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Prioritizing Community Transformation Initiatives using Multi-Criteria Decision Analysis: A Framework for Changloon Transformation Project

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ABSTRACTS

Introduction : The Changloon Transformation Project (CTP) aims to transform a rural Malaysian town into a knowledge society over ten years through a multi-pillar approach focusing on waste, tourism, knowledge, and social transformation. With limited resources and diverse stakeholders, prioritizing initiatives is a key challenge. **Method :** This paper presents a Multi-Criteria Decision Analysis (MCDA) framework tailored to rank initiatives under the CTP. Criteria include alignment with Sustainable Development Goals (SDGs), feasibility, impact, community involvement, scalability, and risk. **Result :** A hypothetical decision matrix and sensitivity analysis demonstrate the framework's practical application. **Conclusion :** Results provide actionable insights for decision-makers and highlight the framework's potential for broader application in resource-constrained settings.

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1. INTRODUCTION

Community transformation projects often face the challenge of balancing limited resources with diverse, high-impact goals. The Changloon Transformation Project (CTP), initiated by Universiti Utara Malaysia (UUM), seeks to address socio-economic and environmental challenges by fostering collaboration across internal and external stakeholders. Its objectives are organized around four pillars: waste transformation, tourism transformation, knowledge transformation, and social transformation. As a rural town with underprivileged demographics, Changloon requires innovative, data-driven approaches to prioritize initiatives effectively.

Universiti Utara Malaysia (UUM), celebrating its 40th year of establishment, leverages its academic expertise and community engagement to lead projects like the CTP. Beyond formal education, UUM emphasizes lifelong learning and instilling a sense of civic responsibility among students. The university aims to bridge the gap between academia and the community by engaging in practical, impactful initiatives.

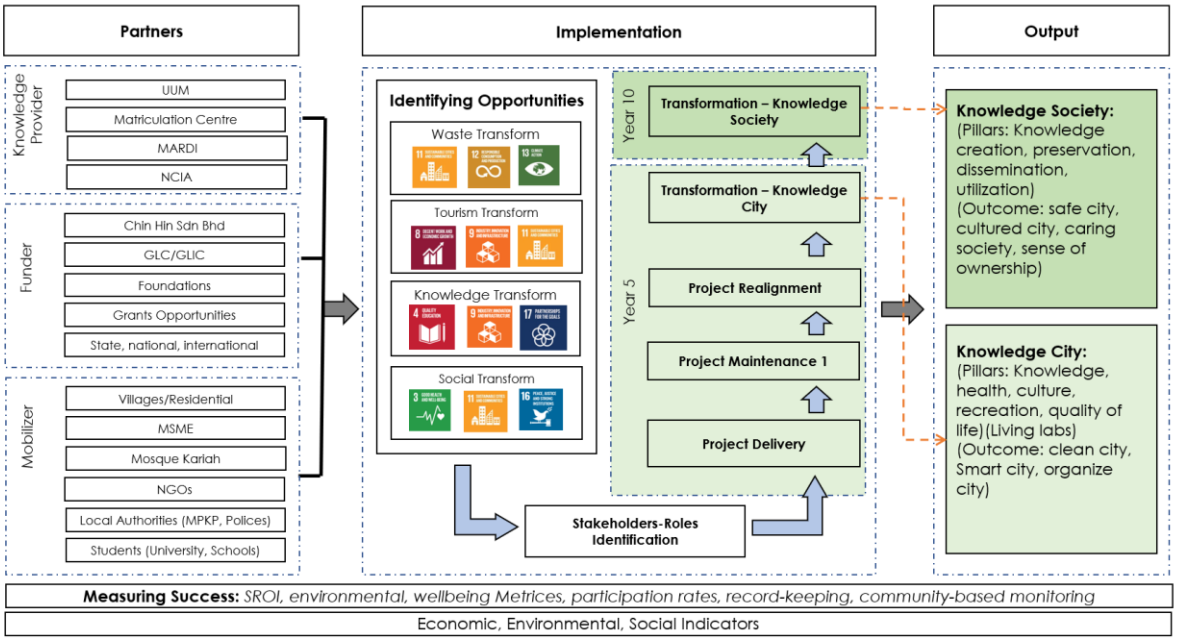

Figure 1. Initial Framework for Changloon Transformation Project: Creating Knowledge Society

The CTP framework provides a roadmap for transforming Changloon into a knowledge society within ten years. By fostering sustainability, inclusivity, and innovation, the project aligns with national development priorities and the Sustainable Development Goals (SDGs).

UUM's approach ensures that the community actively participates in shaping its future, rather than remaining passive recipients of external aid.

This study introduces a Multi-Criteria Decision Analysis (MCDA) framework designed to aid in the selection and prioritization of initiatives under the CTP. By integrating criteria such as alignment with SDGs, feasibility, and impact, the framework provides a structured approach for decision-making. A case study with hypothetical data demonstrates the utility of the framework in addressing resource constraints while ensuring high-impact outcomes.

MCDA is widely recognized as a valuable tool in decision-making for complex, multi-stakeholder projects. Techniques such as the Analytical Hierarchy Process (AHP) and Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) are frequently used to evaluate competing options based on weighted criteria. Recent studies have applied MCDA in sustainability (Deshpande et al., 2020); Goyal et al., 2020), urban planning (Oppio et al., 2022; Cardone et al., 2024), and resource management (Psomas et al., 2021; Rayhan & Bhuiyan, 2024) contexts, demonstrating its flexibility and applicability.

For example, Yuan et al. (2022) highlighted the role of MCDA in optimizing resource allocation for rural development projects, while Gomes et al. (2023) emphasized its importance in disaster management for prioritizing initiatives with limited budgets. Mehta and Kukreja (2023) demonstrated the effectiveness of MCDA in agricultural settings, integrating dynamic models to address evolving community needs. These studies underline MCDA's relevance in projects like the CTP, where decisions must balance immediate needs with long-term goals.

Research by Kourtzanidis et al. (2021) further underscores how multi-criteria approaches support stakeholder engagement in sustainability projects, emphasizing the alignment of community goals with measurable metrics. This approach highlights the adaptability of MCDA in addressing diverse stakeholder priorities.

Another study by Wu (2022) explored the application of MCDA in rural renewal, emphasizing multi-stage evaluation and the integration of diverse stakeholder needs. The study demonstrated how well-structured evaluation criteria, including dimensions such as community development, tourism, and cultural preservation, can enhance decision-making and foster balanced development. These insights are particularly relevant to the CTP, where

aligning academic contributions with community needs and sustainable development goals is essential.

Furthermore, Miranda et al. (2021) highlighted the advantages of using MCDA frameworks over traditional methods like Cost-Benefit Analysis (CBA) for evaluating public projects. Their approach integrates both qualitative and quantitative criteria, ensuring a more comprehensive evaluation of alternatives. This methodology emphasizes transparency and alignment with strategic objectives, which is directly applicable to initiatives like the financial literacy program in the CTP, where balancing socio-economic benefits with feasibility is essential. The use of sensitivity analysis, as explored by Więckowski & Sałabun (2023) and Nabavi et al. (2023), also highlights how MCDA can adapt to evolving priorities. By adjusting weights and criteria, stakeholders can dynamically evaluate and reprioritize initiatives, ensuring flexibility in decision-making.

Finally, recent advancements in computational tools for MCDA, including software like Super Decisions and Python-based libraries, have enhanced the accessibility and applicability of these methods. Integrating such tools with frameworks like the CTP can further optimize decision processes and outcomes.

2. METHODS

The methodology for this study is designed to develop and apply a Multi-Criteria Decision Analysis (MCDA) framework to prioritize initiatives under the Changloon Transformation Project (CTP). This section outlines the steps taken to identify evaluation criteria, construct the decision matrix, and perform sensitivity analysis.

2.1. Criteria Development

The selection of evaluation criteria is critical to the success of the MCDA framework. Six criteria were identified based on their relevance to the objectives of the CTP and their applicability across diverse initiatives:

1. Alignment with SDGs: *Measures the extent to which an initiative contributes to Sustainable Development Goals (SDGs), such as quality education, reduced inequalities, and sustainable cities.*
2. Feasibility: *Evaluates the availability of resources, including funding, technical expertise, and infrastructure, required for implementation.*
3. Impact: *Assesses the potential economic, environmental, and social benefits of the initiative on the community.*

4. Community Involvement: *Reflects the level of engagement and participation from local stakeholders and beneficiaries.*
5. Scalability: *Examines the potential to replicate or expand the initiative within or beyond the Changloon area.*
6. Risk: *Accounts for potential challenges or obstacles that may arise during implementation.*

These criteria were selected to ensure that decisions align with both immediate priorities and long-term sustainability goals.

2.2 Decision Matrix

The decision matrix serves as the foundation for evaluating and ranking initiatives. Each initiative was scored against the six criteria using a 10-point scale, with higher scores indicating better performance. The initiatives evaluated included:

- Waste Management in Schools: *Targeting waste reduction and recycling in educational institutions.*
- Eco-Tourism Development: *Promoting sustainable tourism practices in Changloon*.
- Educational SDG Workshops: *Enhancing knowledge and awareness of sustainable development among community members.*
- Financial Literacy Program: *Addressing socio-economic disparities through financial education and empowerment.*

The hypothetical decision matrix for these initiatives is summarized in Table 1, providing a clear comparison of scores across all criteria. The total score for each initiative was calculated as the sum of individual criterion scores.

Table 1. Hypothetical Decision Matrix for CTP Initiatives

Initiative	Alignment with SDGs (10)	Feasibility (10)	Impact (10)	Community Involvement (10)	Scalability (10)	Risk (10)	Total Score (60)
Waste Management in Schools	9	8	8	9	7	8	49
Eco-Tourism Development	7	6	9	8	9	7	46
Educational SDG Workshops	8	7	7	8	8	9	47
Financial Literacy Program	9	7	9	8	8	7	48

2.3 Sensitivity Analysis

Sensitivity analysis was conducted to evaluate the robustness of the rankings generated by the decision matrix. This involved adjusting the weights assigned to each criterion under different scenarios to assess how changes in priorities impact the rankings. Four scenarios were analyzed:

- Equal Weights: *All criteria were assigned equal importance.*
- High Impact Weight: *Greater emphasis was placed on the impact of the initiatives*.
- High Feasibility Weight: *Feasibility was prioritized, reflecting resource constraints.*
- High Risk Weight: *Risk mitigation was emphasized, focusing on minimizing potential challenges.*

This methodology ensures a systematic approach to prioritizing initiatives, balancing immediate needs with strategic goals, and providing actionable insights for the effective implementation of the CTP. The inclusion of decision matrix scores and sensitivity analysis results as visual tables provides clarity and a robust foundation for data-driven decision-making.

3. RESULTS AND DISCUSSION

3.1. Results

The sensitivity analysis revealed variations in initiative rankings under different weighting scenarios, providing a deeper understanding of how criteria priorities impact decision-making.

The results of the sensitivity analysis are summarized in Table 2, showcasing how the rankings of initiatives shift under different weighting scenarios.

Table 2. Sensitivity Analysis of CTP Initiatives

Scenario	Waste Management	Eco-Tourism	Educational SDG	Financial Literacy
Equal Weights	49	46	47	48
High Impact Weight	50	48	46	50
High Feasibility Weight	51	45	48	49
High Risk Weight	50	44	50	47

3.2. Key Observations

1. Waste Management in Schools consistently ranked high across all scenarios due to its balanced performance in feasibility, scalability, and community involvement. This

initiative demonstrates strong alignment with SDG goals related to responsible consumption and waste management.

2. Financial Literacy Program ranked prominently when community impact was emphasized, highlighting its role in addressing socio-economic challenges in Changloon's underprivileged communities.
3. Eco-Tourism Development showed a notable rise in rankings when impact was given higher weight, reflecting its long-term potential for economic growth and environmental sustainability.
4. Educational SDG Workshops performed well in scenarios emphasizing risk mitigation and community involvement, underscoring its relevance for building local capacity and fostering awareness.

3.3. Discussion

1. ***Prioritization Insights***: The rankings suggest a strong case for initiating Waste Management in Schools and Financial Literacy Programs in the early phases of the project. These initiatives require relatively low resources compared to their potential impact and scalability, making them ideal for implementation under budget constraints. Eco-Tourism Development, while impactful, requires higher upfront investments and careful planning to avoid environmental degradation. Educational SDG Workshops, on the other hand, address intangible benefits such as community awareness and capacity building, which may take longer to realize.

2. ***Addressing Trade-offs***: The analysis highlights the trade-offs between high-impact but resource-intensive initiatives (e.g., Eco-Tourism Development) and scalable, lower-cost options (e.g., Waste Management). Decision-makers must weigh these factors based on immediate needs versus long-term benefits. For example, prioritizing waste management could establish visible, early wins for the project, fostering community trust and involvement. Meanwhile, eco-tourism initiatives might align better with medium-term goals, as they require more comprehensive planning and stakeholder engagement.

3. ***Community-Centric Decision-Making***: The high scores for community involvement in Waste Management and Financial Literacy Programs underscore the importance of grassroots participation. Engaging local stakeholders in the decision-making process enhances trust and ensures that initiatives align with community needs. For instance, the Financial Literacy Program not only empowers individuals but also strengthens Changloon's

socio-economic resilience, aligning with SDG goals such as reducing inequalities and fostering economic growth. The initiative's flexibility in addressing specific community needs highlights its transformative potential.

4. ***Sensitivity Analysis Insights***: The results also illustrate the framework's adaptability. In scenarios emphasizing risk mitigation, the Educational SDG Workshops excelled, suggesting they are well-suited for environments with high uncertainty. Conversely, when impact was prioritized, Eco-Tourism Development emerged as a top choice, showing its potential to generate long-term economic benefits. This adaptability ensures that the framework can accommodate changing priorities and evolving project dynamics. Stakeholders can adjust criteria weights to reflect real-time considerations, making it a flexible tool for managing complex, multi-stakeholder initiatives.

5. ***Role of Advanced Tools***: Integrating advanced tools such as Geographic Information Systems (GIS) and temporal analysis could enhance decision-making by providing spatial and temporal dimensions to the data. For example, GIS could identify areas in Changloon where waste management programs or eco-tourism initiatives would have the most significant impact, optimizing resource allocation and implementation strategies.

6. ***Future Applications and Refinements***: While the study relied on hypothetical data, future iterations should incorporate empirical data collected through stakeholder surveys, field studies, and monitoring programs. Real-world data will validate the framework, refine the criteria, and provide more robust insights into initiative rankings. Revisiting this framework after the first year of implementation will offer valuable lessons for improving decision-making processes. Additionally, expanding the framework to include cross-sectoral initiatives could enhance its utility and applicability in other community transformation contexts.

4. CONCLUSION

The Changloon Transformation Project (CTP) represents a significant step toward transforming a rural town into a knowledge society through a structured, multi-pillar approach. This study demonstrates the effectiveness of a Multi-Criteria Decision Analysis (MCDA) framework in prioritizing initiatives, ensuring that resources are allocated to maximize impact and scalability. By integrating criteria such as alignment with SDGs, feasibility, impact, community involvement, scalability, and risk, the framework provides a balanced and transparent method for decision-making.

The results highlight the importance of prioritizing initiatives such as Waste Management in Schools and Financial Literacy Programs, which are both feasible and impactful. These initiatives not only address immediate community needs but also build momentum for broader transformation. The sensitivity analysis underscores the adaptability of the framework, allowing stakeholders to dynamically adjust priorities as project conditions evolve. This flexibility ensures that decision-making remains relevant and responsive to changing circumstances.

Future work should focus on validating the framework with empirical data and expanding its scope to include additional dimensions, such as spatial analysis through GIS and real-time monitoring. As the CTP progresses, revisiting and refining the framework will enhance its applicability, ensuring it continues to guide Changloon's journey toward sustainability, inclusivity, and resilience. This approach provides a replicable model for other community transformation efforts, bridging the gap between vision and actionable strategies.

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