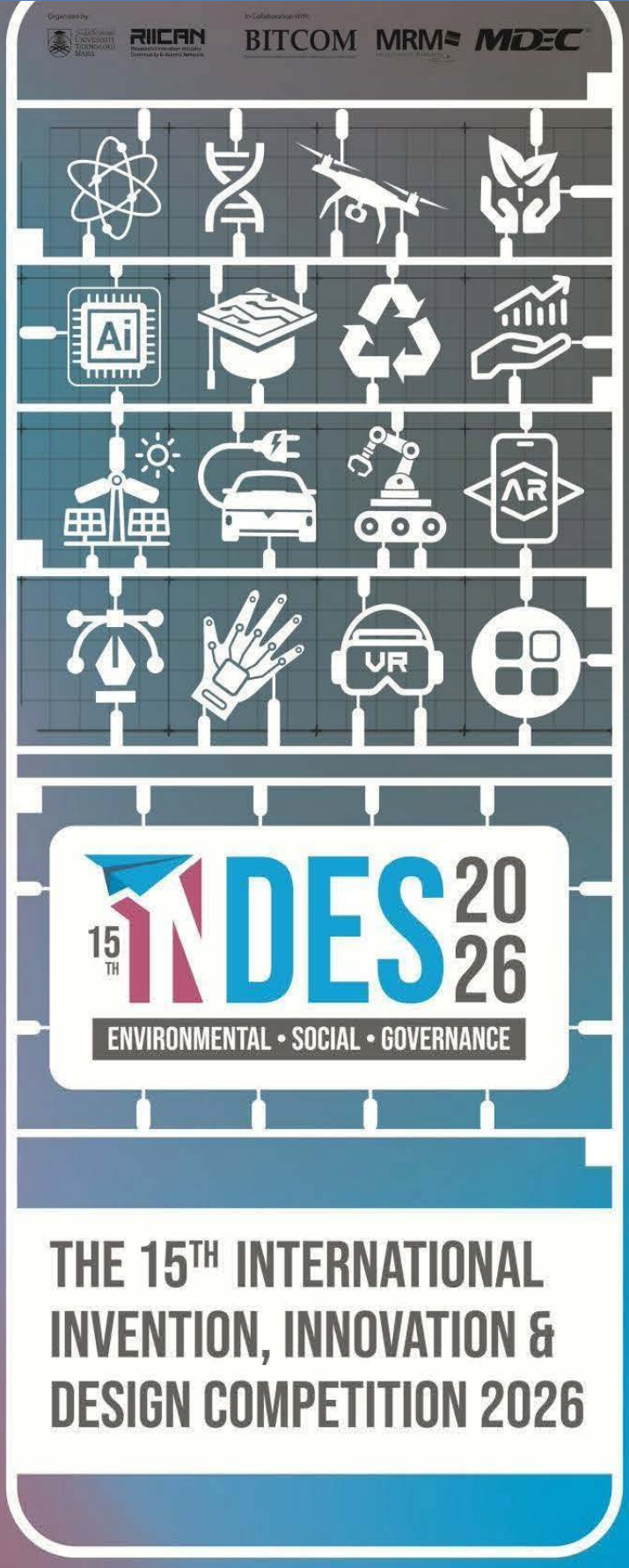


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EXTENDED ABSTRACT

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THE 15th INTERNATIONAL
INVENTION, INNOVATION &
DESIGN COMPETITION 2026

Organized by:
Office of Research, Industry,
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aCCSC: Technology-Enabled Citizen-Centric Smart City Framework

Che Ahmad Rahiman Bin Che Rozaid[1], Seng Boon Lim[1*], Mohd Fadzil Bin Abdul Rashid[1], Nor Hisham Bin Md Saman[1], Suraya Binti Masrom[2]

[1]Faculty of Built Environment, Universiti Teknologi MARA Cawangan Perak, 32610, Seri Iskandar, Perak, Malaysia
[2]Faculty of Computer and Mathematical Sciences, Universiti Teknologi MARA Cawangan Perak, 32610, Seri Iskandar, Perak, Malaysia

Corresponding author: lim@uitm.edu.my

ABSTRACT

In current citizen-centric smart city research, citizen participation and responsibility are emphasised, yet the role of technological elements remains theoretically under-specified. This study develops an adapted Citizen-Centric Smart City (aCCSC) framework by integrating technology enablement from the Social-Ecological-Technological Systems (SETS) perspective into the CCSC framework (Lim & Malek, 2022). Using Ipoh City Council (MBI) as the case study, data were collected via a structured questionnaire administered to 397 respondents. Descriptive analysis and SEM-PLS were employed to examine the effects of Citizen Participation (i.e., Participation Level, Participation Literacy, and Participation Cycle), Citizen Responsibility (i.e., Citizen Role, and Civic Attitude), and Technology Enablement (i.e., Digital Infrastructure, IoT, and Online Platform) on aCCSC. The results show that Participation Level ($\beta = 0.299$, $p < 0.001$), Participation Literacy ($\beta = 0.268$, $p < 0.001$), Civic Attitude ($\beta = 0.179$, $p = 0.004$), and Citizen Role ($\beta = 0.143$, $p = 0.026$) significantly influence aCCSC. In contrast, Participation Cycle, Digital Infrastructure, IoT, and Online Platform are not statistically significant as direct predictors of aCCSC. The model explains 46.4% of the variance in aCCSC ($R^2 = 0.464$). These findings reposition technology not as a primary driver, but as an enabling condition that supports and amplifies citizen-centric processes. The study contributes a rebalanced smart city framework that prioritises citizen-driven governance while systematically positioning technology as an enabling domain.

Keywords: Citizen-centric, smart city development, social inclusion, socio-ecological-technological system (SETS), technology enablement

1. INTRODUCTION

Smart city development has expanded rapidly as cities pursue urban efficiency, service delivery, and sustainability through digital transformation. However, many initiatives remain technology-driven, positioning citizens primarily as end users rather than active actors in governance (Kummitha & Crutzen, 2017). In response, the citizen-centric smart city (CCSC) framework positions citizens as co-producers of urban services and governance, yet gives limited attention to how technological elements support participation and decision-making (Lim & Malek, 2022). This gap is particularly critical in Malaysia, where local authorities are advancing smart city agendas, yet the transition from technology-centred implementation to people-centred governance remains uneven. This study addresses this gap by adapting the CCSC framework (see Figure 1) through the integration of technology enablement derived from the Social-Ecological-Technological Systems (SETS) perspective (Branny et al., 2022; Sharifi, 2023). Using a local authority case study in Malaysia, this study examines the relationships between citizen participation, citizen responsibility, and technology enablement in shaping a more balanced citizen-centric smart city framework.

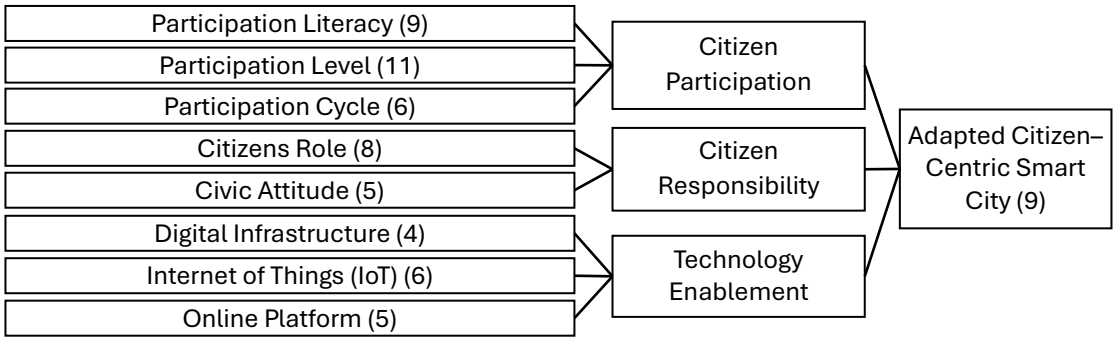


Figure 1 Conceptual framework for the adapted citizen-centric smart city
Source: adapted from Lim and Malek (2022), and Sharifi (2023)

2. METHODOLOGY

The study adopted a quantitative case study design focusing on the Ipoh City Council (MBI) jurisdiction. Ipoh was selected as it represents a growing Malaysian city actively pursuing smart city initiatives while facing challenges in strengthening citizen participation and integrating technology into governance. The population of Ipoh is approximately 872,424, with a minimum sample size of 386, determined at the 95% confidence level with a 5% margin of error. A total of 397 valid responses were collected between 1 and 31 December 2025 using a structured questionnaire. Data collection was conducted across multiple settings, including local authority programmes, community activities, commercial areas, and online platforms. Stratified random sampling was employed to ensure representation across different urban population segments. A pilot study involving 30 respondents was conducted to ensure instrument clarity and reliability. Data were analysed using descriptive statistics and Partial Least Squares Structural Equation Modelling (PLS-SEM) to assess both measurement and structural relationships.

3. FINDINGS

The respondent profile indicates a predominantly male sample (65.3%) with a concentration in the 20–29 age group (33.8%). Despite diverse educational backgrounds, organised grassroots participation remains limited, with 37.8% inactive in residents' associations and 36.5% residing in areas without such organisations. This suggests that Ipoh could be in the weak institutionalisation of community-based participation. The structural relationships of the adapted Citizen-Centric Smart City Framework (aCCSC), as illustrated in Figure 2, provide empirical support for this condition. Of the 62 measurement items, 51 met the required validity thresholds, indicating a robust measurement model. At the structural level, Participation Level ($\beta = 0.299$, $p < 0.001$) emerged as the strongest predictor of aCCSC, followed by Participation Literacy ($\beta = 0.268$, $p < 0.001$), Civic Attitudes ($\beta = 0.179$, $p = 0.004$), and Citizen Roles ($\beta = 0.143$, $p = 0.026$). These results confirm that governance- and citizen-related dimensions are the primary drivers of smart city outcomes, as outlined by Lim and Malek (2022).

In contrast, Participation Cycle ($\beta = -0.021$, $p = 0.759$), Digital Infrastructure ($\beta = -0.074$, $p = 0.114$), Internet of Things (IoT) ($\beta = 0.045$, $p = 0.374$), and Online Platform ($\beta = -0.015$, $p = 0.744$) did not demonstrate significant direct effects. This indicates that technology-related constructs do not function as direct determinants of aCCSC in the current context, but rather serve as enabling conditions that support participatory and governance processes. This finding extends the SETS perspective (Sharifi, 2023) by empirically demonstrating that technological elements function as enabling rather than driving components within the system. The model explains 46.4% of the variance in aCCSC ($R^2 = 0.464$), indicating moderate explanatory power. Collectively, this reinforces

the argument that smart city development in Ipoh is fundamentally citizen-driven, with technology acting as a complementary enabler rather than a primary driver.

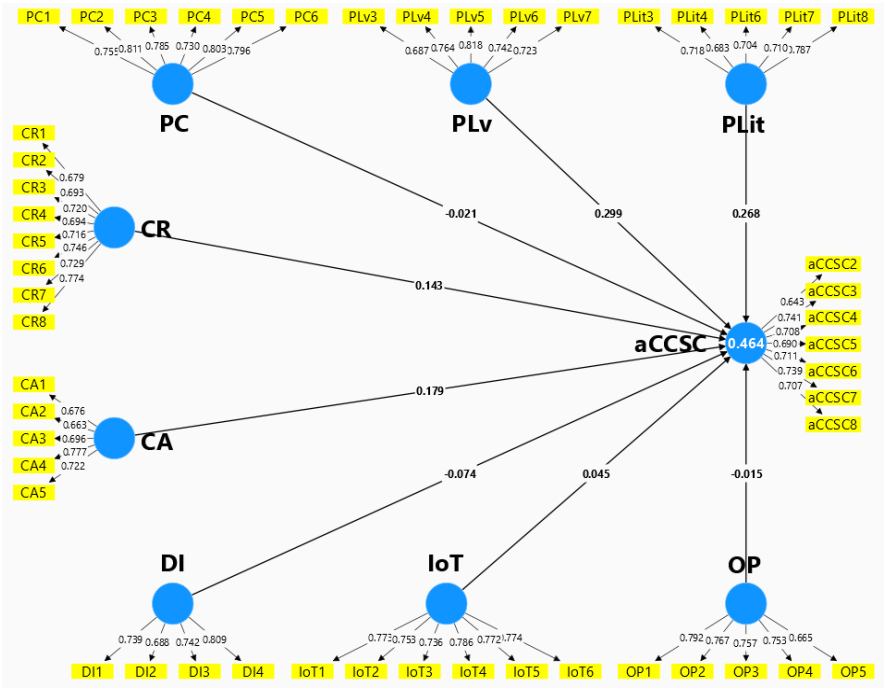


Figure 2 Structural Model of the Adapted Citizen-Centric Smart City Framework (aCCSC) using PLS-SEM Analysis
Source: author

4. CONCLUSION

This study demonstrates that smart city outcomes are primarily driven by citizen participation and citizen responsibility, while technology functions as an enabling condition rather than a direct driver. These findings challenge the assumption that expanding digital infrastructure alone will produce stronger citizen-centric outcomes. Local authorities should invest not only in digital platforms and systems, but also in participation, literacy, meaningful engagement, civic attitudes, and active citizen roles. The proposed aCCSC framework provides a more grounded basis for aligning Malaysian smart city implementation with people-centred urban governance by explicitly positioning technology as an enabling domain.

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