered users can manage their personal information, take care of their junk and inventory, track transaction status, and check their sales history.

- Notification system: This platform has a notification system to enhance communication efficiency. Notifications will be sent to the administrator's LINE official account to update the system and approve the seller's LINE account when the buyer expresses interest or completes the purchase, and to facilitate coordination for receiving the goods. You can also follow the status and various press releases on the Facebook page NU Zero Waste Club.

The comprehensive approach outlined in the NU Zero Waste Application's conceptual framework provides a detailed overview of the system's operational procedures. It ensures efficient system administration, user management, and effective communication through integrated notification channels. This framework is designed to support sustainable waste trading practices and enhance the user experience within the Tha Pho community.

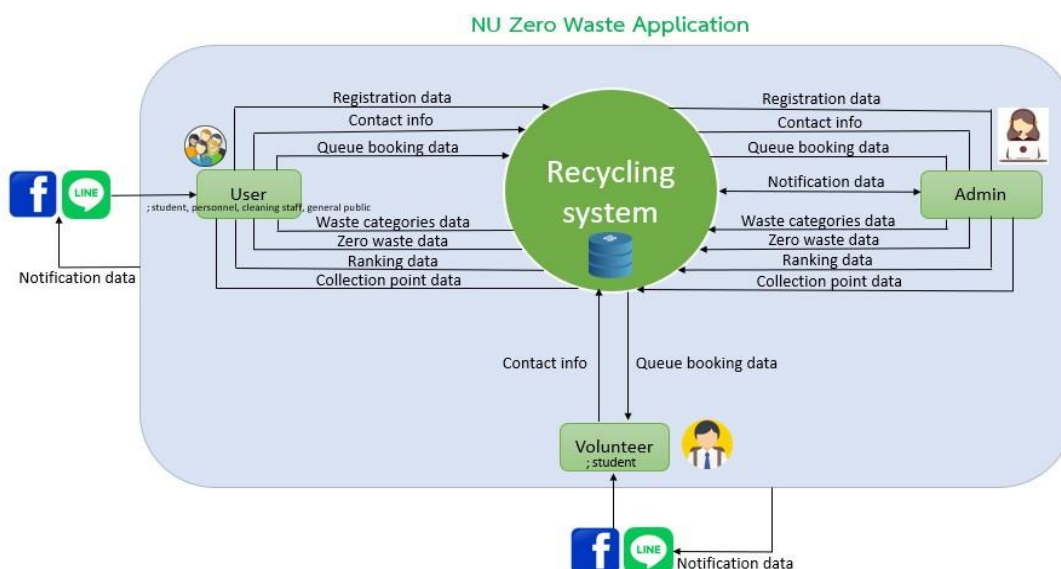


Figure 1 Prototype of NU Zero Waste Application



Figure2 Facebook page



Figure 3 Line Official

Results

The researchers have effectively created a web application system using HTML and PHP programming languages, while MySQL is utilized for database administration. To handle notifications, the Line API has been seamlessly integrated into the application. The system includes a user-friendly operational interface for enhanced usability.

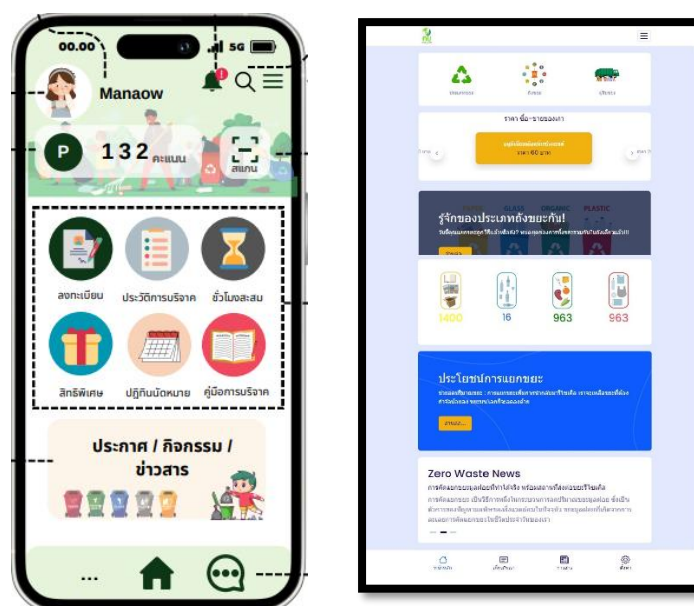


Figure 4 Compare before and after of Web application

Using design thinking theory to create a recycling web application can result in many advantages. This finding is consistent with the findings of Johnson and Thompson & Henderson (2022), namely:

User focus: Design thinking focuses on understanding the needs and experiences of users. This approach ensures that the recycling web application is easy to use, attractive, and effectively meets the needs of users. The results confirm previous results that design thinking problem-solving provides a framework for identifying, understanding, and solving problems, which helps to overcome challenges such as increasing user engagement, optimizing the recycling process, and improving communication and knowledge sharing between users and various stakeholders (Redante et al., 2019; Pusca & Northwood, 2018).

Innovation: By promoting ideas and questioning assumptions, design thinking can promote creative features and solutions that distinguish recycling web applications in the market and provide different value to users (Carlgren, Rauth & Elmquist, 2016). As Smith et al. (2023) confirmed, a commitment to sustainability is essential. Therefore, design thinking can help develop solutions that not only meet the needs of users, but also But it also makes a positive contribution to the environment. The focus on recycling allows the web application to promote sustainable practices and significantly influence waste management initiatives.

Discussion

The study conducted in the Tha Pho sub-district of Phitsanulok Province underscored the utilization of a web application to streamline recycling business services. Through integration with popular messaging platforms, the application endeavored to enhance communication and notification processes for system administrators, sellers, and buyers within the community. This strategy prioritized efficiency, time savings, and an enhanced user experience.

The application of design thinking to education or web application design provided several advantages. It empowered researchers to approach problems analytically, gaining a deeper comprehension of underlying issues. Design thinking facilitated comprehensive knowledge acquisition, uncovering latent problems that may have been initially overlooked. By pinpointing core issues, researchers were able to formulate systematic solutions. This methodology encouraged a thorough examination of potential solutions from various perspectives, fostering effective problem-solving. The iterative nature of design thinking ensured a thorough exploration of all possibilities, thereby increasing the likelihood of successful outcomes.

Recommendations

For the waste trading web application serving the Tha Pho community, it is advisable to integrate notification features via popular messaging platforms such as Line and Facebook. This integration will afford users convenient and swift access to information and updates regarding waste trading within the community. Additionally, it is imperative to rectify any

operational glitches in the system and ensure its seamless functionality before deploying it for practical use.

Further research would focus on the system's development and refinement. Specifically, enabling users to log in using their existing accounts from other communities is recommended. This enhancement will facilitate seamless participation and promote broader adoption of the waste trading system. Furthermore, exploring opportunities to digitize and integrate other service systems within the Tha Pho community will aid in establishing a comprehensive digital platform that caters to various community needs and augments overall efficiency.

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