

## A Framework of Economic Indicators for Transit-Oriented Development (Fei-Tod): A Case Study of Bandar Sunway, Malaysia

Nurulhuda Ali<sup>1\*</sup>, Anuar Alias<sup>2</sup>, Hasniyati Hamzah<sup>3</sup>, Ismail Muhammad<sup>4</sup>, Khairul Nizam Othman<sup>5</sup>, Norazalina Yusnita Abdul Rahman<sup>6</sup> and Siti Fairuz Che Pin<sup>7</sup>

<sup>1</sup>Sr, Department of Built Environment Studies & Technology, Universiti Teknologi MARA (Perak), Malaysia

<sup>2</sup>Professor Sr Dr, Department of Building & Property Management, Faculty of Accountancy & Management, UTAR, Malaysia

<sup>3</sup>Sr Dr, Department of Real Estate, Faculty of Built Environment, Universiti Malaya, Malaysia

<sup>4</sup>TPr, Selangor Greater Klang Valley (SGKV), Selangor, Malaysia

<sup>5</sup>Dr, Kampong Bharu Development Corporation, Malaysia

<sup>6</sup>Dr, Department of Built Environment Studies & Technology, Universiti Teknologi MARA (Perak), Malaysia

<sup>7</sup>Sr, Department of Built Environment Studies & Technology, Universiti Teknologi MARA (Perak), Malaysia

### ABSTRACT

Transit-Oriented Development (TOD) has emerged as a potential solution to urban sprawl and traffic congestion in rapidly urbanizing Malaysian cities. However, the absence of standardised economic assessment tools has hindered effective TOD implementation and evaluation. This study aims to address this gap by developing a comprehensive Framework of Economic Indicators for Transit-Oriented Development (FEI-TOD) tailored to the Malaysian context, with a specific focus on Bandar Sunway as a case study. The research employs a mixed-method approach, integrating a systematic literature review using the PRISMA method, a three-round Delphi survey with TOD experts, and structured interviews with key stakeholders in Bandar Sunway. This methodological triangulation ensures the incorporation of global best practices, expert consensus, and local insights. The study systematically identifies common elements of successful TOD projects globally, compiles and evaluates potential economic indicators, and develops a context-specific framework for Bandar Sunway. The resulting FEI-TOD comprises 45 indicators across five categories: land use, density, transit facilities, value earnings, and economic attributes. This framework contributes to both the theoretical understanding of TOD's economic impacts and the practical implementation of sustainable urban development strategies in rapidly growing Malaysian cities. The FEI-TOD serves as a decision-support tool for urban planners, policymakers, and developers, facilitating evidence-based decision-making in TOD planning and implementation. The study's findings have significant implications for urban policy and practice in Malaysia, aligning with national urban development goals and the United Nations' Sustainable Development Goals, particularly SDG 11. The adaptability of the FEI-TOD suggests potential for broader application across diverse urban contexts in Malaysia and other rapidly urbanising regions.

### \*Corresponding author

Nurulhuda Ali, Sr, Department of Built Environment Studies & Technology, Universiti Teknologi MARA (Perak), Malaysia.

**Received:** July 09, 2025; **Accepted:** July 14, 2025, **Published:** July 23, 2025

**Keywords:** Transit-Oriented Development, Economic Indicators, Urban Planning, Sustainable Development, Delphi Method

### Introduction

Urban development in Malaysia is increasingly characterised by rapid urbanisation and complex spatial challenges, particularly urban sprawl, and transportation inefficiencies [1]. As cities expand, traditional urban development models have struggled to address the growing complexities of metropolitan growth, leading to significant transportation and land use inefficiencies [2]. Transit-oriented development (TOD) has emerged as a promising strategic approach to mitigate these challenges. It offers a comprehensive urban planning framework that integrates transportation infrastructure with sustainable land use and economic development [3].

Despite the potential of TOD, Malaysian urban planning currently faces critical limitations in systematic assessment and implementation. A significant gap exists in developing standardised economic assessment tools that can effectively evaluate TOD projects. Existing approaches often lack the nuanced, context-specific economic indicators necessary for comprehensive urban development strategies. This methodological limitation impedes evidence-based decision-making and constrains the potential of TOD to address urban development challenges comprehensively.

Recognising these critical gaps, this research aims to develop a Framework of Economic Indicators for Transit-Oriented Development (FEI\_TOD) specifically tailored to the Malaysian urban context. The primary objectives of the study include: (1) developing a systematic

framework of economic indicators that can be applied to TOD projects, (2) creating a context-specific assessment tool for Bandar Sunway that integrates global best practices with local insights, and (3) providing urban planners and policymakers with robust decision-support instrument for sustainable urban development.

By addressing these objectives, the research seeks to contribute to both the theoretical understanding of TOD's economic impacts and the practical implementation of sustainable urban development strategies. The proposed framework aligns with the United Nations Sustainable Development Goal 11, which focuses on sustainable cities and communities. The study's innovative approach of methodological triangulation combining systematic literature review, expert Delphi surveys, and local stakeholder interviews, ensures a comprehensive and nuanced understanding of TOD's economic dimensions in the Malaysian urban landscape.

### Literature Review

Transit-oriented development (TOD) has emerged as a transformative urban planning paradigm that seeks to address the complex challenges of modern urban growth and sustainability [4]. The evolution of TOD reflects a global shift towards more integrated, sustainable urban development strategies that prioritise efficient transportation infrastructure, compact land use, and economic vitality [5]. Internationally successful Tod models have demonstrated the potential to reduce urban sprawl, minimise transportation-related carbon emissions, and enhance urban economic productivity [6].

The economic dimension of urban development has increasingly become a critical focus for researchers and urban planners [7]. Existing assessment approaches have traditionally struggled to capture the multifaceted economic impacts of urban infrastructure projects comprehensively [8, 9]. have highlighted the complex interplay between transportation, infrastructure, land use, and economic value creation. However, significant challenges remain in developing standardised economic indicators that can effectively evaluate the holistic impact of TOD initiatives across diverse urban contexts [10].

In the Malaysian context, urbanisation has proceeded at an unprecedented pace, presenting challenges and opportunities for sustainable urban development [11].

The nation's urban policy landscape has been characterised by rapid economic growth, increasing metropolitan density, and significant infrastructure investments [12].

Despite these advancements, TOD implementation in Malaysia continues to face substantial challenges, including fragmented planning approaches, limited integrated transportation systems, and insufficient economic assessment methodologies [13].

The complexity of TOD evaluation demands a nuanced approach that goes beyond traditional urban planning metrics. Economic indicators play a crucial role in understanding the potential value and impact of urban development projects [14, 15]. emphasised the need for comprehensive frameworks that can capture the economic, social, and environmental dimensions of urban transformation. This multidimensional perspective is particularly critical in rapidly developing contexts like Malaysia, where urban growth intersects with complex socio-economic dynamics.

Previous studies have identified several key challenges in TOD implementation, including land use inefficiencies, transportation infrastructure limitations, and the lack of standardised economic

assessment tools. The Malaysian urban development context presents a unique case study, characterised by rapid economic growth, a complex urban landscape, and the need for sustainable development strategies that can balance economic productivity with environmental and social considerations [16].

By synthesising global TOD perspectives, examining existing economic assessment approaches, and analysing the specific challenges of the Malaysian urban context, this research seeks to contribute to a more comprehensive understanding of TOD's potential as a transformative urban development strategy. The proposed framework aims to bridge existing gaps in TOD evaluation, providing a robust context-specific approach to assessing the economic dimensions of urban infrastructure projects.

### Research Methodology

The study employed a qualitative research approach to develop and verify economic indicators for transit-oriented development (TOD) assessment in Malaysia, utilising methodological triangulation to ensure robust and verified findings. This approach integrated multiple research strategies to provide a holistic understanding of TOD economic assessment, drawing from systematic literature review, expert verification, and stakeholder engagement.

A systematic literature review was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) protocol to establish a comprehensive initial framework of TOD indicators. Through this process, 77 potential economic indicators across various urban development domains were identified. The systematic review served as a critical foundation for understanding global TOD perspectives and identifying potential economic assessment parameters.

The Delphi survey method emerged as a primary qualitative research technique for developing consensus-based economic indicators. This structured approach involves a three-round expert verification process with a selected panel of TOD experts. The expert panel comprised 16 professionals from federal, state, and local government levels, with extensive experience in TOD projects.

The expert selection followed a rigorous top-down approach, focusing on professionals with significant TOD project experience. The experts were chosen based on their years of experience, involvement in TOD initiatives, and roles in policy formulation and decision-making. The experts included senior management officers from federal, state, and local government agencies, having an average of 10-20 years of experience and involvement in multiple TOD projects.

Data analysis employed both descriptive and statistical techniques. Mode analysis was used to synthesise expert ratings, identifying indicators with the strongest consensus. Additionally, principal component analysis (PCA) was conducted to validate the results and reduce the dimensionality of the indicator dataset, ensuring a statistically robust approach to indicator selection.

The stakeholder interview employed a qualitative approach to verify and contextualise the economic indicators for TOD. Key stakeholders from Sunway Group with extensive experience in TOD planning and development were purposively selected for in-depth structured interviews. The interview protocol was designed to verify the 31 economic indicators developed through the Delphi survey, focusing on their relevance, applicability, and practical significance in the Bandar Sunway context. data were collected through semi-structured interviews and analysed using thematic analysis with Nvivo 14

software. This stakeholder interview phase was critical in providing context-specific insights, verifying the economic indicators, and ensuring the framework's relevance to the Malaysian TOD landscape.

The methodology's strength lies in its comprehensive and iterative approach to developing context-specific economic indicators. By integrating systematic literature review, expert verification, and stakeholder engagement, the research developed a robust framework for assessing TOD economic vitality tailored to the Malaysian urban context. This approach addresses previous limitations in TOD assessment by providing a systematic, consensus-driven methodology for indicator development. The framework's development process, which emphasises methodological rigor and contextual relevance, is visually depicted in Figure 1.

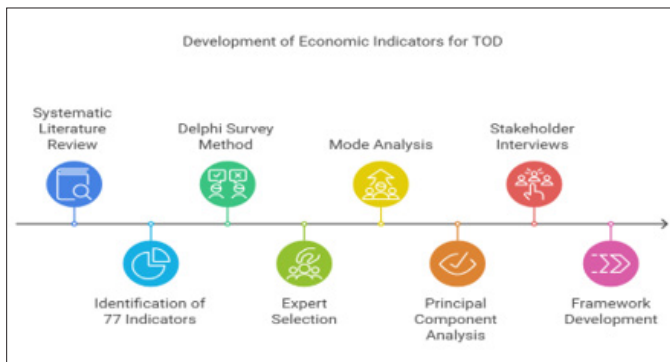


Figure 1: Framework Development Process for Economic Indicators in TOD

## Results

### Delphi Survey

The Delphi survey process provided a rigorous mechanism for developing and refining economic indicators for TOD. Initially, an extensive pool of potential indicators was compiled, drawing from the systematic literature review. Through a three-round expert verification process, the study engaged a panel of 16 TOD experts from federal, state, and local government levels. The iterative consensus-building approach systematically narrowed down the initial 77 sets of indicators. Experts evaluated and rated each indicator based on its relevance, applicability, and potential impact on TOD vitality in the Malaysian context.

In the first round, experts evaluated the initial 77 identified indicators, which were systematically categorised into potential economic

dimensions. Through iterative rounds of feedback and discussions, the indicators were progressively refined. By the first round, the list was consolidated to 48 indicators, further reduced to 34 in the second round, and ultimately finalised to 31 core economic indicators in the final round. This iterative process ensured comprehensive expert consensus and contextual relevance.

### Stakeholder Interview

The stakeholder interview was crucial in verifying the finalised 31 core economic indicators within the local context. Interviews with key professionals from Sunway Group provided nuanced insights into the practical implementation of TOD. The representatives offered critical perspectives on the contextual applicability of the finalised economic indicators, highlighting local challenges, opportunities, and specific considerations to the Bandar Sunway urban landscape.

The resulting 45 economic indicators, categorised into five main domains of land use, density, transit facilities, value earnings, and economic attribute offer urban planners, policymakers, and developers a nuanced tool for assessing TOD initiatives. The methodology ensures that the indicators not only reflect global practices but are also grounded in the specific economic and urban development in Malaysia.

### Framework Development

The research developed a comprehensive economic indicator consisting of 45 indicators categorised into five primary domains:

- Land Use:** Examining the spatial integration and functional diversity of TOD areas.
- Density:** Analysing population and development concentration around transit nodes.
- Transit Facilities:** Assessing the quality, accessibility, and connectivity of transportation infrastructure.
- Value Earnings:** Evaluating economic benefits and value generation associated with TOD.
- Economic Attributes:** Investigating broader economic characteristics and impacts of TOD projects.

This multidimensional framework provides a holistic approach to understanding and assessing TOD economic vitality, reflecting the complex interplay of urban development factors. By integrating expert verification and stakeholder insights, this research develops a comprehensive, context-specific framework for assessing the economic vitality of transit-oriented development projects. The framework is illustrated in Figure 2.

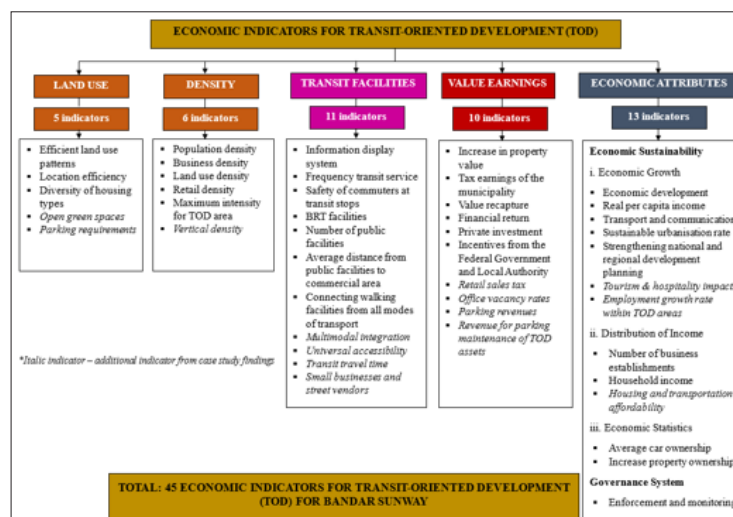


Figure 2: Economic Indicator Framework for TOD

## Discussions

### Theoretical Contributions

The research presents significant theoretical advancements in transit-oriented development (TOD) economic assessment methodologies. By integrating systematic literature review, Delphi consensus techniques, and stakeholder verification, this research pioneers an innovative approach to developing context-specific economic indicators. This aligns with prior findings on integrating participatory approaches in the urban planning framework [17].

The constructivist research philosophy underlying this framework reinforces the importance of co-creating knowledge through expert consensus and iterative validation [18].

The methodological innovation lies in the hybrid integration of qualitative and quantitative techniques, specifically using Principal Component Analysis (PCA) in conjunction with expert consensus. This addresses limitations in prior assessments, where frameworks were argued to lack contextual relevance and multidimensionality [19]. Consequently, the study advances the theoretical understanding of economic indicator development, offering a structured pathway for contextualising indicators across diverse urban environments.

### Practical Implications

The economic indicator framework developed in this study provides actionable insights for urban planners, policymakers, and developers. By organising 45 indicators across five critical domains, the research offers a nuanced approach to assessing TOD economic vitality, facilitating comprehensive planning and evaluation processes. This supports the argument that a multidimensional framework enables more informed urban planning strategies, allowing stakeholders to holistically evaluate TOD initiatives beyond traditional metrics [20].

The framework's relevance to Malaysian urban development is particularly significant. Cities struggling with rapid urbanisation can use these indicators to prioritise sustainable investments, optime transit infrastructure, and monitor socioeconomic outcomes of TOD projects [21]. Furthermore, such a framework aids in aligning local development goals with global sustainable development standards, fostering equitable and data-driven urban growth [22].

### Alignment with Sustainable Development

The research demonstrates significant alignment with global sustainable development objectives, particularly United Nations Sustainable Development Goal 11 (SDG 11), which focuses on sustainable cities and communities. By integrating performance measures with TOD principles, the framework supports objectives such as reducing urban sprawl, improving mobility, and promoting sustainable economic activities [23].

The TOD economic indicators directly contribute to sustainable urban development by emphasising integrated land use, transit connectivity, and economic efficiency. The framework promotes urban development strategies that can reduce carbon emissions, enhance mobility, and create economically vibrant communities [24]. By providing a structured approach to assessing TOD economic vitality, the research supports broader sustainable urbanisation strategies that balance economic growth with environmental and social considerations.

The multidimensional nature of the indicator framework reflects a holistic approach to urban development, recognising the complex interplay between economic, social, and environmental factors [25].

This approach aligns with contemporary urban planning theories that emphasise integrated and sustainable development models.

By bridging theoretical innovation with practical applicability and sustainable development principles, the research offers a comprehensive contribution to understanding and implementing effective TOD strategies in the Malaysian context and potentially beyond [26, 27].

## Conclusion

### Research Outcomes

This study has successfully developed and validated an economic indicator framework tailored for assessing transit-oriented development (TOD) projects. The framework was systematically validated through expert consensus and stakeholder engagement, ensuring its relevance and applicability to urban planning contexts. The key findings highlight the importance of integrating multidimensional economic indicators that capture the variance characteristics of TOD projects, including land-use efficiency, transit accessibility, and economic viability. These findings emphasise the framework's potential to inform data-driven decisions, fostering more sustainable and inclusive urban development.

The significance of the FEI-TOD lies in its capacity to bridge theoretical concepts with practical applications. By providing a structured approach to evaluating TOD initiatives, the FEI-TOD addresses gaps in existing methodologies and contributes to the broader discourse on sustainable urban development. This innovative tool equips urban planners, policymakers, and developers with actionable insights to optimise transit infrastructure and enhance economic outcomes, advancing the field of urban development research.

### Limitations and Future Research

While the research presents a robust framework, certain limitations warrant acknowledgment. The scope of the study was primarily focused on TOD projects within the Malaysian context, which may limit its generalizability to other regions with different socio-economic and urban planning dynamics. Additionally, the reliance on expert consensus for indicator validation introduces potential biases that may affect the objectivity of the framework.

Future research may explore the broader application of the FEI-TOD framework across diverse geographical and cultural settings to examine its adaptability and relevance. Comparative studies could provide valuable insights into the framework's performance in various urban environments, offering opportunities for refinement. Furthermore, longitudinal studies could assess the long-term impacts of TOD projects using the framework, ensuring its efficacy in monitoring and evaluating economic outcomes over time. Expanding the indicator set to include emerging dimensions such as digital infrastructure and green technologies could further enhance its relevance in addressing contemporary urban challenges. These recommendations underscore the need for ongoing research to advance the FEI-TOD framework, ensuring its continued contribution to the sustainable and equitable transformation of the urban landscape.

## References

1. Yasin MY, Yusoff MM, Abdullah J, Noor NM (2020) Is urban sprawl a threat to sustainable development? A review of characteristics and consequences. *Geografia* 16: 56-68.
2. Bibri SE (2020) Data-driven smart sustainable cities: A conceptual framework for urban intelligence functions and related processes, systems, and sciences. *Advances in the Leading Paradigms of Urbanism and their Amalgamation: Compact Cities, Eco-Cities, and Data-Driven Smart Cities* 143-173.
3. Liu L, Zhang M, Xu T (2020) A conceptual framework and implementation tool for land use planning for corridor transit oriented development. *Cities* 107: 102989.
4. Knowles R D, Ferbrache F, Nikitas A (2020) Transport's historical, contemporary and future role in shaping urban development: Re-evaluating transit oriented development. *Cities* 99: 102607.
5. Negi AS, Mann PK (2024) Compact urban development and sustainable development: a legal study. *Panjab University Law Review* <https://pulr.puchd.ac.in/index.php/pulr/article/view/276>.
6. Bhagwati P, Kumar M (2024) Transit-Oriented Development: Learnings from Global Examples. *LOGI-Scientific Journal on Transport and Logistics* 15: 1-12.
7. Zeng X, Yu Y, Yang S, Lv Y, Sarker MNI (2022) Urban resilience for urban sustainability: Concepts, dimensions, and perspectives. *Sustainability* 14: 2481.
8. Shi F, Shi W (2023) A critical review of smart city frameworks: new criteria to consider when building smart city framework. *ISPRS International Journal of Geo-Information* 12: 364.
9. Le H, Gurry F, Lennox J (2023) An application of land use, transport, and economy interaction model. *Research in Transportation Economics* 99: 101294.
10. Wan T, Lu W, Sun P (2023) Equity impacts of the built environment in urban rail transit station areas from a transit-oriented development perspective: a systematic review. *Environmental Research Communications* <https://iopscience.iop.org/article/10.1088/2515-7620/acf8b2/pdf>.
11. Ali J, Moser S (2024) New cities for a 'new Kuwait': planning for national continuity and stability. *International Planning Studies* 29: 252-267.
12. van Grunsven L, Benson M (2020) Urban development in Malaysia: Towards a new systems paradigm. *Utrecht University: Utrecht, The Netherlands* <https://thinkcityinstitute.org/wpcontent/uploads/2020/11/Issue-2.pdf>.
13. Ahmad T (2023) *Steering Cities Towards Sustainability: Low-carbon Transportation and Community Regeneration*. Teri Press 12.
14. Al Mujahed LKA (2024) Smart Cities and Sustainable Development Goals: A Systematic Review and Future Research Directions. *Journal of Sustainable Economy* 6: 100193.
15. Allam Z, Sharifi A, Bibri SE, Jones DS, Krogstie J (2022) The metaverse as a virtual form of smart cities: Opportunities and challenges for environmental, economic, and social sustainability in urban futures. *Smart Cities* 5: 771-801.
16. Kumar H, Singh MK, Gupta M, Madaan J (2020) Moving towards smart cities: Solutions that lead to the Smart City Transformation Framework. *Technological Forecasting and Social Change* 153: 119281.
17. Sukanya R, Tantia V (2023) Urbanization and the impact on economic development. In *New Perspectives and Possibilities in Strategic Management in the 21st Century: Between Tradition and Modernity* IGI Global 369-408.
18. Bibri SE, Krogstie J, Kärrholm M (2020) Compact city planning and development: Emerging practices and strategies for achieving the goals of sustainability. *Developments in the built environment* 4: 100021.
19. Cresswell J (2013) *Qualitative inquiry & research design: Choosing among five approaches*. Sage Publications 1-395.
20. Costa A PdA, Choren R, Pereira DAdM, Terra AV, Costa IPd A, et al. (2024) Integrating multicriteria decision making and principal component analysis: a systematic literature review. *Cogent Engineering* 11: 2374944.
21. Anjum M, Min H, Sharma G, Ahmed Z (2024) Advancing Sustainable Urban Development: Navigating Complexity with Spherical Fuzzy Decision Making. *Symmetry* 16: 670.
22. Caros NS (2023) *Preparing Urban Mobility for the Future of Work: Impacts and Adaptation* Massachusetts Institute of Technology 1-334.
23. United Nations (2015) *Sustainable Development Goals (SDGs)* <https://sdgs.un.org/goals>.
24. Zhong R, Pei F, Yang K, Xia Y, Wang H, et al. (2021) Coordinating socio-economic and environmental dimensions to evaluate regional sustainability-towards an integrative framework. *Ecological Indicators* 130: 108085.
25. De Oliveira B (2024) The philosophical foundations of participatory action research: pragmatism, critical theory, constructivism, feminist epistemology and participatory democracy. *Qualitative Research Journal* <https://www.emerald.com/insight/content/doi/10.1108/qj-07-2024-0151/full/html>.
26. Puchol Salort P, O'Keeffe J, van Reeuwijk M, Mijic A (2021) An urban planning sustainability framework: Systems approach to blue green urban design. *Sustainable Cities and Society* 66: 102677.
27. Abdi MH, Lamíquiz Daudén PJ (2022) Transit-oriented development in developing countries: A qualitative meta-synthesis of its policy, planning and implementation challenges. *International journal of sustainable transportation* 16: 195-221.

**Copyright:** ©2025 Nurulhuda Ali, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.