



PLANNING MALAYSIA:

Journal of the Malaysian Institute of Planners

VOLUME 24 ISSUE 4 (2026), Page 386 – 405

A MULTI-CRITERIA QUALITY ASSESSMENT FRAMEWORK FOR AFFORDABLE HOUSING PROJECTS IN KUALA LUMPUR AT DESIGN STAGE USING THE INTEGRATED VALUE MODEL FOR SUSTAINABLE ASSESSMENT (MIVES)

**Ahmad Nashriq Abdul Mutalib¹, Ainoriza Mohd Aini^{1*}
and Zafirah Al Sadat Zyed¹**

*¹Department of Real Estate, Faculty of Built Environment,
UNIVERSITI MALAYA, 50603 KUALA LUMPUR, MALAYSIA*

Abstract

Affordable housing is a policy focus area in Malaysia, with the 13th Malaysia Plan aiming to develop one million affordable housing by 2035. This paper creates a Multi-Criteria Quality Assessment Framework of Affordable Housing Projects in Kuala Lumpur during the Design Phase based on the Integrated Value Model of Sustainable Assessment (MIVES). Development of the framework was based on three steps, with a desktop analysis of twelve Malaysian housing related policies generating 43 policy provisions, which were screened to 25 candidate criteria and reduced to a final 24 through a Modified Delphi Method involving 35 experts. The importance weights were obtained through surveying 450 prospective house buyers. MIVES was chosen because its value functions are defined by the policies and guidelines that set the quality standards for affordable housing, allowing projects to be assessed against these established benchmarks. A Reference Project allows each project to be both classified against a policy-defined benchmark and ranked relative to the others. The most weighted criteria are the area safety level (4.82%), house price (4.79%), and waste management (4.59%). Application of frameworks to five actual Kuala Lumpur projects created consistent rankings, two of the projects being Above Benchmark.

Keywords: Affordable Housing; Multi-Criteria Decision Analysis; MIVES; Housing Quality Assessment; Rank Reversal; Kuala Lumpur

¹ Corresponding author. Email: ainoriza@um.edu.my

INTRODUCTION

Housing is widely recognised as a fundamental human right, yet its increasing commodification has progressively undermined access to adequate shelter for millions globally (Mehdipanah et al., 2023; Farha et al., 2022). The global housing affordability crisis has intensified over recent decades, as housing-related expenditures continue to outpace income and wage growth across both developed and developing economies (Wetzstein, 2017; Lee et al., 2022). Globally, approximately 1.6 billion people lack access to adequate housing, with this figure projected to rise to 3 billion by 2030 (UN-Habitat, 2022). In Malaysia, the house price-to-income ratio was recorded at 4.3 in 2022, classified as seriously unaffordable under internationally accepted benchmarks (Bank Negara Malaysia, 2021; Department of Statistics Malaysia, 2022). Average house prices in Kuala Lumpur reached RM780,728 in 2024 (National Property Information Centre, 2024). The 13th Malaysia Plan (RMK13, 2026-2035) formalised a national commitment to build one million affordable homes over ten years (Economic Planning Unit, 2025), making housing quality a central policy priority.

While supply has received policy attention, the quality of what is being built has received comparatively less scrutiny. Affordable housing quality is multi-dimensional, encompassing physical adequacy, safety, access to services, facility provision, and financial sustainability (Wimalasena et al., 2022; Howden-Chapman et al., 2023). Multi-Criteria Decision Analysis (MCDA) is well-suited for structuring such evaluations (Mecca et al., 2023). However, significant gaps persist: most MCDA housing studies derive criteria from academic literature without anchoring them to the regulatory context (Passos Neto et al., 2023); derive weights from housing professionals rather than house buyers (Mulliner et al., 2012); and do not address the rank reversal problem, where rankings change when the evaluation set changes (Belton & Gear, 1983; Triantaphyllou, 2001). This study addresses these gaps by developing a MIVES-based quality assessment framework for affordable housing in Kuala Lumpur at the design stage.

LITERATURE REVIEW

Housing Quality as a Multi-Dimensional Concept

Housing quality encompasses spatial adequacy, safety, environmental quality, access to services, facility provision, and financial sustainability (Wimalasena et al., 2022; Howden-Chapman et al., 2023). Mismatches between affordable housing supply and demand in Malaysia have been linked to product and locational attributes such as unit size, configuration, density, and accessibility (Saleh et al., 2024), underscoring the need to assess these quality dimensions at the design stage. In Malaysia's predominantly Muslim urban context, criteria such

as proximity to mosques and Islamic mortuary facilities are central to residents' quality experience, underscoring the necessity of context-specific framework development (Brkanić et al., 2023). Most housing quality research adopts a post-occupancy perspective, whereas design-stage assessment supports approval decisions before construction begins.

MCDA in Housing Assessment and the Rank Reversal Problem

MCDA is widely applied in the built environment, with Analytic Hierarchy Process (AHP) (46%), TOPSIS (20%), MIVES (11%), and Complex Proportional Assessment (COPRAS) (9%) the most frequently used methods (Mecca et al., 2023; Villalba et al., 2024). Mulliner et al. (2012) derived criterion weights from interviews and a questionnaire survey of housing and planning professionals across the UK, establishing professional perception as the basis for criterion weighting in housing MCDM. Simpeh et al. (2024) found that community safety, waste management, and education access were most highly prioritised by affordable housing residents. In Greater Kuala Lumpur specifically, Badrudin et al. (2022) found that young households prioritise affordability and proximity to employment in their housing choices, reinforcing the value of grounding criterion weights in buyer priorities. The rank reversal problem, documented by Belton and Gear (1983) and confirmed across TOPSIS and COPRAS (Wang & Luo, 2009; García-Cascales & Lamata, 2012; de Farias Aires & Ferreira, 2019; Shyur & Shih, 2024), is particularly problematic in rolling regulatory contexts where project batches change continuously.

MIVES as a Policy-Aligned MCDA Method

MIVES (Modelo Integrado de Valor para una Evaluación Sostenible) is a value-based MCDA method in which the raw performance of each criterion is converted to a common 0-to-1 value scale through criterion-specific value functions anchored to externally specified reference points (Alarcon et al., 2011; Pons et al., 2016; Biswal et al., 2022). Because these reference points can be set directly from regulatory or policy standards, MIVES lends itself to policy-aligned assessment. In the built environment it has been applied to infrastructure, school buildings, and residential developments to benchmark projects against defined sustainability and quality standards (Cots et al., 2022; Maleki et al., 2024; Tan et al., 2024).

METHODS

Stage 1: Criteria Derivation

A systematic desktop analysis of twelve Malaysian housing policies and planning guidelines including NAHP, PPAM, Residensi Wilayah, PPR, DBKL,

PLANMalaysia, the KL Low Carbon Building Code (LCBC) 2023, and the DOSM Crime Statistics Malaysia 2024 identified 43 candidate quality provisions. Each provision was screened against three inclusion conditions, all of which had to be met for it to be retained: it had to be (i) measurable at the design stage, (ii) relevant to high-rise affordable housing in Kuala Lumpur, and (iii) quantifiable or expressible on an ordinal scale. Provisions failing any condition, such as those assessable only after occupancy, were excluded. This screening reduced the 43 provisions to 25 candidate criteria, which were carried forward to expert validation.

Stage 2: Expert Validation via Modified Delphi

Two rounds of the Modified Delphi Method were conducted with a purposively selected panel of professionals directly involved in the planning, approval, or delivery of affordable housing in Kuala Lumpur, comprising government officers and private-sector developers. Panellists were required to hold at least a bachelor's degree and a minimum of ten years of relevant experience. Of 60 experts invited by email, 35 completed Round 1 and 30 completed Round 2; the Round 1 panel comprised 20 policymakers from agencies including DBKL, JWP, and KPKT and 15 affordable housing developers. For each criterion, responses were analysed using the Interquartile Range (IQR) as the primary measure of consensus, which is appropriate for ordinal Likert-scale data. An item was retained when the IQR was 1.0 or less and at least 60% of respondents rated it at levels 4 or 5, indicating both consistency and positive agreement on relevance. An item was eliminated when the IQR was 1.0 or less but at least 60% of respondents rated it at levels 1 or 2, indicating consistent rejection. Items with IQR exceeding 1.0 were carried forward to the subsequent round regardless of agreement percentage. The process was concluded when all items reached either consensus acceptance or consensus rejection, a condition met at the end of Round 2. In Round 1, the 25 candidate criteria were evaluated, of which 23 achieved consensus for inclusion and two were eliminated on consensus of irrelevance: Distance to Public Health Institution and Land Tenure and Classification. Experts also proposed two additional criteria during Round 1, Maintenance Fees and Level of Furnishing, which were carried into Round 2. In Round 2, Maintenance Fees achieved consensus and was added to the framework, while Level of Furnishing was eliminated on consensus of irrelevance. The process therefore reduced the initial 25 candidates by two eliminations and added one new criterion, yielding a final set of 24 validated quality criteria.

Stage 3: Buyer Survey for Criterion Weighting

A structured questionnaire survey using a five-point Likert scale (1 = Not Important; 5 = Most Important) was administered to 450 potential house buyers in Kuala Lumpur from May to August 2025. All respondents were Malaysian citizens based or working in KL expressing interest in purchasing affordable housing. The sample of 450 exceeds the Krejcie and Morgan (1970) minimum of 384. All 24 criteria achieved complete responses (n = 450). The Kolmogorov-Smirnov test confirmed non-normal distribution for all criteria (p < 0.001). Criterion weights were calculated as each criterion's mean divided by the sum of all means.

MIVES Framework and Value Functions

For each criterion i , a linear value function converts the raw performance x_{ij} of project j into a value V_i between 0 and 1. The function is defined by two criterion-specific reference points: x_{min} , the performance scoring 0 (the minimum acceptable level), and x_{max} , the performance scoring 1 (the target level). For benefit criteria, where higher performance indicates better quality, the value function is:

$$V_i(x_{ij}) = \frac{x_{ij} - x_{min}}{x_{max} - x_{min}}$$

For cost criteria, where lower performance indicates better quality (for example house price, development density, and distance to amenities), the value function is:

$$V_i(x_{ij}) = \frac{x_{min} - x_{ij}}{x_{min} - x_{max}}$$

In both cases the value is bounded to the interval [0, 1]. In Table 1, the "Min." column reports x_{min} and the "Max." column reports x_{max} for each criterion. The composite Quality Index I_j for project j aggregates the weighted value scores across all n criteria (Pons et al., 2016):

$$I_j = \sum_{i=1}^n w_i \cdot V_i(x_{ij})$$

where w_i is the importance weight of criterion i . The reference points were established through a systematic review of the relevant Malaysian housing policies and planning guidelines identified in Stage 1. The benchmark for each criterion was determined by a consistent selection rule. Where a policy specifies

a value for a criterion, that value was adopted directly as the benchmark. Where several policies specify different values for the same criterion, precedence was given to the principal national instrument, the National Affordable Housing Policy (NAHP), over programme- or agency-specific guidelines. For example, the House Price benchmark of RM300,000 follows the national affordable-housing ceiling; the RM400,000 permitted under the PR1MA programme is not treated as the benchmark but instead defines the minimum-performance (worst) anchor. The Development Density benchmark of 150 units per acre likewise adopts the DBKL planning standard directly. For criteria measured on ordinal scales, such as Aesthetic Design and Waste Management, no policy prescribes a numerical value because the rating scale was developed within this study; for these, the benchmark was set at the midpoint of the scale to represent an acceptable baseline of provision. Table 1 presents the full parameters and policy sources for all 24 criteria. The value functions for all 24 criteria are illustrated in the Appendix (Figures 1 to 24). The benchmark value is a policy-defined threshold used to construct the Reference Project and to classify projects; it does not alter the shape of the value function. The Reference Project is assigned the benchmark value for each criterion simultaneously, yielding $I_{RP} = 0.4747$. Projects with $I_j \geq I_{RP}$ are classified as Above Benchmark; those with $I_j < I_{RP}$ as Below Benchmark. This classification serves as a design guidance tool, not a mandatory planning decision.

Table 1: MIVES Value Function Parameters, Benchmark Values, and Policy Sources for All 24 Criteria

No.	Criteria	Type	Min.	Max.	Benchmark	v(bench)	Policy Source
<i>Unit Characteristics</i>							
1	House Price	Cost	RM400k	RM150k	RM300k	0.400	NAHP; PPAM; PR1MA
2	Built-Up Area	Benefit	700 sqft	1,500 sqft	900 sqft	0.250	NAHP; PPAM
3	No. of Bedrooms	Benefit	2	5	3	0.333	NAHP; PPAM; PPR
4	No. of Bathrooms	Benefit	1	3	2	0.500	PPAM
5	Car Parking Spaces	Benefit	0	3 lots	1 lot	0.333	NAHP; DBKL
6	Aesthetic Design	Benefit	Score 1	Score 5	Score 3	0.500	DBKL
7	Development Density	Cost	350 u/ac	120 u/ac	150 u/ac	0.870	NAHP; DBKL
8	Maintenance Fees	Cost	RM0.50	RM0.20	RM0.30	0.667	JWP
<i>Facilities</i>							
9	Recreation Facilities	Benefit	Score 1	Score 4	Score 2	0.333	DBKL
10	Multi-Purpose Hall	Benefit	800 sqft	2,000 sqft	1,000 sqft	0.167	DBKL; PLANMalaysia
11	Surau	Benefit	600 sqft	2,000 sqft	800 sqft	0.143	DBKL; PLANMalaysia
12	Islamic Mortuary Room	Benefit	80 sqft	500 sqft	323 sqft	0.579	DBKL

Ahmad Nashriq Abdul Mutalib, Ainoriza Mohd Aini and Zafirah Al Sadat Zyed
A MULTI-CRITERIA QUALITY ASSESSMENT FRAMEWORK FOR AFFORDABLE HOUSING PROJECTS
IN KUALA LUMPUR AT DESIGN STAGE USING THE INTEGRATED VALUE MODEL FOR
SUSTAINABLE ASSESSMENT (MIVES)

No.	Criteria	Type	Min.	Max.	Benchmark	v(bench)	Policy Source
13	Management Room	Benefit	200 sqft	700 sqft	400 sqft	0.400	DBKL
14	Kindergarten/Childcare	Benefit	1,800 sqft	2,324 sqft	2,000 sqft	0.382	DBKL; PLANMalaysia
15	Laundry Room	Benefit	200 sqft	600 sqft	400 sqft	0.500	DBKL
16	Waste Management	Benefit	Score 1	Score 3	Score 2	0.500	NHP; PLANMalaysia
17	Energy Efficiency	Benefit	Score 1	Score 4	Score 2	0.333	KL LCBC 2023
Location							
18	Access to Employment	Cost	20 km	5 km	10 km	0.667	NHP; Mulliner et al. (2012)
19	Access to School	Cost	5.0 km	1.0 km	2.5 km	0.625	PLANMalaysia; DBKL
20	Access to Public Transport	Cost	3.0 km	0.4 km	1.5 km	0.577	Residensi Madani; JWP
21	Access to Commercial Area	Cost	5.0 km	1.0 km	2.5 km	0.625	PLANMalaysia
22	Access to Open Space	Cost	5.0 km	1.0 km	2.5 km	0.625	PLANMalaysia
23	Access to Mosque	Cost	5.0 km	1.0 km	2.5 km	0.625	DBKL
24	Area Safety Level	Cost	409/100k	0/100k	246/100k	0.399	DOSM (2024)

Note: Min = worst performance ($V_i = 0$); Max = best performance ($V_i = 1$); Benchmark = policy standard. v(bench) = value score at benchmark. NAHP = National Affordable Housing Policy; PPAM = Programme Perumahan Awam Malaysia; DBKL = Dewan Bandaraya Kuala Lumpur; PLANMalaysia = Federal Town and Country Planning Dept.; JWP = Jabatan Perumahan Wilayah Persekutuan; NHP = National Housing Policy; LCBC = Low Carbon Building Code KL 2023; DOSM = Department of Statistics Malaysia.

RESULTS

Respondent Profile

Table 2 presents the demographic profile of 450 respondents. The sample is predominantly adults aged 31-50 years (76.2%), married (73.3%), Muslim (93.1%), and educated to at least degree level (75.4%). Government servants represent 60.7%, consistent with the primary PPAM target group, and 64.4% fall within the B40 and M40 income range.

Table 2: Demographic Profile of Survey Respondents (n = 450)

Variable	Category	n	%	Variable	Category	n	%
Age	19-30 years	65	14.4	Religion	Islam	419	93.1
	31-40 years	154	34.2		Non-Islam	31	6.9
	41-50 years	189	42.0	Sector	Government	273	60.7
	51+ years	42	9.3		Private / Others	177	39.3
Marital status	Married	330	73.3	Income	Below RM4,849 (B40)	128	28.4
	Single / Others	120	26.7		RM4,850-RM10,959 (M40)	162	36.0

Variable	Category	n	%	Variable	Category	n	%
Education	SPM/Diploma	111	24.7	Purchase purpose	Above RM10,960	160	35.6
	Bachelor's degree	224	49.8		Own occupation	243	54.0
	Postgraduate	115	25.6		Investment / Rental / Others	207	46.0

Criteria Importance Weights

Table 3 presents descriptive statistics and derived weights. All criteria have N = 450. Mean scores range from 3.431 to 4.773. The top five criteria are Area Safety Level (4.82%), House Price (4.79%), Waste Management (4.59%), Access to Employment (4.46%), and Maintenance Fees and Development Density (both 4.43%). Both top-ranked criteria record IQR = 0, indicating universal consensus. Recreation Facilities ranks lowest (3.47%) despite prominent developer marketing, revealing a clear misalignment between supply-side promotion and buyer priorities.

Table 3: Descriptive Statistics and Derived Weights for All 24 Quality Criteria (n = 450)

Rank	Criteria	Category	N	Mean	SD	Weight (%)
1	Area Safety Level	Location	450	4.773	0.492	4.82
2	House Price	Unit Char.	450	4.738	0.591	4.79
3	Waste Management	Facilities	450	4.547	0.724	4.59
4	Access to Employment	Location	450	4.413	0.742	4.46
5	Maintenance Fees	Unit Char.	450	4.389	0.794	4.43
6	Development Density	Unit Char.	450	4.389	0.774	4.43
7	Access to Public Transport	Location	450	4.376	0.778	4.42
8	Access to School	Location	450	4.360	0.803	4.41
9	No. of Bedrooms	Unit Char.	450	4.320	0.740	4.37
10	Built-Up Area	Unit Char.	450	4.289	0.799	4.33
11	Car Parking Spaces	Unit Char.	450	4.271	0.813	4.32
12	Surau	Facilities	450	4.202	0.947	4.25
13	Access to Mosque	Location	450	4.200	0.870	4.24
14	Energy Efficiency	Facilities	450	4.147	0.923	4.19
15	Access to Commercial Area	Location	450	4.104	0.804	4.15
16	Kindergarten/Childcare	Facilities	450	4.031	0.985	4.07
17	No. of Bathrooms	Unit Char.	450	4.000	0.842	4.04
18	Islamic Mortuary Room	Facilities	450	3.876	1.044	3.92
19	Management Room	Facilities	450	3.820	0.937	3.86

Rank	Criteria	Category	N	Mean	SD	Weight (%)
20	Access to Open Space	Location	450	3.749	0.982	3.79
21	Multi-Purpose Hall	Facilities	450	3.540	0.994	3.58
22	Aesthetic Design	Unit Char.	450	3.527	0.942	3.56
23	Laundry Room	Facilities	450	3.476	1.032	3.51
24	Recreation Facilities	Facilities	450	3.431	0.930	3.47

Project Assessment

Five completed affordable housing projects in Kuala Lumpur were selected from those listed on the official portals of KPKT, PPAM, and JWP. They were chosen purposively to span five different areas of the city and to capture the variation in provision across the 24 quality criteria, ranging from higher- to lower-provision schemes. The raw performance data for each project were extracted from these agency sources and independently cross-checked with the relevant agencies and the respective developers prior to assessment. Table 4a presents the raw performance inputs for all projects. Table 4b presents the corresponding value scores $V_i(x_{ij})$, Quality Index I_j , and benchmark classification.

Table 4a: Raw Performance Inputs for All Five Projects and Reference Project (RP)

No.	Criteria	Unit	RP	P1	P2	P3	P4	P5
<i>Unit Characteristics</i>								
1	House Price	RM	300,000	320,000	295,000	310,000	285,000	280,000
2	Built-Up Area	sqft	900	800	870	750	820	950
3	No. of Bedrooms	count	3	3	3	2	3	3
4	No. of Bathrooms	count	2	2	2	2	2	2
5	Car Parking Spaces	lots	1	1	2	1	1	2
6	Aesthetic Design	score (1-5)	3	3	3	2	3	4
7	Development Density	u/acre	150	160	140	320	180	130
8	Maintenance Fees	RM/sqft	0.30	0.32	0.25	0.45	0.28	0.22
<i>Facilities</i>								
9	Recreation Facilities	score (1-4)	2	2	2	1	2	3
10	Multi-Purpose Hall	sqft	1,000	900	1,100	800	950	1,200
11	Surau	sqft	800	800	900	650	780	1,000
12	Islamic Mortuary Room	sqft	323	280	320	100	300	350
13	Management Room	sqft	400	350	440	220	380	500
14	Kindergarten/Childcare	sqft	2,000	1,900	2,050	1,850	1,950	2,100

No.	Criteria	Unit	RP	P1	P2	P3	P4	P5
15	Laundry Room	sqft	400	350	400	250	360	450
16	Waste Management	score (1-3)	2	2	2	1	2	3
17	Energy Efficiency	score (1-4)	2	2	3	1	2	3
Location								
18	Access to Employment	km	10.0	8.0	5.0	12.0	9.0	3.0
19	Access to School	km	2.5	2.0	1.8	3.5	2.8	1.2
20	Access to Public Transport	km	1.5	1.8	1.2	2.5	2.0	0.5
21	Access to Commercial Area	km	2.5	2.0	1.8	3.5	3.0	1.5
22	Access to Open Space	km	2.5	2.5	2.2	4.0	3.5	2.0
23	Access to Mosque	km	2.5	2.5	2.0	3.5	2.8	1.0
24	Area Safety Level	per 100,000	246	200	220	231	210	180

Note: RP = Reference Project assigned exactly the policy benchmark value for each criterion. P1 = Mont Kiara; P2 = Bandar Tun Razak; P3 = Wangsa Maju; P4 = Kepong; P5 = Bukit Bintang. Scores 1-5 for ordinal criteria per Table 1 scale.

Table 4b: Value Scores $V_i(x_{ij})$ and Quality Index I_j for All Projects

No.	Criteria	w(%)	$V_i(RP)$	$V_i(P1)$	$V_i(P2)$	$V_i(P3)$	$V_i(P4)$	$V_i(P5)$
Unit Characteristics								
1	House Price	4.79	0.400	0.320	0.420	0.360	0.460	0.480
2	Built-Up Area	4.33	0.250	0.125	0.212	0.062	0.150	0.312
3	No. of Bedrooms	4.37	0.333	0.333	0.333	0.000	0.333	0.333
4	No. of Bathrooms	4.04	0.500	0.500	0.500	0.500	0.500	0.500
5	Car Parking Spaces	4.32	0.333	0.333	0.667	0.333	0.333	0.667
6	Aesthetic Design	3.56	0.500	0.500	0.500	0.250	0.500	0.750
7	Development Density	4.43	0.870	0.826	0.913	0.130	0.739	0.957
8	Maintenance Fees	4.43	0.667	0.600	0.833	0.167	0.733	0.933
Facilities								
9	Recreation Facilities	3.47	0.333	0.333	0.333	0.000	0.333	0.667
10	Multi-Purpose Hall	3.58	0.167	0.083	0.250	0.000	0.125	0.333
11	Surau	4.25	0.143	0.143	0.214	0.036	0.129	0.286
12	Islamic Mortuary Room	3.92	0.579	0.476	0.571	0.048	0.524	0.643
13	Management Room	3.86	0.400	0.300	0.440	0.040	0.360	0.600
14	Kindergarten/Childcare	4.07	0.382	0.191	0.477	0.095	0.286	0.573
15	Laundry Room	3.51	0.500	0.375	0.500	0.125	0.400	0.625
16	Waste Management	4.59	0.500	0.500	0.500	0.000	0.500	1.000

Ahmad Nashriq Abdul Mutalib, Ainoriza Mohd Aini and Zafirah Al Sadat Zyed
A MULTI-CRITERIA QUALITY ASSESSMENT FRAMEWORK FOR AFFORDABLE HOUSING PROJECTS
IN KUALA LUMPUR AT DESIGN STAGE USING THE INTEGRATED VALUE MODEL FOR
SUSTAINABLE ASSESSMENT (MIVES)

No.	Criteria	w(%)	V _i (RP)	V _i (P1)	V _i (P2)	V _i (P3)	V _i (P4)	V _i (P5)
17	Energy Efficiency	4.19	0.333	0.333	0.667	0.000	0.333	0.667
Location								
18	Access to Employment	4.46	0.667	0.800	1.000	0.533	0.733	1.000
19	Access to School	4.41	0.625	0.750	0.800	0.375	0.550	0.950
20	Access to Public Transport	4.42	0.577	0.462	0.692	0.192	0.385	0.962
21	Access to Commercial Area	4.15	0.625	0.750	0.800	0.375	0.500	0.875
22	Access to Open Space	3.79	0.625	0.625	0.700	0.250	0.375	0.750
23	Access to Mosque	4.24	0.625	0.625	0.750	0.375	0.550	1.000
24	Area Safety Level	4.82	0.399	0.511	0.462	0.435	0.487	0.560
Quality Index I_j			0.4747	0.4544	0.5690	0.2002	0.4347	0.6882
Rank			RP	3rd	2nd	5th	4th	1st
Classification			Ref.	Below	Above	Below	Below	Above

Note: Green = Above Benchmark ($I_j \geq I_{RP} = 0.4747$); Red = Below Benchmark. Classification is a design guidance indicator only, not a mandatory planning decision.

Table 5: Final MIVES Rankings and Benchmark Classification

Rank	Project	Location	Quality Index I _j	vs. I _{RP}	Classification
1	P5	Bukit Bintang	0.6882	+0.214	Above Benchmark
2	P2	Bandar Tun Razak	0.5690	+0.094	Above Benchmark
RP	Reference Project	—	0.4747	—	Reference
3	P1	Mont Kiara	0.4544	-0.020	Below Benchmark
4	P4	Kepong	0.4347	-0.040	Below Benchmark
5	P3	Wangsa Maju	0.2002	-0.275	Below Benchmark

Note: $I_{RP} = 0.4747$. Green shading = Above Benchmark; Red shading = Below Benchmark.

P5 achieves the highest Quality Index ($I_5 = 0.6882$), driven by outstanding location performance including employment access at 3 km, public transport at 0.5 km, and mosque access at 1.0 km, alongside full waste management provision ($V_{16} = 1.000$). P2 is also Above Benchmark ($I_2 = 0.5690$). P3 records the lowest index ($I_3 = 0.1800$), driven by high development density (320 u/acre) and absence of waste management facilities. P4 falls 0.040 below the Reference Project threshold, indicating targeted improvements in development density and transport accessibility could elevate it to Above Benchmark status.

DISCUSSION

The derivation of 24 quality criteria directly from twelve Malaysian housing policies ensures the framework evaluates projects against standards already in regulatory form. The buyer-derived weights from 450 respondents introduce a demand-side perspective largely absent from existing housing assessment frameworks. The narrow weight spread across the top criteria reflects that buyers expect all fundamental dimensions to be addressed simultaneously. The prominence of Islamic-specific facilities (Surau rank 12, Mosque access rank 13, Islamic Mortuary Room rank 18) reflects culturally specific quality dimensions not captured by Western frameworks, and confirms the importance of context-specific criteria derivation in a Muslim-majority urban setting.

The demographic composition of the survey sample, in which 60.7% of respondents are government-sector employees and 93.1% are Muslim, reflects the intended beneficiary population of the programmes that supply affordable housing in Kuala Lumpur. Affordable housing in the city is delivered largely through programmes such as PPAM, *Residensi Wilayah*, and PR1MA, whose eligibility rules prioritise first-time buyers in the B40 and M40 income groups, with PPAM reserved for civil servants. These target groups are predominantly Bumiputera Malay, who are constitutionally Muslim and who constitute approximately 47% of Kuala Lumpur's population (Department of Statistics Malaysia, 2020). The high shares of government-sector and Muslim respondents are therefore consistent with the demographic profile of the population these programmes are designed to serve. It follows that the weights assigned to religiously specific facilities, namely Surau, Access to Mosque, and Islamic Mortuary Room, reflect the genuine preferences of the intended beneficiaries, underscoring the importance of incorporating the Muslim perspective in affordable housing development in this context. These weights are nonetheless specific to the target-buyer profile examined here; other buyer segments may prioritise criteria differently, and the weight set can be re-derived for different populations, as noted in the future research directions.

The Reference Project mechanism provides a stable, policy-defined quality threshold derived independently of the project dataset. Unlike dataset-dependent methods such as TOPSIS, where adding or removing a project changes the ideal solution and consequently all other scores, MIVES value functions are fixed to policy reference points. This ensures that a project's score remains unchanged regardless of which other projects are evaluated alongside it, a critical requirement for a regulatory instrument applied to rolling project submissions. The borderline case of P4, falling 0.040 below the threshold, demonstrates the framework's practical utility: it enables precise, criterion-level developmental feedback rather than binary rejection, identifying exactly which dimensions require improvement and by how much.

Although the framework can support all affordable housing stakeholders, it is oriented primarily towards the policymakers and government agencies that manage affordable housing delivery in Kuala Lumpur, such as DBKL, KPKT, and JWP. These agencies select the developers admitted to affordable housing programmes and grant incentives such as subsidies, allocated or discounted land, higher permissible densities, and expedited (green-lane) approval. At the design-approval stage, DBKL, as the local planning authority, can apply the framework when reviewing development proposals, while KPKT and JWP can use it to evaluate projects submitted under the affordable housing programmes they administer, in each case verifying that a design meets the quality standards embedded in national and local policy before approval or programme admission is granted. Developers can use the same tool to self-assess and refine their designs before submission, and housing policymakers can draw on aggregated results across projects to monitor quality and refine benchmark standards.

This framework does not claim MIVES to be superior to other MCDA methods for housing assessment; its contribution lies in configuring MCDA around value functions anchored to the policies and guidelines defining affordable housing quality. MIVES suits this purpose because its bounded value function, scoring 0 at minimum acceptable performance and 1 at maximum, matches the bounded nature of affordable housing standards: a minimum built-up area is mandated, yet oversized units would compromise affordability, and basic facilities such as a surau are required while luxury provisions such as a swimming pool are not. This aligns with the government's emphasis on eliminating components that do not contribute to function and value in publicly funded projects (Economic Planning Unit, 2015); performance beyond the maximum reference point yields no additional score, discouraging over-provision.

CONCLUSION

This study developed a Multi-Criteria Quality Assessment Framework for Affordable Housing Projects in Kuala Lumpur at the Design Stage Using MIVES (Modelo Integrado de Valor para una Evaluación Sostenible). Four principal contributions are made: (1) 24 quality criteria derived from twelve Malaysian housing policies and planning guidelines and validated by an expert stakeholder panel through a Modified Delphi process; (2) buyer-derived weights from 450 respondents (N = 450 for all criteria) revealing area safety, house price, and waste management as top priorities; (3) MIVES value functions anchored to the policies and guidelines that define affordable housing quality, enabling assessment against established benchmarks; and (4) the use of a Reference Project within

MIVES as a methodological mechanism that enables assessment to move beyond binary benchmark classification to the comparative ranking of projects.

Two key limitations are acknowledged. First, the framework assigns a single representative value per criterion per project. Real projects offer multiple unit types with varying specifications such as differing price ranges or built-up areas. Future research should accommodate multiple criterion values per project, for instance through weighted averaging across unit types. Second, some benchmark values are referenced differently across policies: the National Housing Policy specifies RM300,000 as the maximum affordable price while PR1MA allows RM400,000. Future research should conduct stakeholder validation of each benchmark value with policymakers and potential house buyers to resolve such conflicts. Additional directions include extending the framework to landed affordable housing typologies, applying it across other Malaysian states, and stratifying buyer surveys by income group (B40, M40, and civil servants) to examine whether group-specific frameworks produce more precise quality assessments.

ACKNOWLEDGEMENT

The authors would like to thank all survey respondents and expert panel members who participated in this study. Special thanks are extended to Tn. Mohd Izwan Nuzaihan Bin Jamil, Director of Perumahan Penjawat Awam Malaysia (PPAM), Jabatan Perdana Menteri and his staff for their support, particularly in facilitating communication with the developers, and to the developers and government officers involved in the expert validation. This research received no external funding.

DISCLOSURE STATEMENT

The authors declare no conflict of interest.

REFERENCES

- Alarcon, B., Aguado, A., Manga, R., & Josa, A. (2011). A value function for assessing sustainability: Application to industrial buildings. *Sustainability*, 3(1), 35–50. DOI: <https://doi.org/10.3390/su3010035>
- Badrudin, I. S., Zyed, Z. A. S., & Tedong, P. A. (2022). Preliminary housing continuum model framework for young households in Greater Kuala Lumpur. *Planning Malaysia*, 20(5), 79–94. DOI: <https://doi.org/10.21837/pm.v20i24.1185>
- Bank Negara Malaysia. (2021). *Financial stability review second half 2021*. Bank Negara Malaysia. https://www.bnm.gov.my/documents/20124/6459002/fsr21h2_en_book.pdf

- Belton, V., & Gear, A. E. (1983). On a short-coming of Saaty's method of analytic hierarchies. *Omega*, 11(3), 228–230. DOI: [https://doi.org/10.1016/0305-0483\(83\)90047-6](https://doi.org/10.1016/0305-0483(83)90047-6)
- Biswal, D., Joglekar, S. N., & Mandavgane, S. A. (2022). MIVES: A multi-attribute value function-based methodology for sustainability assessment. In A. J. Kulkarni (Ed.), *Multiple criteria decision making* (pp. 1–18). Springer. DOI: https://doi.org/10.1007/978-981-16-7414-3_1
- Brkanić, I., Stober, D., & Mihić, M. (2023). Housing quality assessment model based on the spatial characteristics of an apartment. *Buildings*, 13(9), 2181. DOI: <https://doi.org/10.3390/buildings13092181>
- Cots, D. B., Pardo-Bosch, F., Blanco, A., Aguado, A., & Pujadas, P. (2022). A systematic review on MIVES: A sustainability-oriented multi-criteria decision-making method. *Building and Environment*, 223, 109515. DOI: <https://doi.org/10.1016/j.buildenv.2022.109515>
- de Farias Aires, R. F., & Ferreira, L. (2019). A new approach to avoid rank reversal cases in the TOPSIS method. *Computers & Industrial Engineering*, 132, 84–97. DOI: <https://doi.org/10.1016/j.cie.2019.04.023>
- Department of Statistics Malaysia. (2020). *Population and housing census of Malaysia 2020: Federal Territory of Kuala Lumpur*. Department of Statistics Malaysia. <https://www.dosm.gov.my>
- Department of Statistics Malaysia. (2022). *Household income and basic amenities survey report 2022*. DOSM. <https://www.dosm.gov.my/portal-main/release-content/household-income-survey-report--malaysia--states>
- Department of Statistics Malaysia. (2024). *Statistik jenayah: Crime statistics Malaysia 2024*. Jabatan Perangkaan Malaysia. https://storage.dosm.gov.my/crime/crime_2023.pdf
- Economic Planning Unit. (2015). *Guidelines for value management: UPE Circular No. 1 Year 2015*. Economic Planning Unit, Prime Minister's Department. <https://ekonomi.gov.my/sites/default/files/2020-02/Pekeliling%20UPE%20Bil%201%20Tahun%202015.pdf>
- Economic Planning Unit. (2025). *13th Malaysia Plan 2026-2035*. Prime Minister's Department. https://rmk13.ekonomi.gov.my/wp-content/uploads/2025/09/Executive_Summary_Thirteenth_Malaysia_Plan.pdf
- Farha, L., Freeman, S., & Gabarre de Sus, M. (2022). *The Shift Directives: From financialized to human rights-based housing*. The Shift. <https://make-the-shift.org/wp-content/uploads/2022/12/Directives-Updated-Dec-9.pdf>
- García-Cascales, M. S., & Lamata, M. T. (2012). On rank reversal and TOPSIS method. *Mathematical and Computer Modelling*, 56(5–6), 123–132. DOI: <https://doi.org/10.1016/j.mcm.2011.12.022>
- Howden-Chapman, P., Bennett, J., Edwards, R., Jacobs, D., Nathan, K., & Ormandy, D. (2023). Review of the impact of housing quality on inequalities in health and well-being. *Annual Review of Public Health*, 44, 233–254. DOI: <https://doi.org/10.1146/annurev-publhealth-071521-111836>

- Krejcie, R. V., & Morgan, D. W. (1970). Determining sample size for research activities. *Educational and Psychological Measurement*, 30(3), 607–610. DOI: <https://doi.org/10.1177/001316447003000308>
- Lee, Y., Kemp, P. A., & Reina, V. J. (2022). Drivers of housing (un)affordability in the advanced economies: A review and new evidence. *Housing Studies*, 37(10), 1739–1752. DOI: <https://doi.org/10.1080/02673037.2022.2123623>
- Maleki, B., Casanovas-Rubio, M. d. M., Tsavdaridis, K. D., & Antequera, A. d. I. F. (2024). Integrated value model for sustainable assessment of modular residential towers. *Sustainability*, 16(2), 497. DOI: <https://doi.org/10.3390/su16020497>
- Mecca, S., Del Giudice, V., & De Paola, P. (2023). Assessing sustainable development: A review of MCDA for urban and architectural sustainability. *Journal of Multi-Criteria Decision Analysis*, 30(3–4). DOI: <https://doi.org/10.1002/mcda.1818>
- Mehdipanah, R. (2023). Without affordable, accessible, and adequate housing, health has no foundation. *Milbank Quarterly*, 101(S1), 419–443. DOI: <https://doi.org/10.1111/1468-0009.12626>
- Mulliner, E., Smallbone, K., & Maliene, V. (2012). An assessment of sustainable housing affordability using a MCDM method. *Omega*, 41(2), 270–279. DOI: <https://doi.org/10.1016/j.omega.2012.05.002>
- National Property Information Centre. (2024). *Property market report 2024*. Valuation and Property Services Department. <https://napic2.jp-ph.gov.my/ms/data-penerbitan/laporan-pasaran-harta/laporan-pasaran-harta-2024>
- Passos Neto, G. d. M., Alencar, L. H., & Valdes-Vasquez, R. (2023). Multiple-criteria methods for assessing social sustainability in the built environment. *Sustainability*, 15(23), 16231. DOI: <https://doi.org/10.3390/su152316231>
- Pons, O., De la Fuente, A., & Aguado, A. (2016). The use of MIVES as a sustainability assessment MCDM method for architecture and civil engineering. *Sustainability*, 8(5), 460. DOI: <https://doi.org/10.3390/su8050460>
- Saleh, A. F., Mohd Aini, A., Ab Majid, R., Mustafa, M. H., & Jamaludin, A. F. (2024). Modelling housing mismatch for affordable housing demand and supply in Malaysia. *Planning Malaysia*, 22(3), 335–351. DOI: <https://doi.org/10.21837/pm.v22i32.1511>
- Shyur, H.-J., & Shih, H.-S. (2024). Resolving rank reversal in TOPSIS. *Informatica*, 35(4), 837–858. DOI: <https://doi.org/10.15388/24-INFOR576>
- Simpeh, E. K., Akoto, M., Mensah, H., Ahadzie, D. K., Duah, D. Y. A., & Reney, N. A. (2024). Field diagnosis of criteria for selecting affordable housing in less developed countries. *Urbanization, Sustainability and Society*, 1(1), 18–38. DOI: <https://doi.org/10.1108/USS-10-2023-0007>
- Tan, T., Zheng, L., Xue, F., Bao, Z., Fang, Z., & Liu, X. (2024). MIVES multi-criteria framework to sustainability index of DfMA. *Journal of Civil Engineering and Management*, 30(3), 234–247. DOI: <https://doi.org/10.3846/jcem.2024.20953>
- Triantaphyllou, E. (2001). Two new cases of rank reversals when the AHP and some of its additive variants are used. *Journal of Multi-Criteria Decision Analysis*, 10(1), 11–25. DOI: <https://doi.org/10.1002/mcda.284>

- UN-Habitat. (2022). *World Cities Report 2022: Envisaging the future of cities*. United Nations Human Settlements Programme. https://unhabitat.org/sites/default/files/2022/06/wcr_2022.pdf
- Villalba, P., Sánchez-Garrido, A. J., & Yepes, V. (2024). A review of MCDM methods for building assessment, selection, and retrofit. *Journal of Civil Engineering and Management*, 30(5), 465–480. DOI: <https://doi.org/10.3846/jcem.2024.21621>
- Wang, Y. M., & Luo, Y. (2009). On rank reversal in decision analysis. *Mathematical and Computer Modelling*, 49(5–6), 1221–1229. DOI: <https://doi.org/10.1016/j.mcm.2008.06.019>
- Wetzstein, S. (2017). The global urban housing affordability crisis. *Urban Studies*, 54(14), 3159–3177. DOI: <https://doi.org/10.1177/0042098017711649>
- Wimalasena, N. N., Chang-Richards, A., Wang, K. I.-K., & Dirks, K. (2022). Housing quality indicators: A systematic review. In *Proceedings of the 10th World Construction Symposium* (pp. 531–544). https://ciobwcs.com/downloads/papers22/WCS2022_Proceedings_43.pdf

Received: 12th June 2026. Accepted: 14th June 2026

APPENDIX

Figures 1-24. MIVES Linear Value Functions for All 24 Quality Criteria

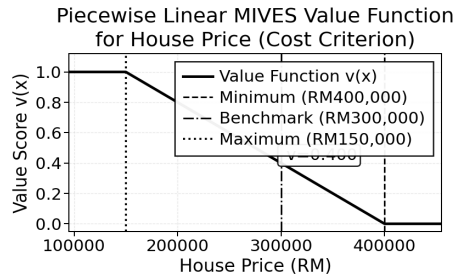


Fig. 1. House Price (Cost, $w=4.79\%$)

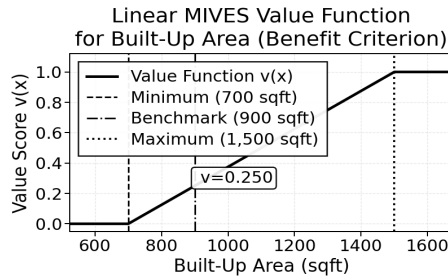


Fig. 2. Built-Up Area (Benefit, $w=4.33\%$)

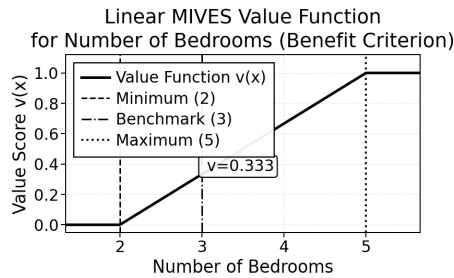


Fig. 3. No. of Bedrooms (Benefit, $w=4.37\%$)

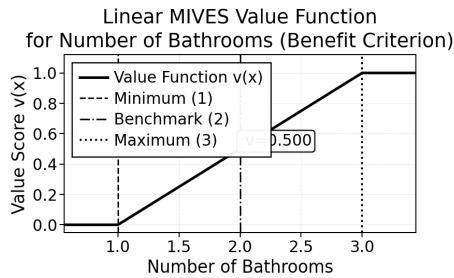


Fig. 4. No. of Bathrooms (Benefit, $w=4.04\%$)

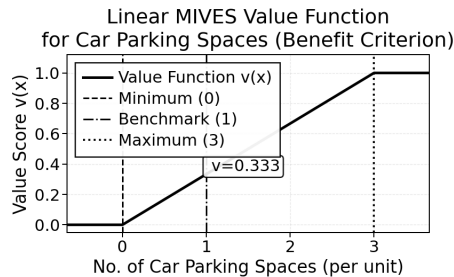


Fig. 5. Car Parking (Benefit, $w=4.32\%$)

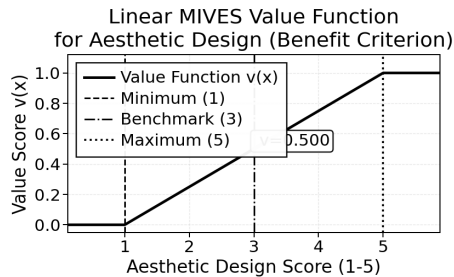


Fig. 6. Aesthetic Design (Benefit, $w=3.56\%$)

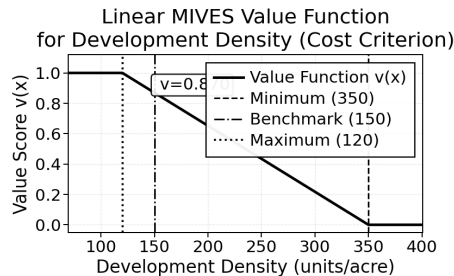


Fig. 7. Development Density (Cost, $w=4.43\%$)

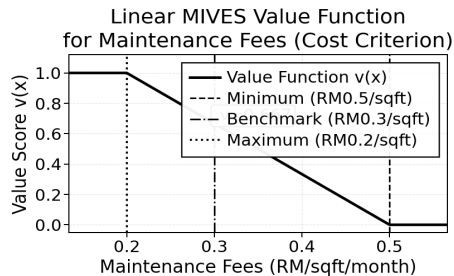


Fig. 8. Maintenance Fees (Cost, $w=4.43\%$)

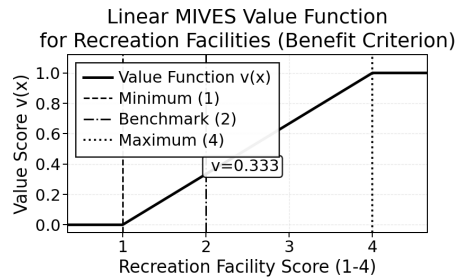


Fig. 9. Recreation Facilities (Benefit, $w=3.47\%$)

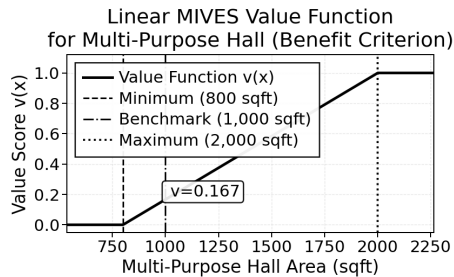


Fig. 10. Multi-Purpose Hall (Benefit, $w=3.58\%$)

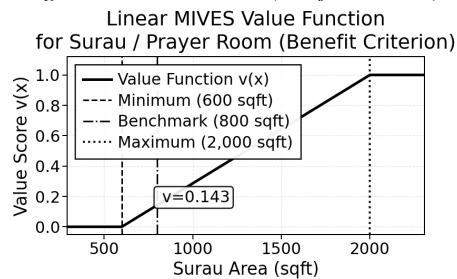


Fig. 11. Surau (Benefit, $w=4.25\%$)

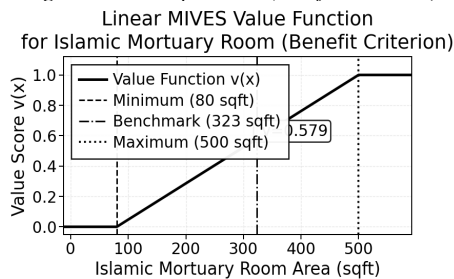


Fig. 12. Islamic Mortuary Room (Benefit, $w=3.92\%$)

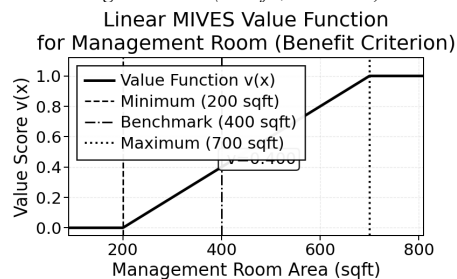


Fig. 13. Management Room (Benefit, $w=3.86\%$)

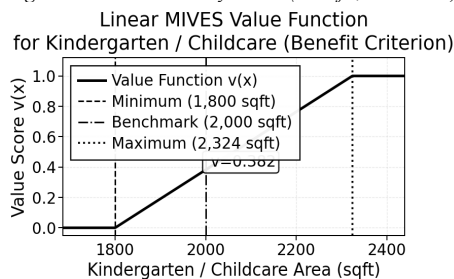


Fig. 14. Kindergarten/Childcare (Benefit, $w=4.07\%$)

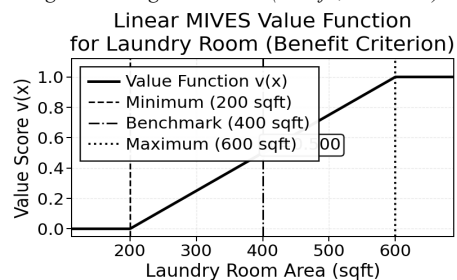


Fig. 15. Laundry Room (Benefit, $w=3.51\%$)

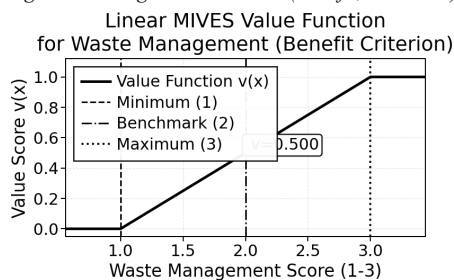


Fig. 16. Waste Management (Benefit, $w=4.59\%$)

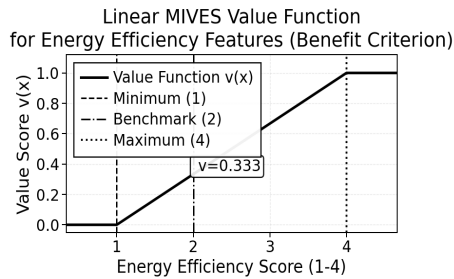


Fig. 17. Energy Efficiency (Benefit, $w=4.19\%$)

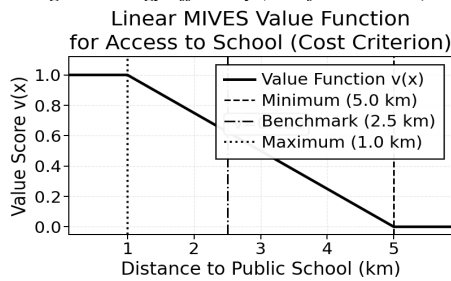


Fig. 19. Access to School (Cost, $w=4.41\%$)

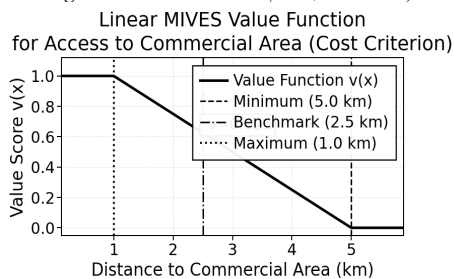


Fig. 21. Access to Commercial Area (Cost, $w=4.15\%$)

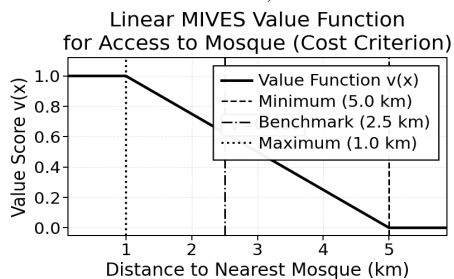


Fig. 23. Access to Mosque (Cost, $w=4.24\%$)

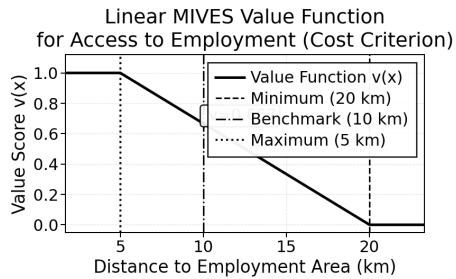


Fig. 18. Access to Employment (Cost, $w=4.46\%$)

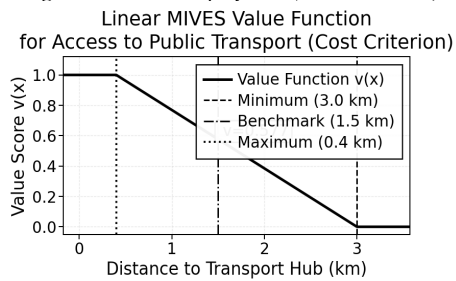


Fig. 20. Access to Public Transport (Cost, $w=4.42\%$)

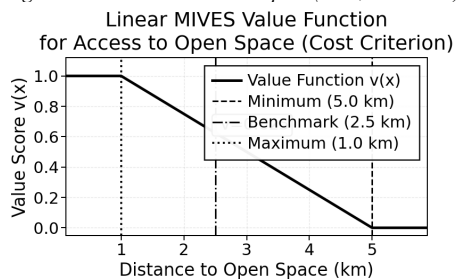


Fig. 22. Access to Open Space (Cost, $w=3.79\%$)

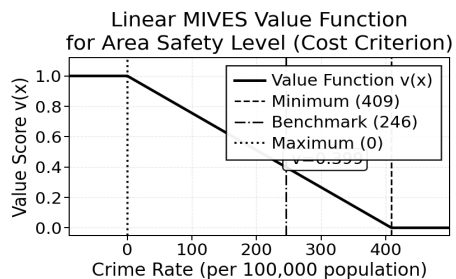


Fig. 24. Area Safety Level (Cost, $w=4.82\%$)