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ASSESSING THE IMPACT OF TRANSIT-ORIENTED DEVELOPMENT ON RESIDENTS' QUALITY OF LIFE IN NORTHERN MALAYSIA

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Abstract

Transit-Oriented Development (TOD) is gaining wide acceptance by many state's governments in Malaysia due to its potential to create a liveable neighbourhood with enhanced mobility. Therefore, this study aims to assess the impact of TOD on the residents' quality of life in Malaysia northern states. The data for this study were gathered from a survey on 360 residents who used the Northern KTM commuter train service. Descriptive and inferential statistics including chi-square test and PLS-SEM technique was performed to analyse the data and produce the findings. The findings of this study shown that there were significant differences in travel behaviour patterns (companions, frequencies, and walking durations) with respect to respondents' travel purposes. Moreover, it was revealed that land-use diversity and walkable design as important TOD principles that contribute to their quality of life. The findings of this research would serve as a base but critical information to direct future National Estate Development Plan.

Keywords: Transit-Oriented Development, Quality of Life, 5Ds Principles, northern Malaysia, PLS-SEM

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INTRODUCTION

Transit-oriented development (TOD) is an urban planning concept that emphasised on integrating transport and land use planning in a way that promotes the use of public and active transportation over the use of the private motor vehicles (Curtis, Renne, & Bertolini, 2009; van Lierop, Maat, & El-Geneidy, 2017). The TOD concept was first proposed by an American architect named Peter Calthorpe in 1993 and therefore American cities such as San Francisco and Atlanta became the first to implement TOD projects (Mu & de Jong, 2012). Later on, it gained much attention in European cities. Various cities development with TOD adoption have been reported in London, Copenhagen, Meckenbeuren, and Barcelona (Holloway, 2016; PLANMalaysia, 2018; Woo, 2020). Most recently, Asian governments like South Korea, India, Indonesia, Thailand, Singapore and including Malaysia have begun to adopt this concept into their urban planning policies (Khare, Villuri, Chaurasia, & Kumari, 2021; Niu, Hu, Shen, Lau, & Gan, 2019; Nyunt & Wongchavalidkul, 2020; PLANMalaysia, 2021; Sinaga, Suharyono, Musadieq, & Iqbal, 2020; Tamakloe, Hong, & Tak, 2021).

Although transit-oriented development (TOD) has recently emerged as a trending topic in both urban development agenda and academic studies (Azmi et al., 2021; PLANMalaysia, 2021), most studies did not assess the extent of TOD adoption in a comprehensive manner. For instance, a recent study conducted by Ramlan et al. (2021) solely focussed on "land-use diversity" principle in assessing the extend of TOD adoptions in Klang Valley. Meanwhile, Meng, Li, Taylor, and Scrafton (2021), Huang, Parker, and Minaker (2021) and Dong's (2021) studies primarily emphasised on "demand management" principle in western countries. Therefore, a comprehensive study that evaluates a wider range of TOD principles is needed to assist urban planners and policy-makers in making inclusive decisions regarding TOD strategic planning and policies. Hence, the present study intends to include not just land-use diversity and demand management principles, but also population and employment density, walkable design as well as destination accessibility in evaluating the extend of TOD adoptions and its impact on residents' Quality of Life (QoL).

LITERATURE REVIEW

TOD Principles

The fundamental principles of TOD are diversity, density and design, shortly known as "3Ds" (Calthorpe, 1993). Later, another two Ds namely destination accessibility and demand management were introduced (Cervero & Kockelman, 1997; Ogra & Ndebele, 2014). Table 1 summarises the principles of TOD studied in 20 different academic publications. From these publications it is evident that global TOD's adoption revolves around 5Ds principles which include; 1. Land-use diversity, 2. Population and employment density, 3. Walkable design, 4. Destination accessibility, and 5. Demand management.

Table 1: Common principles of TOD adoption from the literature

No	Authors	Settings	DLU	DST	DSG	DAC	DMG
1.	Yap, Chua, and Skitmore (2021)	Malaysia	X	X	X	X	X
2.	Tamakloe et al. (2021)	Korea	X	X	X		
3.	Ramlan et al. (2021)	Malaysia	X				
4.	Meng et al. (2021)	Australia					X
5.	Khare et al. (2021)	India	X	X	X	X	X
6.	Huang et al. (2021)	Canada					X
7.	Dong (2021)	USA					X
8.	Azmi et al. (2021)	Malaysia	X	X	X	X	X
9.	Staricco and Vitale Brovarone (2020)	Italy	X	X	X		
10.	Sinaga et al. (2020)	Indonesia	X			X	
11.	Nyunt and Wongchavalidkul (2020)	Thailand	X	X	X		X
12.	Jones (2020)	Canada		X			
13.	Jaafar Sidek et al. (2020)	Malaysia				X	X
14.	Ganning and Miller (2020)	USA	X	X	X		
15.	Abutaleb, McDougall, Basson, Hassan, and Mahmood (2020)	UAE	X	X	X	X	
16.	Pongprasert and Kubota (2019)	Thailand			X	X	
17.	Gomez, Omar, and Nallusamy (2019)	Malaysia	X	X	X		X
18.	Appleyard, Frost, and Allen (2019)	USA	X	X	X	X	
19.	Al Saeed and Furlan (2019)	Qatar	X	X	X	X	
20.	Abutaleb, McDougall, Basson, Hassan, and Mahmood (2019)	UAE	X	X	X	X	

*Note. DLU = Land-Use Diversity, DST = Density, DSG = Design, DAC = Destination Accessibility, DMG = Demand Management

Quality of Life

A better quality of life (QoL) is one of the paramount objectives of TOD adoption. A higher density may cause overcrowding and negatively affect the QoL, while mixed land use development may provide conveniences to residents and improve

their QoL. Thus, there may be a trade-off between physical efficiency and QoL. Thus, a successful TOD adoption would not compromise the residents' QoL (Abdullah & Mazlan, 2016). In general, QoL can be viewed as the subjective aspects of well-being (Salvador-Carulla, Lucas, Ayuso-Mateos, & Miret, 2014). Felce and Perry (1995) introduced five domains of well-being namely; 1. physical, 2. material, 3. social, 4. emotional and 5. developmental activity. Each domain encompassed several sub-domains. For example, the physical well-being domain comprised health, fitness, personal safety and mobility. Meanwhile, material well-being domain includes housing quality, privacy, security and neighbourhood. Cross-examination with TOD literatures (Abdullah & Mazlan, 2016; Appleyard et al., 2019; Renne, 2007) revealed that only "neighbourhood" and "mobility" are matched with indicators that reflect benefits of TOD adoption for the residents. Thus, the present study assessed the impact of TOD adoptions on residents' QoL in terms of "neighbourhood" and "mobility".

Neighbourhood. In this study, quality of life from the neighbourhood aspect is perceived as residents' well-being with regards to living conditions and atmosphere in their residential areas that are located nearby railway stations. Indicators such as well-maintained neighbourhood, provision of adequate public facilities, pollution-free, crime-free, less traffic congestion, cost of living and affordable housing were adapted from several previous studies (Abdullah & Mazlan, 2016; Appleyard et al., 2019; Niles & Nelson, 1999; Yap & Goh, 2017) especially from Renne's (2007) work.

Mobility. On the other hand, quality of life in terms of "mobility" is viewed as ease for residents who lived nearby railway stations to move within the neighbourhood and reach other destinations outside of the neighbourhood. Indicators including walkability, safety, well-served public transport, incurred travel expenses and travel time consumption adapted from the same sources as "neighbourhood" aspect were used to measure the mobility dimension.

METHODOLOGY

Sampling Process

This study conducted a cross-sectional survey to gather the research data. The survey targeted residents who used KTM Commuter Northern Sector train service. There are 20 railway stations under the management of KTM Commuter Northern Sector (see Appendix A). Nevertheless, the full record (i.e., directory) of every resident and retailer among the target population was not accessible by the research team because it is a confidential data protected by the federal government for Malaysian citizen privacy. Hence, there is no legit sample frame (i.e., directory) that can be used to randomly draw out the research samples from the target population.

Alternatively, this study adopted purposive sampling to draw out the research samples from the target population. Purposive sampling is a non-

probability sampling design in which the required information is gathered from specific groups of subjects on some rational criteria (Sekaran & Bougie, 2016). Although non-probability sampling is often criticised for its ability to generalise the finding to the target population, in reality it is more likely appropriate in fieldwork research (Bryman & Bell, 2015). Specifically, studies with humans as subjects are less likely to involve random samples (Polit & Beck, 2010) and is actually problematic and unfit for social science studies (Krause, 2019). In fact, carefully controlled non-probability sampling (i.e., purposive sampling) can provide valid and meaningful results (Cooper & Schindler, 2014; Memon, Ting, Chuah, & Cheah, 2017). Hence, this study purposely select passengers who ride trains that operate under the management of KTM Commuter Northern Sector.

Recent literatures on sample size determination for survey research strongly recommend researchers to compute minimum required sample size based on statistical power analyses (Hair, Risher, Sarstedt, & Ringle, 2019; Memon et al., 2020). On that account, the research team adopted Cohen's (1992) rule of thumb to determine minimum sample size required for this study. Cohen's (1992) rule of thumb determines required sample size by the means of power analyses based on the largest number of predictors in a regression-based model (i.e., maximum number of predictors pointed at a particular variable in a research model). In this study, the number of total sample size required for a regression-based model with five predictors; 1. Diversity, 2. Density, 3. Design, 4. Destination and 5. Demand is 147 respondents (see Appendix B). Meanwhile, other parameter settings ($f^2 = 0.15$, $\alpha = 0.05$, and power of 80%) were determined based on default behavioral science criteria as denoted by Hair, Hult, Ringle, and Sarstedt (2017).

Data Collection Procedures

The survey was conducted using self-completed questionnaire forms. A self-completed questionnaire is a survey instrument in which each respondent reads and answers the same set of questions in a pre-determined order without the presence of the researcher (Saunders, Lewis, & Thornhill, 2016). The questionnaire form consisted of three parts; Part A: General Information, Part B: Travel Behaviour Patterns, Part C: TOD Principles and Part D: Residents' Quality of Life. Part A and Part B used combination of nominal scale and open-ended questions. Meanwhile, both Part C and Part D employed 5-points interval scale. For Part C, the scale was labelled as; 1 (unimportant) and 5 (very important). On the other hand, the scale was labelled as; 1 (strongly disagree) and 5 (strongly agree) in Part D.

The survey forms were distributed to the target respondents through drop-and-collect approach because it is easy, fast, and has high possibility to acquire 100 percent response rate (Fraenkel, Wallen, & Hyun, 2012; Sekaran & Bougie, 2016). Two enumerators were assigned for the data collection purpose.

The enumerators rode the train from Padang Besar station to Butterworth station during peak hours to distribute and recollect the survey forms. Respondents were approached while they are commuting the train. A brief explanation regarding the study was given to the respondents prior to leaving the survey form to them to be answered. Their consent to participate was also asked during the briefing. The survey forms were recollected before the respondents were getting-off from the train.

The survey targeted the commuter passengers instead of residents who live nearby the station areas due to the following rationals:

1. It is not ethical to invade people's privacy by knocking on their doors and ask them to participate in the survey.
2. Not all stations are located nearby residential areas (i.e., within 800-m buffer distance).
3. The survey is more likely to receive lower response rate due to refusals or incomplete responses. It is easier for respondents to avoid the enumerators when they are at homes.
4. Chances to acquire eligible respondents are higher since most passengers are the regular customers of KTM commuter service. The result of preliminary study also revealed that not all people that linger at and nearby the station areas have actually ride the train and aware about the facilities and surroundings at the railway station. Some of them were there just to fetch or send their family members or friends at the station.
5. Respondents will have more time to complete the survey while in they are in the journey to their respective destinations. If the survey forms are distributed at the station areas instead of on the train, the target respondents tend to refuse from participating or return incomplete survey forms because they might be in a rush to catch the train or leave the station areas.

ANALYSES AND FINDINGS

Survey Responses and Data Screening

This study had gathered a total of 440 responses within a week of data collection period. From these 440 responses, 407 were from residents who used the KTM Commuter Northern Sector train service. However, some of the respondents were excluded from the analysis due to incomplete responses and straight-lining responses. All related information about the survey responses was summarised in Table 2.

Table 2: Survey responses information

No	Information	Total
1.	All responses	407
2.	Incomplete responses	4
3.	Straight-lining responses	43
4.	Total eligible responses	360

Table 2 revealed that there were 43 residents who responded to the questionnaire with straight-lining answers. Straight-lining answers can be considered as suspicious responses that are probably posited by unengaged respondents (Hair et al., 2017). Hence, these kinds of responses need to be excluded from the analysis. Altogether, there were 360 residents who served as eligible respondents and valid samples for this study.

Demographic Information

Demographic section in the survey form for residents requested the respondents to provide information regarding their; 1. gender, 2. age, 3. race, 4. highest education level, 5. household income, 6. job sector, 7. home ownership status and 8. travel purpose.

Table 3: Background of the respondents

	Information	Frequency (n = 360)	Percentage
1.	**Gender**		
	Male	192	53.3
	Female	168	46.7
2.	**Generations (age range)**		
	Gen Z: 9 to 24 years old	141	39.2
	Gen Y: 25 to 40 years old	161	44.7
	Gen X: 41 to 56 years old	49	13.6
	Baby boomers: 57 to 75 years old	9	2.5
3.	**Race**		
	Malay	317	88.1
	Chinese	16	4.4
	Indian	21	5.8
	Others	6	1.7
4.	**Highest Education Level**		
	UPSR / PMR / SPM	76	21.1
	STPM	12	3.3
	Diploma	108	30.0
	Bachelor Degree	141	39.2
	Others	23	6.4

Table 3 (continue)

	Information	Frequency	Percentage
5.	**Household Income Group (MYR range)**		
	B40: 4,850 and below	270	75.0
	M40: 4,851 to 10,970	78	21.7
	T20: 10,971 and above	12	3.3
6.	**Job Sector**		
	Private company staff	138	38.3
	Government servant	89	24.7
	Self-employed	48	13.3
	Retiree	4	1.1
	Students	76	21.1
	Homemaker	5	1.4
7.	**Home ownership status**		
	Self-owned	107	29.7
	Rental	107	29.7
	Family-owned	146	40.6
8.	**Travel Purposes**		
	Working	192	53.3
	Leisure (e.g., shopping trips, vacations, visiting family or friends)	168	46.7

Table 3 summarised demographic information of the respondents. Male respondents dominated the sampled data (51.1%). Majority of the respondents were Generation Y (44.7%), followed by respondents in the age group of Generation Z (39.2%). Meanwhile, with respect to race, Malay respondents were the majority (88.1%). There were only small percentage of Chinese (4.4%), Indian (5.8%) and other ethnics (1.7%). This data almost consistent with the actual proportion of ethnics in Malaysia's total population.

Next, in regards to education level, majority of respondents were those who received higher education. They were either bachelor degree graduates (39.2%), diploma holders (30.0%). In fact, there were also few respondents who had a master's and doctorate degrees in the sampled dataset which were classified under "Others" category. Despite being highly educated, most of the respondents came from B40 household income group (75.0%).

According to job sector classifications, majority were working for private companies (38.3%). There were also fair proportions of government servants (24.7%) and students (21.1%). The percentage of respondents who possessed their own house and lived on a rental basis were equal at 29.7%. Meanwhile, the majority lived in family-owned house (40.6%). Finally, respondents who rode the train mainly for working purpose (53.3%) dominated the dataset compared to those who used the train service for leisure purposes (46.7%).

Travel Behaviour Patterns

Before testing the causal relationships between TOD adoption and QoL, it is imperative to examine the patterns of travel behaviour of the respondents. Different travel behaviour patterns across diverse respondents' background might lead to variations on how they would perceive outcome of the TOD adoption (Jaafar Sidek et al., 2020; Renne, 2008). These variations would complicate researchers to conclude the finding of causal relationships between independent variables (TOD principles) and dependent variables (neighbourhood and mobility). Therefore, Pearson's chi-square test (χ^2) was employed to justify if any significant variance in the travel purpose with respect to demographic subgroups was evident.

Table 4: Cross tabulation between respondents' demographics and travel purposes

Demographics	Subgroups	Frequency		χ^2
		Work	Leisure	*p*-value
Gender	Male	126	66	.001
	Female	66	102	
Generations	Gen Z	29	112	.001
	Gen Y	116	45	
	Gen X	42	7	
	Baby boomers	5	4	
Race	Malay	177	140	.002
	Chinese	2	14	
	Indian	12	9	
	Others	1	5	
Highest Education Level	UPSR / PMR / SPM	36	40	.025
	STPM	8	4	
	Diploma	52	56	
	Bachelor Degree	77	64	
	Others	19	4	
Household Income Group	B40	122	148	.001
	M40	59	19	
	T20	11	1	
Job Sector	Private company staff	106	32	.001
	Government servant	73	16	
	Self-employed	13	35	
	Retiree	-	4	
	Students	-	76	
	Homemaker	-	5	
Home ownership status	Self-owned	83	24	.001
	Rental	47	60	
	Family-owned	62	84	

Overall, it could be concluded that there were significant differences in travel purposes with respect to demographic subgroups at $p < 0.05$. Hence, it was evident that the data for residents' sample group was not homogenous and varied according to travel purposes. On that account, the analysis for testing causal relationships between TOD principles and QoL need to be performed separately according to category of travel purposes.

The Relationships between TOD Principles and QoL Dimensions

The relationships between TOD principles and QoL dimensions namely neighbourhood and mobility were assessed using PLS-SEM technique. PLS-SEM is a variance-based statistical analysis technique for estimating structural equation models (Hair et al., 2017). Typically, Malaysian researchers use SmartPLS software as a tool to conduct PLS-SEM analysis because there are lots of training and technical support available for this software. The research team of this study also used the same software, namely SmartPLS version 3.3.9 (Ringle, Wende, & Becker, 2015). This study used PLS-SEM technique to fulfil the second research objective because it is among the best statistical analysis to predict causal relationship between two or more latent variables (Hair, Ringle, & Sarstedt, 2011; Šiška, 2018).

In general, PLS-SEM analysis involves two stages of assessment namely; 1. measurement model, and 2. structural model. The purpose of measurement model assessment is to evaluate the validity and reliability of constructs (latent variables) being studied. Meanwhile, structural model is performed to test the significance of hypothesised relationships between constructs (Hair et al., 2019). Altogether, there were two sets of PLS-SEM models; 1. travel for working, and 2. travel for leisure, established to estimate the impact of TOD adoption on respondents' QoL. As discussed in the literature review section, QoL for residents' view was operationalised in terms of Neighbourhood (QLN) and Mobility (QLM) qualities, while TOD adoptions were operationalised in terms of 5Ds principles; 1. Land-Use Diversity (DLU), 2. Density (DST), 3. Walkable Design (DSG), 4. Destination Accessibility (DAC), and 5. Demand Management (DMG).

Measurement Model Analysis

Measurement model analysis in PLS-SEM includes the assessments of; 1. composite reliability, ρ_c coefficient to indicate internal consistency, 2. average variance extracted (AVE) statistics to measure convergent validity, and 3. HTMT ratio to justify discriminant validity (Hair et al., 2019). As a result, all measurement model assessment criteria were passed after deletion of few items. All constructs demonstrated composite reliability, ρc more than 0.7 (Gefen, Straub, & Boudreau, 2000), AVE more than 0.5 (Fornell & Larcker, 1981), and

HTMT ratio below 0.85 (Kline, 2015). Summary of measurement model results for both travel purposes was attached in Appendix C.

Structural Model Analysis

To assess the significance of relationships between constructs in the structural model, values such as *t*-statistics and *p*-values were observed (Mandhani, Nayak, & Parida, 2020; Zhang, Liu, Lu, & Xiao, 2019). Meanwhile, path coefficients, β were assessed to indicate the direction of the relationships being studied (negative or positive relationships). A significant relationship should demonstrate *t*-statistics more than 1.65 ($t > 1.65$), for one-tailed test (Hair et al., 2019). All structural model results were illustrated in Figure 1 (work sample group) and Figure 2 (leisure sample group).

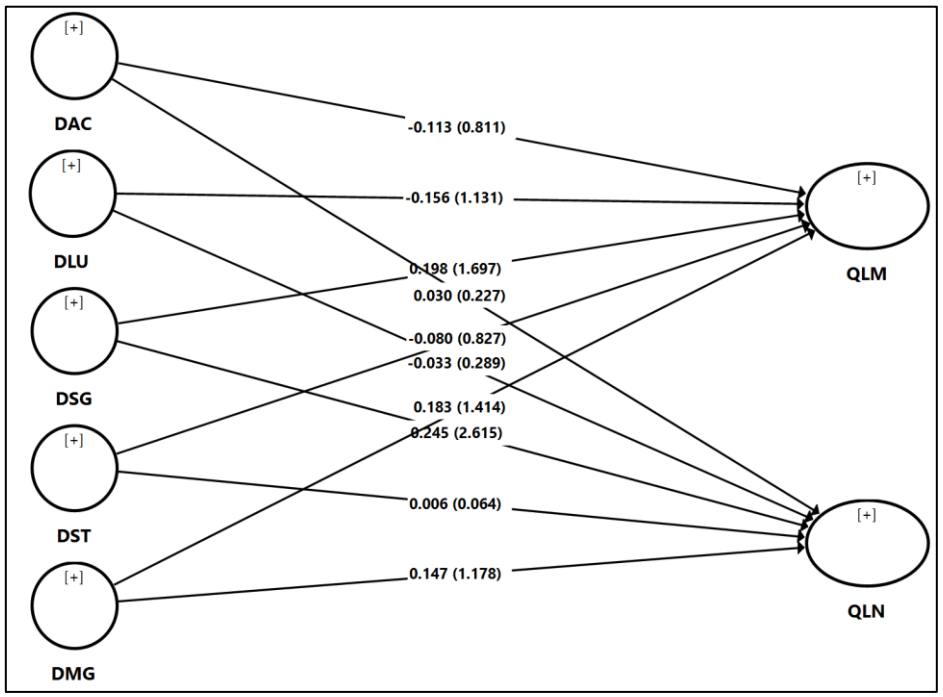

Figure 1: Structural model (work sample group, n = 192)

Note. DLU = Land-use diversity, DSG = Walkable design, DST = Density, DAC = Destination accessibility, DMG = Demand management, QLM = Quality of life: Mobility, QLN = Quality of life: Neighbourhood.
**Values inside brackets represent t-values. Values outside brackets represent path coefficients.*

Results presented in Figure 1 revealed that only two relationships were significant. DSG showed significant and positive relationships with both outcome variables, QLM ($\beta = 0.198$, $t = 1.697$) and QLN ($\beta = 0.245$, $t = 2.615$). The results were implying that only walkable design has a positive impact on residents'

neighbourhood and mobility qualities from the viewpoints of respondents who rode the train for working purpose.

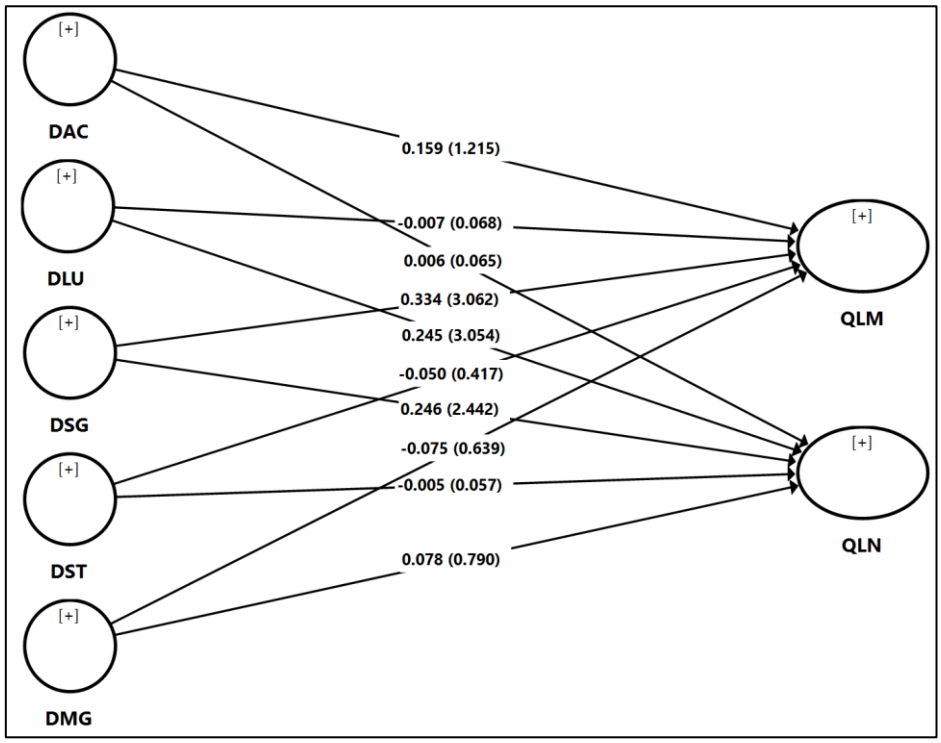

Figure 2: Structural model (leisure sample group, n = 168)
Note. DLU = Land-use diversity, DSG = Walkable design, DST = Density, DAC = Destination accessibility, DMG = Demand management, QLM = Quality of life: Mobility, QLN = Quality of life: Neighbourhood.
**Values inside brackets represent t-values. Values outside brackets represent path coefficients.*

In comparison to structural model of travel for working purpose, there were three significant relationships for leisure sample group structural model. In the same vein, DSG showed significant and positive relationships with both outcome variables, QLM (β = 0.334, t = 3.062) and QLN (β = 0.246, t = 2.442). Another significant relationship found in the leisure sample group structural model was between DLU and QLN (β = 0.245, t = 3.054). The results were implying that both land-use diversity and walkable design had a positive impact on residents' neighbourhood quality from the perspective of travel for leisure sample group. In addition, leisure sample group also demonstrated that walkable design had a positive impact on residents' mobility quality.

DISCUSSION AND CONCLUSION

Until recently, the impact of TOD adoption on communities' QoL was left untested in the academic studies. Existing studies had reported positive impact of TOD adoption on household transportation expenditures (Dong, 2021), positive impact of transit-oriented shopping mall developments on train ridership (Abutaleb et al., 2020) and positive relationship between TOD adoption and ridership demand (Nyunt & Wongchavalidkul, 2020). Although QoL was perceived as the benefit gained from TOD adoption in previous studies (Abdullah & Mazlan, 2016; Appleyard et al., 2019; Gomez et al., 2019; Yap et al., 2021), none of the study statistically test the relationship between TOD adoption and QoL.

On that account, the present study had produced a novel empirical evidence that portrayed the impact of critical success factors of TOD adoption on residents' QoL in the form of content neighbourhood and ease of mobility. PLS-SEM analysis performed in the present study demonstrated significant positive effects of "walkable design" principle on both QoL dimensions, for residents who travel to work. Additionally, residents who travel for leisure purpose also revealed a positive relationship between "land-use diversity" principle and neighbourhood. Besides residents' perspectives, the present study also considered the retail operators' viewpoints in estimating the impact of TOD adoption on QoL.

To the best of our research team's knowledge, statistical results that verify the impact of critical success factors of TOD adoption on communities' QoL was reported for the first time in the present study. Though direct comparisons with previous empirical studies were not relevant due to differences in operationalisation of TOD success factors and QoL dimensions being studied, current finding offered a novel empirical evidence by operationalising TOD adoption based on its development principles (i.e., 5Ds) and testing QoL as its outcome variable. Current finding also supported notions of prior scholars who viewed QoL as the benefit realised from TOD adoption (Abdullah & Mazlan, 2016; Appleyard et al., 2019; Gomez et al., 2019; Yap et al., 2021). Albeit statistical evidence from this study verified that not all TOD principles would affect QoL of the studied community, it highlighted factors that are truly critical (i.e., walkable design and land-use diversity) in ensuring TOD adoption brings benefits to the community.

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APPENDICES

Appendix A: KTM Commuter Northern Sector Stations

No.	Station Names	No.	Station Names
1.	Padang Besar	11.	Bukit Mertajam
2.	Bukit Ketri	12.	Bukit Tengah
3.	Arau	13.	Butterworth
4.	Kodiang	14.	Simpang Ampat
5.	Anak Bukit	15.	Nibong Tebal
6.	Alor Setar	16.	Parit Buntar
7.	Kobah	17.	Bagan Serai
8.	Gurun	18.	Kamunting
9.	Sungai Petani	19.	Taiping
10.	Tasek Gelugor	20.	Padang Rengas

Appendix B: Sample size determination based on Cohen's (1992) rule of thumb

Exhibit 1.7 Sample Size Recommendation a in PLS-SEM for a Statistical Power of 80%

Maximum Number of Arrows Pointing at a Construct	Significance Level											
	1%				5%				10%			
	Minimum R^2				Minimum R^2				Minimum R^2			
	0.10	0.25	0.50	0.75	0.10	0.25	0.50	0.75	0.10	0.25	0.50	0.75
2	158	75	47	38	110	52	33	26	88	41	26	21
3	176	84	53	42	124	59	38	30	100	48	30	25
4	191	91	58	46	137	65	42	33	111	53	34	27
5	205	98	62	50	147	70	45	36	120	58	37	30
6	217	103	66	53	157	75	48	39	128	62	40	32
7	228	109	69	56	166	80	51	41	136	66	42	35
8	238	114	73	59	174	84	54	44	143	69	45	37
9	247	119	76	62	181	88	57	46	150	73	47	39
10	256	123	79	64	189	91	59	48	156	76	49	41

Source: Cohen, J. A power primer. *Psychological Bulletin*, 112, 155–519.

Source: Adopted from Hair et al. (2017)

Appendix C: Full results of measurement model assessments

Constructs	Code	Items	Factor Loadings	
			Work	**Leisure**
DLU	DLU01	Residential area development	.787	.706
	DLU02	Commercial area development	.825	.872
	DLU03	Institutional area development	.730	.827
	DLU04	Industrial area development	.874	.807
DSG	DSG01	Pedestrian walkway with roof	.755	
	DSG02	Pedestrian walkway with safety feature	.763	.663
	DSG03	Pedestrian walkway connected to surrounding establishments	.695	.666
	DSG04	Pedestrian walkway connected to bus and taxi stations	.741	.715
	DSG05	Pedestrian walkway with shaded trees	.707	Deleted
	DSG06	Pedestrian walkway that PWD-friendly	.684	.671
	DSG07	Streets with adequate intersections to provide good connectivity	.760	.816
	DSG08	Streets with dead-ends to limit private vehicles passing through station areas	.717	.752
	DSG09	Streets with adequate wayfinding	.727	.721
DST	DST01	Population density	.873	.838
	DST02	Employment density	.884	.922
	DST03	Urban density	.842	.801
DAC	DAC01	Various transportation choices in proximity	.564	.847
	DAC02	Various bus service operators	.835	.867
	DAC03	Availability of bus stop in proximity	.830	.861
	DAC04	Located near highway exit / entrance	.756	.688
DMG	DMG01	Park-and-ride building	.649	.703
	DMG02	On-land car park	.665	.754
	DMG03	Parking spaces for bicycles	.589	.674
	DMG04	Municipal / public service facilities	.758	.814
	DMG05	Retail services	.833	.794
	DMG06	Located nearby landmarks	.860	.735

Note. DLU = Land-use diversity, DSG = Walkable design, DST = Density, DAC = Destination accessibility, DMG = Demand management

Constructs	Code	Items	Factor Loadings	
			Work	**Leisure**
QLM	QLM01	My neighbourhood is well served with public transport.	.609	Deleted
	QLM02	The use of public transport saves my travel expenses.	Deleted	.750
	QLM03	The use of public transport saves my travel time.	.480	.759
	QLM04	Many residents of my neighbourhood prefer to use public transportation rather than their own vehicles.	.723	Deleted
	QLM05	My neighbourhood is easy to walk around.	.690	.658
	QLM06	I can easily walk to the train station from my house.	.796	Deleted
	QLM07	I feel safe from traffic (road) accidents while walking / cycling.	.797	Deleted
	QLM08	It is easy to cross the street in my neighbourhood.	.839	Deleted
	QLM09	The provided pedestrian walkways are always in good condition.	.782	.738
	QLM10	Most drivers give way to pedestrians crossing the road.	.718	.631
QLN	QLN01	Comfort and better place to live than other areas.	.669	Deleted
	QLN02	Well-maintained from time to time.	.754	.720
	QLN03	Free from any pollution	.751	Deleted
	QLN04	Free from traffic congestion.	Deleted	Deleted
	QLN05	Free from social problems and crime cases	.685	Deleted
	QLN06	Has a good road facility	.711	.695
	QLN07	Has many public spaces for recreation	.704	.744
	QLN08	Has access to many employment opportunities	Deleted	Deleted
	QLN09	Well-provided with community facilities	.713	.663
	QLN10	Has strong sense of community	.741	.768
	QLN11	Can shop complete daily necessities	Deleted	.763
	QLN12	Feel safe walking at any time	.657	.761
	QLN13	Cost of living is not burdensome	Deleted	.662
	QLN14	Houses are affordable for all income groups	Deleted	Deleted

Note. QLM = Quality of life: Mobility, QLN = Quality of life: Neighbourhood

Constructs	Composite Reliability		Average Variance Extracted	
	Work	Leisure	Work	Leisure
DLU	.881	.880	.649	.649
DSG	.910	.880	.530	.514
DST	.901	.891	.751	.731
DAC	.838	.890	.569	.671
DMG	.872	.883	.536	.558
QLM	.906	.834	.522	.503
QLN	.901	.904	.505	.512

Note. DLU = Land-use diversity, DSG = Walkable design, DST = Density, DAC = Destination accessibility, DMG = Demand management, QLM = Quality of life: Mobility, QLN = Quality of life: Neighbourhood

HTMT Ratio (leisure sample group, n = 192)

Constructs	DMG	DST	DSG	DAC	DLU	QLM	QLN
DMG							
DST	.582						
DSG	.763	.478					
DAC	.831	.582	.707				
DLU	.651	.633	.469	.522			
QLM	.172	.114	.185	.123	.159		
QLN	.313	.187	.359	.254	.186	.639	

HTMT Ratio (leisure sample group, n = 168)

Constructs	DMG	DST	DSG	DAC	DLU	QLM	QLN
DMG							
DST	.562						
DSG	.742	.677					
DAC	.758	.605	.759				
DLU	.519	.579	.547	.581			
QLM	.245	.220	.410	.351	.196		
QLN	.377	.340	.461	.365	.403	.727	

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