Driving Sustainability: Establishing the First Drive-Thru Recycling Center in Malaysia Higher Education Institution - A Case Study from Universiti Utara Malaysia

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Abstract. In response to escalating environmental challenges and the imperative for sustainable waste management, Universiti Utara Malaysia has pioneered the establishment of Malaysia's first Drive-Thru Recycling Centre (DTRCUUM) within a higher education institution. This innovative initiative integrates green engineering principles with user-centric design, promoting convenient recycling practices among campus residents and the local community. Until August 2025, DTRC-UUM has successfully diverted around 102.1 tonnes of recyclable materials from landfills, conserving natural resources and contributing RM65,125 to the local community. This paper presents the conceptual framework, implementation strategy, and measurable impacts of DTRC-UUM, positioning it as a replicable model for sustainable development in academic institutions.

Keywords: waste management, sustainability, recycling, green engineering, higher education

INTRODUCTION

Higher Education Institutions (HEIs) play a pivotal role as catalysts for societal transformation. Not only through their traditional functions of teaching, learning, and research, but also through their ability to model sustainable practices and institutional leadership in environmental stewardship. Universities are microcosms of society; the habits, systems, and innovations cultivated within their campuses often mirror and influence broader community behaviors. In Malaysia, the rapid pace of urbanization, population growth, and industrial development has resulted in a significant increase in solid waste generation. This situation poses an ongoing challenge to environmental management, particularly within university settings where thousands of students, staff, and visitors interact daily, generating substantial amounts of recyclable and non-recyclable waste.

While numerous recycling campaigns, educational outreach programs, and sustainability policies have been implemented across Malaysian universities, the effectiveness of these initiatives has often been hindered by issues such as limited accessibility, lack of incentive structures, inconsistent participation, and inadequate digital integration. In many cases, recycling is still perceived as a voluntary or secondary activity rather than a convenient and rewarding habit embedded in campus culture. Thus, there is a critical need for innovative waste management solutions that are not only environmentally effective but also user-friendly, technologically integrated, and behaviorally motivating.

Recognizing this challenge, Universiti Utara Malaysia (UUM) took a pioneering step by establishing the first Drive-Thru Recycling Centre (DTRC) in Malaysia's higher education landscape which launched in October 2024 (Tan, 2024; Bernama, 2024; CeTMA, 2024; UUMTODAY, 2024). Conceptualized as a convergence of green engineering, behavioral design, and digital innovation, the DTRC aims to simplify recycling practices by offering a quick, accessible, and rewarding process that fits seamlessly into the daily routines of students, staff, and local residents. Unlike conventional collection systems that require manual sorting or centralized drop-off points, the DTRC adopts a drive-thru model where users can conveniently deposit recyclable materials without leaving their vehicles.

The initiative is also supported by the IdamanXchange mobile application, developed in collaboration with EIdaman Sdn. Bhd., which allows users to track their recycling contributions and redeem reward points through digital payment platforms. This integration of technology not only enhances participation but also promotes a culture of accountability and measurable impact.

By combining behavioral incentives, community collaboration, and real-time digital tracking, the DTRC exemplifies a forward-looking approach to sustainability in higher education. This paper discusses the conceptual foundation, implementation strategy, outcomes, and broader implications of the DTRC initiative. It also situates the project within the context of emerging trends in digital sustainability and behavioral innovation, demonstrating how HEIs can evolve beyond policy adopters to become active agents of environmental transformation at both local and national levels.



(a) (b)

FIGURE 1- (a) UUM Drive-Thru Recycling Centre and (b) DTRC-UUM Launching

A BRIEF REVIEW

Past sustainability initiatives across Malaysian HEIs have explored a variety of waste reduction and recycling strategies, reflecting a growing institutional commitment to environmental stewardship. However, despite the diversity of approaches, many of these initiatives lacked systematic integration of user convenience, digital engagement, and behavioral incentives, resulting in limited long-term participation and inconsistent outcomes.

For instance, Universiti Putra Malaysia (UPM) implemented a *Waste Bank Programme* that allowed students and staff to exchange recyclable materials for monetary incentives. The initiative successfully collected over 14,817 kilograms of waste and fostered basic awareness of recycling behavior among campus users (Mohd Alias *et al*., 2019). Similarly, the University of Malaya's (UM) *Zero Waste Campaign (ZWC)* focused on waste diversion through composting, anaerobic digestion, and systematic waste segregation, achieving an impressive milestone of over 1.1 million kilograms of waste diverted from landfills (Universiti Malaya, 2024). These programs highlight the potential for university-driven environmental innovation; however, they also reveal gaps in continuity, scalability, and the use of digital mechanisms to sustain user engagement.

Empirical research underscores these limitations. A study by Na'im *et al.* (2022) reported that recycling rates in Malaysian HEIs ranged widely between 0.03% and 29.26%, illustrating disparities in implementation success and low consistency in behavioral participation. For example, Universiti Kebangsaan Malaysia (UKM) introduced a single-use plastic reduction policy to curb environmental waste on campus. Yet, despite strong policy support, the initiative encountered difficulties due to limited infrastructure, insufficient monitoring, and inconsistent behavioral compliance among students and vendors. These challenges suggest that traditional top-down or policydriven approaches alone are insufficient to foster lasting behavioral change without complementary systems that make recycling both easy and rewarding.

A recurring limitation across these prior models lies in their lack of integration between convenience, technology, and behavioral design. Many relied heavily on manual collection, voluntary participation, and passive awareness campaigns, which often failed to overcome psychological and logistical barriers to sustained

participation. Recognizing this gap, the DTRC established by UUM introduces a novel, user-centric approach that combines green infrastructure with digital reward systems and behavioral nudges. By allowing users to drop off recyclables without leaving their vehicles and by linking participation to tangible digital incentives via the IdamanXchange application, the DTRC eliminates key barriers to engagement. Furthermore, it promotes longterm habit formation through real-time feedback, gamification, and a sense of shared community responsibility.

In essence, the DTRC at UUM represents an evolution of prior university-based recycling models which is one that bridges physical infrastructure with behavioral science and digital technology. This integrated approach not only enhances operational efficiency and user experience but also provides a replicable framework for other HEIs seeking to strengthen sustainability practices in alignment with national environmental and digital transformation agendas.

CONCEPTUAL FRAMEWORK

The DTRC was built upon three main pillars: accessibility, engagement, and impact.

- Accessibility: The drive-thru model was chosen to minimize effort and time, allowing users to participate in recycling without leaving their vehicles.
- Engagement: The initiative partnered with E-Idaman Sdn. Bhd. to integrate the IdamanXchange mobile application, enabling users to earn points redeemable via Boost or Touch ‘n Go e-wallets.
- Impact: Environmental impact data, including resources saved and carbon footprint reductions, are communicated to users to foster a sense of contribution and accomplishment.

This model supports a paradigm shift from passive awareness to active and measurable participation in environmental sustainability.

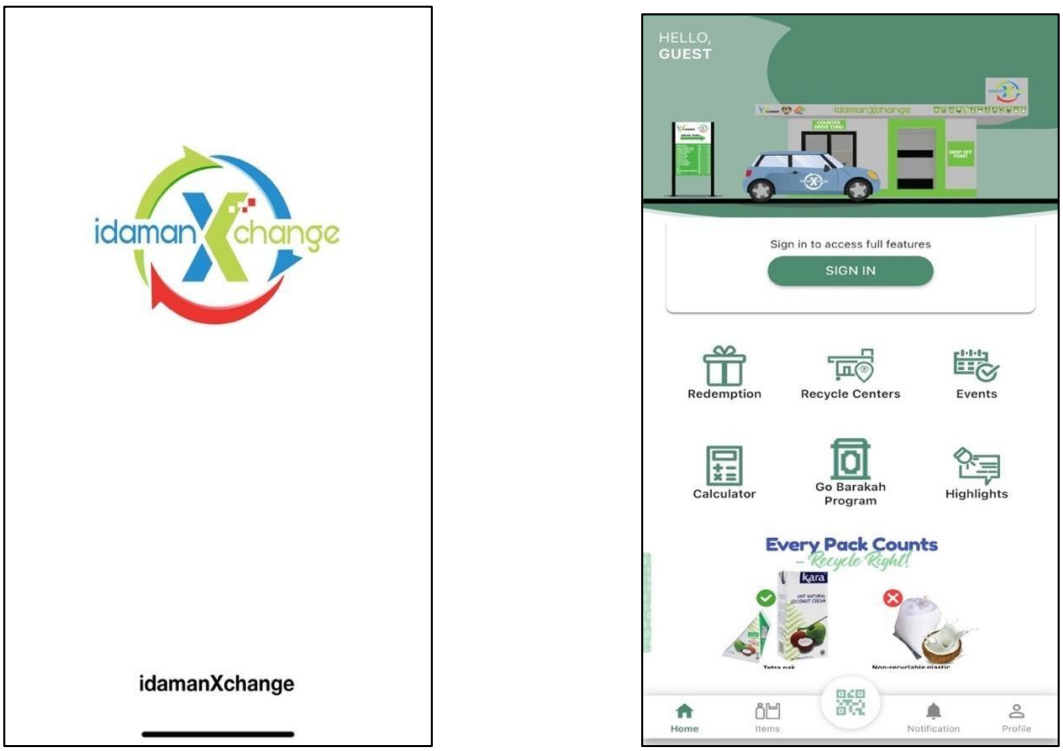


FIGURE 2-IdamanXchange Apps

IMPLEMENTATION STRATEGY

The implementation process involved multi-stakeholder collaboration, internal policy alignment, and community mobilization. First, strategic planning was conducted between UUM and E-Idaman. The location of the DTRC was chosen to maximize visibility and traffic flow, making it easily accessible to both the campus and surrounding communities. Second, infrastructure was established to allow users to drop off various types of recyclables, including plastics, paper, glass, e-waste, and organics.

Although there are no specific lanes designated for each waste type, staff members manually identify and record the categories of waste upon collection and input the data into the system, which is linked to the IdamanXchange application for tracking and reward purposes. Third, digital and physical promotional campaigns were launched to raise awareness and encourage participation. These included student competitions, recycling challenges, and faculty-level engagements.

Notable events such as UUM Press's "Waste Heroes" campaign (UUM Press, 2024), Car Boot Sale @ UUM**,** Changloon Transformation Project (CTP) activities, and hostel-based collection drives played a significant role in fostering a recycling culture on campus. These initiatives successfully increased visibility and participation across various segments of the UUM community. Finally, monthly reports and real-time app tracking provided continuous feedback, strengthening behavioral loops and building a culture of sustainability.

OUTCOMES IMPACTS AND COMPARATIVE INSIGHTS

Since its establishment in 2022, the DTRC at UUM has demonstrated measurable success and profound social impact in transforming recycling behavior within the campus and surrounding communities. Over the period up to August 2025, the DTRC collected an impressive 102.1 tonnes of recyclable materials, including plastics, paper, glass, and e-waste. Through the digital reward mechanism integrated with the IdamanXchange application, participants collectively earned RM65,125 in incentives. Beyond the economic rewards, the environmental benefits were equally significant — the initiative was estimated to have conserved 613 trees, 5,717 gallons of oil, 54.1 million gallons of water, and 60,127 kWh of electricity. These figures clearly demonstrate that sustainable innovation, when coupled with convenience and behavioral motivation, can lead to tangible, large-scale outcomes.

More importantly, the DTRC has achieved a behavioral and cultural shift in how the UUM community perceives recycling. Students and staff began incorporating recycling into their daily routines, often scheduling regular trips to the center as part of campus life. Recycling activities also became integrated into community events and student-led initiatives, reinforcing a culture of environmental responsibility that extended beyond the DTRC's physical boundaries. This behavioral change is perhaps the most meaningful outcome of al. It is also reflecting the project's success not only in waste reduction but also in instilling sustainability as a shared value within the institution.

In comparison with sustainability initiatives at other Malaysian universities, the DTRC distinguishes itself through its innovative operational model. Programs such as University of Malaya's Zero Waste Campaign (ZWC) and Universiti Putra Malaysia's Waste Bank Programme have achieved notable waste diversion outcomes, yet they primarily rely on stationary collection points and traditional participation methods. In contrast, UUM's DTRC introduces a drive-thru concept that prioritizes accessibility and convenience, removing the physical and psychological barriers often associated with recycling participation. The integration of real-time digital rewards via the IdamanXchange app further enhances user engagement, especially among tech-savvy youth who are motivated by instant feedback and visible environmental metrics.

This combination of green engineering, digital innovation, and behavioral science positions DTRC-UUM as a replicable model for higher education institutions seeking to embed sustainability into everyday practices. The initiative not only addresses the logistical aspects of waste management but also transforms recycling into an interactive and rewarding experience. By bridging physical infrastructure with technological engagement, UUM has set a new benchmark in campus-based environmental innovation that is both scalable and adaptable to other institutional or municipal contexts. Ultimately, the outcomes and impacts of the DTRC reaffirm that when environmental initiatives are designed around human behavior, technology, and community collaboration, sustainability becomes not just a policy goal but a lived culture.

CHALLENGES AND LESSON LEARNED

Several challenges emerged during the implementation phase of the DTRC initiative. One of the earliest obstacles was initial skepticism and low awareness among potential users. Many members of the university community were unfamiliar with the drive-thru recycling concept and hesitant to change existing disposal habits. To overcome this, the project team conducted extensive awareness campaigns through posters, social media announcements, and on-ground engagements to promote understanding and participation. Continuous and visible promotion proved essential in encouraging the campus community to utilize the facility consistently.

In addition, technical challenges arose during the integration of the DTRC system with the IdamanXchange mobile application. Issues such as data synchronization delays and user registration errors required troubleshooting and several rounds of system upgrades to ensure accurate tracking of recyclables and reward points. These experiences highlighted the importance of close collaboration between technical teams and operational staff to maintain seamless functionality.

From these challenges, several valuable lessons were learned. First, visibility matters which the physical placement of the DTRC and the use of clear, attractive signage significantly influenced public adoption and participation rates. Second, the gamification works. Participants were more motivated when they could see the tangible outcomes of their recycling efforts, such as reward points and environmental impact statistics displayed through the app. Finally, inclusivity sustains momentum. This momentum comes from the active involvement of students, staff, vendors, and nearby residents fostered a shared sense of ownership and collective responsibility, ensuring that the initiative was embraced as a community-wide sustainability effort rather than a top-down directive.

CONCLUSION AND RECOMMENDATION

The DTRC at UUM stands as a pioneering example of how behavioral design, digital innovation, and community collaboration can converge to create a transformative model for sustainability within higher education. As the first initiative of its kind in Malaysia, the DTRC demonstrates how environmental responsibility can be seamlessly embedded into the everyday practices of students, staff, and surrounding communities. Its success highlights the value of integrating convenience, motivation, and technology to inspire positive behavioral change in waste management and resource conservation.

Beyond its environmental achievements, the DTRC represents a scalable model of sustainable innovation that is adaptable to various institutional and urban contexts. To maximize its long-term impact, this model should be:

- Replicated across other public and private higher education institutions, with contextual customization based on local needs, infrastructure, and community engagement levels.
- Linked to academic programs, co-curricular credits, and sustainability education modules, ensuring that students not only participate in recycling but also understand its relevance to global sustainability goals and responsible citizenship.
- Integrated into national sustainability agendas and SDG reporting frameworks, strengthening Malaysia's commitment to green transformation and aligning institutional efforts with international sustainability benchmarks.

Ultimately, initiatives such as the DTRC illustrate the transformative power of technology-enabled sustainability, where smart infrastructure, behavioral science, and community partnerships intersect to drive meaningful and lasting change. By bridging environmental awareness with digital empowerment and civic responsibility, UUM's DTRC sets a precedent for universities to evolve as living laboratories of sustainability — influencing not only campus operations but also broader societal attitudes toward environmental stewardship, innovation, and sustainable living.

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