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Quality of Life and Digital Transformation in a Thai University: A Smart Campus Perspective

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ABSTRACT

Quality of Life (QoL) in digitally transformed institutions is often discussed in terms of technological efficiency, yet it is experienced through everyday interactions with spaces, environments, and organizational practices. University campuses provide a compelling context for examining this tension, as smart buildings, environmental management, security systems, and energy practices increasingly shape daily academic and social life. This study investigates how Quality of Life is perceived within a smart campus at a public university in Thailand, focusing on the institutional conditions through which digital transformation is lived and interpreted. Survey data were collected from 547 members of the university community using a structured questionnaire. Quality of Life was conceptualized as a higher-order construct reflected by five interrelated dimensions: Smart Building, Smart Environment, Smart People, Smart Security, and Smart Energy. A second-order confirmatory factor analysis was employed to examine the structure of these dimensions and their collective contribution to perceived Quality of Life. The model demonstrates good fit to the data (CFI = 0.954, TLI = 0.950, RMSEA = 0.049). All dimensions contribute significantly to Quality of Life, with Smart Environment showing the strongest association (standardized loading = 0.95), followed by Smart Building (0.84). These findings suggest that Quality of Life in smart campuses emerges less from isolated technologies than from the ways institutional spaces and environmental conditions are experienced in everyday life, highlighting the social and cultural dimensions of smart campus development.

Keywords: Quality of Life, Smart Campus, Smart Building, Institutional Environment, Digital Transformation

INTRODUCTION

Digital technologies are increasingly shaping the ways in which individuals navigate institutional spaces, interact with their environments, and experience daily routines. In universities undergoing digital transformation, smart buildings regulate comfort and access, environmental systems affect daily well-being, security infrastructures influence perceptions of safety, and energy practices inform both sustainability narratives and lived conditions. In these contexts, Quality of Life (QoL) is experienced not as an abstract policy objective or technical metric, but as an integral aspect of everyday academic and social life.

Although Quality of Life has an experiential dimension, discussions in smart and digitally mediated environments have frequently focused on technological efficiency, system performance, and infrastructural optimization. Smart city research has traditionally prioritized connectivity, automation, and data-driven management. In contrast, recent scholarship advocates for more human-centered perspectives that acknowledge the influence of smart environments on everyday living conditions, social experiences, and perceptions of safety (Ahvenniemi et al., 2017; Albino et al., 2015). Within this evolving discourse, Quality of Life has become a central

criterion for assessing whether digital transformation enhances lived experience rather than solely improving technical capability.

Quality of Life is broadly recognized as a multidimensional phenomenon shaped by the interplay of physical, environmental, social, and institutional factors. Research on urban and institutional well-being demonstrates that individuals assess their quality of life through the intersection of multiple conditions in daily life, including comfort within built environments, environmental quality, social interaction, governance practices, and access to resources (Marans & Stimson, 2011). Systematic reviews further highlight that capturing Quality of Life necessitates consideration of both objective conditions and subjective perceptions, especially in complex, digitally mediated environments (Bolzan Wesz et al., 2023; Răducan et al., 2025). This perspective supports hierarchical approaches to QoL, which conceptualize overall quality of life as an emergent outcome of interrelated dimensions rather than isolated indicators.

Empirical studies within smart city contexts reinforce this integrated perspective. Environmental quality, infrastructure design, governance structures, and social conditions collectively influence how individuals assess their quality of life in smart environments (Macke et al., 2018; Hartley, 2023). These findings indicate that Quality of Life is not merely a by-product of individual technologies, but rather reflects the coordination and experience of institutional systems in everyday contexts. However, empirical research examining Quality of Life as a hierarchical and integrated construct remains limited in higher education settings, where digital transformation increasingly shapes both academic routines and social interactions.

University campuses provide a particularly relevant context for investigating these dynamics. As higher education institutions implement smart technologies, campuses increasingly function as micro-scale smart cities, characterized by dense populations, complex infrastructures, and integrated systems for buildings, environmental management, security, and energy use (Neirotti et al., 2014; Yigitcanlar et al., 2018). Simultaneously, campuses serve as lived environments where students, faculty, and staff navigate institutional rules, norms, and expectations daily. This intersection of technological integration and social interaction positions smart campuses as valuable sites for examining how Quality of Life is shaped through everyday engagement with digitally governed environments.

Investigating Quality of Life in these contexts necessitates methodological approaches that reflect its multidimensional character and remain attentive to lived experience. Confirmatory Factor Analysis (CFA) offers a theory-driven framework for analyzing the relationships between observed indicators and underlying constructs, and for determining whether multiple domains collectively shape an overarching Quality of Life construct (Kline, 2016; Hu & Bentler, 1999). When utilized as a second-order model, CFA enables researchers to examine how interrelated institutional dimensions converge to form broader perceptions of Quality of Life, without reducing lived experience to isolated technical measures.

This study examines Quality of Life within a smart campus at a public university in Thailand, conceptualizing QoL as a higher-order construct represented by five interrelated dimensions: Smart Building, Smart Environment, Smart People, Smart Security, and Smart Energy. Utilizing survey data from 547 university community members, the research applies second-order confirmatory factor analysis to investigate how these dimensions collectively shape perceptions of Quality of Life. By emphasizing the everyday experience of digital transformation within institutional life, this study reframes smart campus development as a social and cultural process and contributes to broader discussions of digital transformation and social change in higher education.

Beyond technological infrastructures, Quality of Life is produced through everyday encounters with institutional spaces that shape how individuals move, interact, and attribute meaning to their surroundings. From this perspective, digitally mediated environments such as smart campuses can be understood as socially produced spaces, where technological systems are embedded within organizational routines and cultural practices (Lefebvre, 1991; Orlikowski, 2000).

Quality of Life as A Socially and Institutionally Embedded Concept

Quality of Life (QoL) has long been examined across disciplines such as urban studies, sociology, psychology, and public policy. Rather than being understood as a purely objective condition, QoL is increasingly conceptualized as a socially embedded phenomenon shaped by interactions between individuals and their environments. Foundational work in quality-of-life research emphasizes that well-being emerges through everyday experiences with physical settings, social relationships, institutional arrangements, and access to resources, rather than through isolated material conditions alone (Marans & Stimson, 2011).

Within urban and institutional contexts, QoL is commonly described as a multidimensional construct that integrates both objective conditions—such as environmental quality or infrastructural provision—and subjective perceptions, including satisfaction, safety, and a sense of belonging. This dual perspective reflects the recognition that people evaluate their quality of life not only based on measurable conditions, but also on how those conditions

are interpreted and experienced in daily life (Diener et al., 1999; Cummins, 2005). As a result, contemporary QoL research increasingly focuses on how institutional settings shape lived experience, norms, and expectations.

Systematic reviews of urban quality-of-life research highlight the limitations of fragmented or single-domain approaches. Studies that focus exclusively on economic performance, technological infrastructure, or service efficiency often fail to capture how multiple dimensions of everyday life interact to shape well-being (Bolzan Wesz et al., 2023). These findings support hierarchical conceptualizations of Quality of Life, in which overall well-being is understood as an overarching construct emerging from interrelated domains rather than as a direct outcome of any single factor.

From an institutional perspective, Quality of Life is shaped by organizational arrangements that structure expectations, routines, and shared meanings. Institutions influence how individuals interpret environmental conditions, technological systems, and social relations, positioning Quality of Life as a collectively mediated experience rather than an individual psychological state (Scott, 2014).

Quality Of Life in Smart and Digitally Mediated Environments

The rise of smart cities has intensified scholarly interest in the relationship between digital technologies and Quality of Life. Early smart city research largely emphasized technological innovation, data-driven management, and infrastructural efficiency. However, critics have noted that such approaches often overlook the social and experiential consequences of digital transformation, reducing urban life to technical performance indicators (Albino et al., 2015; Caragliu et al., 2011).

In response, recent scholarship has increasingly reframed smart cities as socio-technical environments in which technologies interact with governance practices, cultural norms, and everyday routines. From this perspective, the success of smart initiatives is evaluated not only by their technical capabilities, but by their capacity to enhance lived experience, environmental quality, and social well-being (Ahvenniemi et al., 2017; Yigitcanlar et al., 2019). Quality of Life has thus emerged as a central concept for assessing whether smart environments meaningfully contribute to human-centered outcomes.

Empirical studies support this shift. Research examining citizens' perceptions of smart city initiatives demonstrates that Quality of Life is shaped by the combined influence of environmental sustainability, infrastructural design, governance arrangements, and social conditions (Macke et al., 2018). Similarly, studies focusing on governance and public perception highlight that smart technologies influence well-being indirectly, through their effects on trust, safety, accessibility, and everyday convenience rather than through technological novelty alone (Hartley, 2023).

Despite these advances, much of the existing literature continues to operationalize Quality of Life through isolated indicators or single-domain measures. Such approaches risk overlooking the interdependence of smart city dimensions and the institutional contexts in which they are embedded. As a result, there remains a need for empirical frameworks that capture Quality of Life as an integrated outcome of multiple, interrelated dimensions within digitally mediated environments.

Smart Campuses as Micro-Scale Smart Cities and Sites of Social Change

University campuses have increasingly been conceptualized as micro-scale smart cities, reflecting their dense populations, complex infrastructures, and integrated management systems. Like cities, campuses incorporate smart buildings, environmental management systems, security infrastructures, and energy networks, all of which shape everyday movement, interaction, and perception. However, campuses also differ from cities in important ways: they are institutionally bounded, centrally governed, and characterized by shared organizational norms and routines.

These characteristics make smart campuses particularly valuable sites for examining how digital transformation influences Quality of Life. Previous research suggests that campuses function as living laboratories for smart city concepts, allowing researchers to observe how integrated systems affect everyday experience within a relatively controlled environment (Neirotti et al., 2014; Yigitcanlar et al., 2018). At the same time, campuses are social and cultural spaces where academic identities, power relations, and institutional expectations are continuously negotiated.

Studies conducted in campus and quasi-urban settings indicate that smart initiatives influence Quality of Life through multiple pathways. Improvements in environmental quality, safety, accessibility, and resource management have been associated with increased satisfaction and perceived well-being among students and staff. Importantly, these outcomes are rarely attributed to individual technologies alone; instead, they emerge from how institutional systems are coordinated and embedded within daily routines (Macke et al., 2018).

Viewing smart campuses as sites of social change highlights the need to examine Quality of Life not merely as an outcome of technological deployment, but as a reflection of broader institutional transformations. Digital governance, sustainability narratives, and security practices shape how individuals experience inclusion, comfort,

and control within academic environments. As such, Quality of Life in smart campuses can be understood as both a lived experience and a culturally mediated outcome of institutional design.

Critical perspectives on smart urbanism emphasize that smart environments are not neutral technological systems but socio-technical arrangements that reorganize governance, visibility, and everyday life. In smart campuses, data-driven infrastructures influence how safety, sustainability, and efficiency are perceived and negotiated by campus members (Kitchin, 2014).

Hierarchical Approaches to Quality of Life and Measurement Implications

Given its multidimensional and socially embedded nature, Quality of Life requires analytical frameworks capable of capturing interdependence among domains. Hierarchical models of QoL address this challenge by conceptualizing overall quality of life as a higher-order construct shaped by multiple, correlated dimensions. This approach aligns with theoretical perspectives that view well-being as an emergent outcome of interconnected life domains rather than as a direct function of isolated conditions (Marans & Stimson, 2011).

In smart and institutional environments, hierarchical approaches are particularly relevant. Dimensions such as environmental sustainability, infrastructure quality, social capacity, security, and energy management are inherently interconnected and often operate through shared governance structures. Empirical research indicates that treating these dimensions as independent variables can obscure their collective influence on perceived Quality of Life (Răducan et al., 2025).

From a methodological standpoint, confirmatory factor analysis provides a theory-driven means of examining hierarchical QoL structures. Second-order CFA enables researchers to assess whether multiple first-order dimensions can be understood as reflecting an overarching Quality of Life construct, while preserving the conceptual distinctiveness of each domain (Kline, 2016). When applied in institutional contexts, this approach supports empirical examination of how integrated systems shape lived experience, rather than reducing Quality of Life to a set of disconnected indicators.

Research Gap and Conceptual Positioning of the Present Study

Although prior research acknowledges the multidimensional nature of Quality of Life in smart environments, empirical studies that integrate hierarchical QoL theory with institutional contexts such as higher education remain limited. Existing studies often emphasize technological capability or policy outcomes, leaving the social and cultural dimensions of everyday experience underexplored.

This study addresses this gap by examining Quality of Life within a smart campus as a socially and institutionally embedded construct. By conceptualizing QoL as a higher-order outcome shaped by five interrelated smart campus dimensions—Smart Building, Smart Environment, Smart People, Smart Security, and Smart Energy—this research bridges smart city scholarship with cultural and institutional perspectives. In doing so, it contributes to broader discussions of how digital transformation reshapes everyday life and social change within higher education institutions.

MATERIALS AND METHODS

Research Approach

A **quantitative research approach** was used to examine how Quality of Life (QoL) is experienced on a digitally transformed university campus. Rather than viewing QoL only as a technical or managerial outcome, this study considers it as shaped by daily interactions with institutional spaces, services, and practices. A survey-based design was chosen to capture the shared perceptions of university community members who regularly engage with smart campus environments.

The research focuses on identifying patterns of experience at the institutional level rather than individual psychological states. By examining collective perceptions of various smart campus dimensions, the study clarifies how Quality of Life results from the coordinated functioning of buildings, environmental management, security, and energy practices within a single institution.

Research Setting

The research was conducted at Mahasarakham University, a large public institution in Thailand with a diverse population of students, faculty, and staff. In recent years, the university has implemented smart building systems, environmental monitoring, digital security infrastructure, and campus-wide energy efficiency initiatives.

The university campus is viewed as a micro-scale smart city, where digital systems, organizational rules, and daily routines intersect within a single institutional environment. Unlike urban settings with multiple authorities, the campus operates under centralized governance, offering a coherent context to examine how digital

transformation affects Quality of Life. This setting allows for focused analysis of how institutional design influences comfort, safety, sustainability, and well-being.

Participants and Data Collection

Participants included undergraduate and graduate students, academic staff, and administrative personnel from the university community. These groups regularly navigate campus spaces, interact with smart systems, and experience digital transformation in their daily routines.

Data were collected using a structured questionnaire distributed during the academic year. A total of 547 completed questionnaires were analyzed, providing a sufficient sample to capture diverse experiences across institutional roles and support robust analysis of institutional perceptions.

Participation was voluntary. Respondents were informed of the research purpose and assured of anonymity. No personally identifiable information was collected, allowing participants to provide candid feedback without concern for institutional oversight.

Instrument Development

The questionnaire was designed to capture how Quality of Life is experienced through daily engagement with the smart campus environment. Rather than focusing on technical system performance, items assessed perceptions of institutional conditions that influence daily campus life.

Quality of Life was assessed across five interrelated dimensions: Smart Building, Smart Environment, Smart People, Smart Security, and Smart Energy. These dimensions represent the main domains through which digital transformation appears in daily campus life. For example, smart building items addressed comfort, accessibility, and movement; environmental items focused on cleanliness, sustainability, and quality; smart people items reflected awareness, participation, and digital readiness; security items captured perceptions of safety and surveillance; and energy items addressed sustainability and responsible resource use.

All items were measured using a five-point Likert-type scale, from strong disagreement to strong agreement. Experts in Quality of Life research and smart campus development reviewed the instrument to ensure conceptual grounding and contextual relevance. Their feedback informed refinements to item wording and improved clarity before data collection.

Analytical Strategy

Data analysis was guided by the view that Quality of Life is a multidimensional and integrated construct. Confirmatory factor analysis (CFA) was used in two stages. First, relationships between individual questionnaire items and their dimensions were examined to assess coherence. Second, a higher-order model tested whether these dimensions collectively shape an overarching perception of Quality of Life.

This analytical strategy was chosen to align theoretical constructs with empirical evidence, not to emphasize methodological complexity. By examining the convergence of multiple dimensions, the analysis interprets Quality of Life as an outcome of coordinated institutional conditions rather than independent experiences.

Trustworthiness of the Measurement

The reliability and validity of the measurement model were evaluated to ensure the findings accurately represent participants' experiences. Internal consistency confirmed that items within each dimension reflected a shared perception, while convergent and discriminant validity verified that dimensions were related yet conceptually distinct.

Because institutional dimensions such as environment, security, and energy management are interconnected, the analysis allowed for some conceptual overlap while maintaining analytical clarity. This approach reflects the reality of smart campus environments, where institutional systems rarely operate independently.

Ethical Considerations

Ethical approval for the study was obtained from the **Institutional Review Board of Mahasarakham University**. All participants provided informed consent prior to participation. The study adhered to ethical principles of voluntary participation, confidentiality, and respect for participants' autonomy. Data were handled responsibly and used solely for academic research purposes.

RESULTS

This section presents results from a second-order confirmatory factor analysis (CFA) of Quality of Life (QoL) as a higher-order construct shaped by five interrelated smart campus dimensions: Smart Building (SB), Smart Environment (SE), Smart People (SP), Smart Security (SS), and Smart Energy (SG). Based on responses from 547

university community members, the analysis assesses how these dimensions collectively influence perceived Quality of Life on campus.

Instead of viewing these dimensions as separate technical components, the analysis examines how they operate together as an integrated system shaping daily experiences, perceptions, and well-being within the smart campus.

Measurement Model and Indicator Reliability

The analysis first assessed how individual questionnaire items reflected their respective institutional dimensions. Indicator reliability was evaluated using standardized factor loadings, explained variance (R^2), and error variances. As shown in Table 1, all indicators load strongly and significantly on their intended constructs ($p < 0.001$), with standardized loadings from 0.720 to 0.866.

These results show that the items consistently capture shared perceptions of campus conditions within each dimension. The explained variance values (R^2), ranging from 0.518 to 0.750, indicate that a substantial portion of respondents' evaluations is explained by the corresponding institutional domains. This suggests that experiences related to buildings, environment, people, security, and energy are perceived as coherent aspects of campus life, not as isolated elements.

Overall, the indicator-level results confirm that the measurement items reliably represent key aspects of everyday experience within the smart campus environment.

Table 1. Standardized Factor Loadings and Indicator Reliability

Indicator	Loading	R^2	Error Variance
SB1	0.828	0.686	0.314
SB2	0.799	0.639	0.361
SB3	0.818	0.669	0.331
SB4	0.829	0.687	0.313
SB5	0.828	0.686	0.314
SB6	0.755	0.570	0.430
SB7	0.838	0.702	0.298
SB8	0.829	0.687	0.313
SB9	0.827	0.684	0.316
SB10	0.821	0.674	0.326
SE1	0.743	0.552	0.448
SE2	0.770	0.593	0.407
SE3	0.784	0.615	0.385
SE4	0.819	0.671	0.329
SE5	0.803	0.645	0.355
SE6	0.733	0.537	0.463
SP1	0.810	0.656	0.344
SP2	0.777	0.604	0.396
SP3	0.829	0.687	0.313
SP4	0.782	0.612	0.388
SP5	0.814	0.663	0.337
SP6	0.823	0.677	0.323
SS1	0.839	0.704	0.296
SS2	0.831	0.691	0.309
SS3	0.830	0.689	0.311
SS4	0.834	0.696	0.304
SS5	0.855	0.731	0.269
SS6	0.849	0.721	0.279
SS7	0.821	0.674	0.326
SS8	0.866	0.750	0.250
SS9	0.855	0.731	0.269
SG1	0.744	0.554	0.446
SG2	0.720	0.518	0.482
SG3	0.810	0.656	0.344
SG4	0.809	0.654	0.346
SG5	0.812	0.659	0.341
SG6	0.756	0.572	0.428
SG7	0.766	0.587	0.413
SG8	0.840	0.706	0.294

Construct Reliability and Convergent Validity

At the construct level, reliability and convergent validity were assessed using Composite Reliability (CR) and Average Variance Extracted (AVE). As shown in Table 2, all five dimensions demonstrate strong internal consistency, with CR values from 0.901 to 0.956. These results indicate that respondents' evaluations within each dimension are highly consistent, reflecting shared interpretations of institutional conditions.

Convergent validity is also well supported. AVE values from 0.602 to 0.710 exceed recommended thresholds, indicating that each construct explains a substantial proportion of variance in its indicators. This suggests that perceptions of smart buildings, environmental quality, people, security, and energy practices each form coherent domains within the campus setting.

Together, these findings show that the proposed dimensions provide a stable and meaningful representation of how Quality of Life is perceived across institutional domains.

Table 2. Reliability and Convergent Validity

Construct	#Items	CR	AVE	$\sqrt{AVE}$
SB	10	0.953	0.668	0.818
SE	6	0.901	0.602	0.776
SP	6	0.918	0.650	0.806
SS	9	0.956	0.710	0.842
SG	8	0.927	0.613	0.783

Discriminant Validity and Interrelated Institutional Dimensions

Discriminant validity was first examined using the Fornell–Larcker criterion, which compares the square root of AVE for each construct with correlations between constructs. As shown in Table 3, several correlations, particularly those involving Smart Environment, exceed the corresponding √AVE values. Technically, this means discriminant validity is not fully established for all construct pairs.

However, this pattern is theoretically consistent with the hierarchical However, this pattern aligns with the hierarchical and integrated nature of Quality of Life in institutional contexts. In campus life, environmental quality, security, energy practices, and social conditions are not experienced as separate domains but overlap and reinforce each other through shared governance and daily routines. Prior research also notes that the Fornell–Larcker criterion may be overly conservative for conceptually related or hierarchical constructs (Henseler et al., 2015; Hair et al., 2017). All HTMT values fall below recommended thresholds, supporting adequate discriminant validity among the first-order dimensions. Taken together, these results support the interpretation of Quality of Life as a higher-order construct that captures shared variance across closely interconnected institutional domains rather than as a set of fully independent factors.

Table 3. Discriminant Validity Assessment (Fornell–Larcker Criterion)

	SB	SE	SP	SS	SG
SB	0.818				
SE	0.799	0.776			
SP	0.792	0.902	0.806		
SS	0.779	0.886	0.878	0.842	
SG	0.786	0.895	0.886	0.871	0.783

Overall Model Fit of the Second-Order CFA

The overall fit of the second-order CFA model was evaluated using multiple goodness-of-fit indices, as summarized in Table 4. The results show a strong correspondence between the proposed model and the observed data. The RMSEA value of 0.049, with a narrow confidence interval (0.046–0.052), indicates a close fit, and incremental fit indices (CFI = 0.954; TLI = 0.950) exceed accepted thresholds.

The standardized root mean square residual (SRMR = 0.028) indicates minimal discrepancies between observed and model-implied relationships. Although the chi-square statistic is significant, as expected with a large sample, the combination of absolute, incremental, and residual-based indices confirms that the hierarchical model robustly represents perceived Quality of Life within the smart campus environment.

Table 4. Model Fit Indices (Second-Order CFA)

Index	Value	Criterion
N	547	-
χ^2 (df)	1587.615 (685)	Reported together with df

p-value	< .001	-
RMSEA (90% CI)	0.049 (0.046–0.052)	≤ .08 (excellent ≤ .06)
CFI	0.954	≥ .90 (excellent ≥ .95)
TLI	0.950	≥ .90 (excellent ≥ .95)
SRMR	0.028	≤ .08 (excellent ≤ .05)
AIC / BIC	32698.115 / 33274.911	Used for model comparison

Second-Order Factor Loadings and Relative Importance of Dimensions

The second-order CFA assessed how strongly each institutional dimension contributes to the overall Quality of Life construct. As shown in Table 5, all five dimensions load positively and significantly on Quality of Life ($p < 0.001$), confirming the validity of the hierarchical structure.

Among the dimensions, Smart Environment shows the strongest association with Quality of Life (standardized loading = 0.954), highlighting the central role of environmental conditions in campus life. This is followed by Smart People (0.945), Smart Energy (0.938), and Smart Security (0.929), indicating that social capacity, sustainability, and safety are key to well-being. Smart Building (0.838) also contributes significantly, reflecting the importance of physical comfort and functional spaces, though its influence is less pronounced than environmental and social dimensions.

The explained variance values (R^2), ranging from 0.702 to 0.911, show that the higher-order Quality of Life construct accounts for a large proportion of variance in each institutional dimension. This supports interpreting Quality of Life as an integrated outcome of coordinated institutional conditions, rather than isolated technological features.

Table 5. Standardized Second-Order Factor Loadings

Path	Std. loading	R^2 of first-order	p-value
QoF → SB	0.838	0.702	< .001
QoF → SE	0.954	0.911	< .001
QoF → SP	0.945	0.893	< .001
QoF → SS	0.929	0.863	< .001
QoF → SG	0.938	0.879	< .001

Representation of the Second-Order CFA Model

Figure 1 illustrates the second-order CFA model, showing the hierarchical structure in which Quality of Life is shaped by five interrelated smart campus dimensions. In this model, Quality of Life serves as an overarching construct, while the first-order dimensions represent distinct but interconnected domains of campus experience.

The strong and statistically significant factor loadings, along with substantial correlations among first-order constructs, reinforce the integrated nature of institutional life within the smart campus. These interrelationships show how environmental quality, social conditions, security, energy practices, and building infrastructure work together to shape perceptions of well-being.

Overall, the results show that Quality of Life in the smart campus context is best understood as a holistic, institutionally embedded construct that emerges from the interaction of multiple interdependent domains of everyday experience.

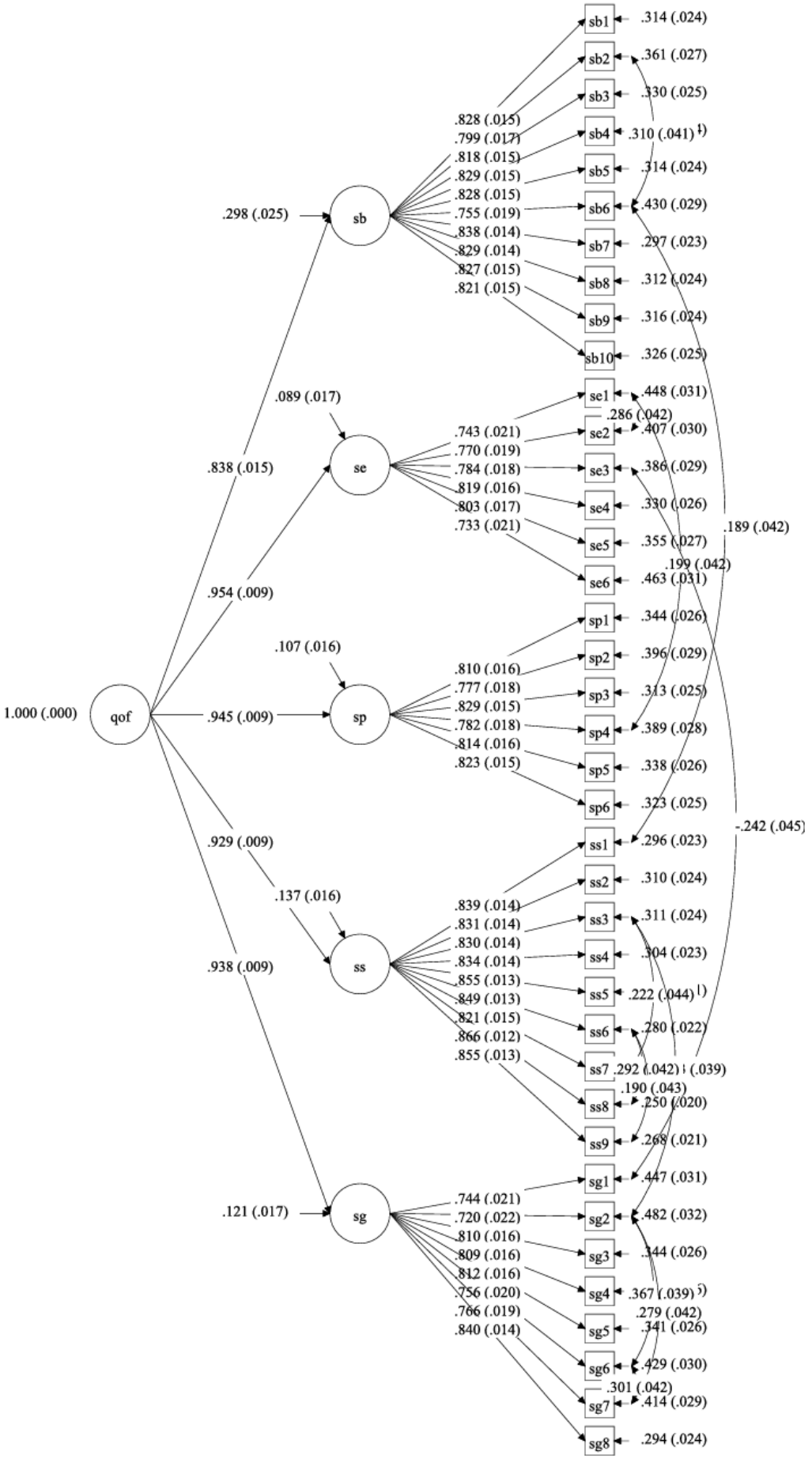

Figure 1. Second-order confirmatory factor analysis of the smart city–oriented Quality of Life measurement model

DISCUSSION

This study examined Quality of Life (QoL) at a public university undergoing digital transformation, viewed as a micro-scale smart city. The findings show that QoL is not solely a technical outcome of smart systems, but an institutionally embedded and socially experienced construct shaped by multiple aspects of campus life. The results empirically support understanding QoL as a higher-order phenomenon reflected in the interrelated domains of buildings, environment, people, security, and energy.

Second-order confirmatory factor analysis shows these dimensions do not operate independently. Instead, they function together as an integrated institutional arrangement shaping how campus members experience comfort, safety, sustainability, and well-being. This finding supports recent literature that well-being in digitally mediated environments results from coordinated systems and shared practices, not isolated technological interventions.

Quality of Life as an Integrated Institutional Experience

The results strongly support conceptualizing Quality of Life as a hierarchical and multidimensional construct. Measurement items consistently captured shared perceptions of institutional conditions, and all five dimensions contributed significantly to the overall Quality of Life construct. This suggests that, in a smart campus context, Quality of Life is experienced as a unified condition rather than as disconnected attributes.

These findings support theories that view Quality of Life as an emergent outcome of daily engagement with institutional environments. Campus members experience smart buildings, environmental management, security systems, and energy practices together through daily routines such as attending classes, navigating campus spaces, using digital services, and participating in campus life. The hierarchical structure identified in this study reflects this reality, where multiple domains converge to shape overall well-being.

Methodologically, the results demonstrate the value of hierarchical modeling for examining Quality of Life in complex institutional settings. More broadly, the findings highlight that Quality of Life in smart campuses is best understood as a collective institutional condition, not merely the sum of individual technological features.

Environmental Conditions as a Central Reference Point for Quality of Life

Among the five dimensions, Smart Environment shows the strongest association with overall Quality of Life. This finding suggests that environmental conditions—such as cleanliness, green spaces, air quality, and visible sustainability practices—serve as a primary reference point through which campus members evaluate their well-being.

The prominence of environmental factors aligns with prior research emphasizing the central role of environmental quality in shaping perceptions of Quality of Life in urban and smart city contexts. This study extends that insight by demonstrating that environmental conditions are especially salient within university campuses. In such settings, environmental quality is encountered frequently and visibly, making it a tangible indicator of institutional care, responsibility, and commitment to well-being.

Moreover, environmental conditions appear to function as a foundational layer that amplifies the perceived value of other smart campus initiatives. Digital infrastructure, security systems, and energy management practices are more likely to contribute positively to Quality of Life when they are embedded within environments that feel healthy, sustainable, and well maintained. This finding highlights the cultural significance of environmental sustainability as a visible and experiential marker of Quality of Life in smart campus development.

Interconnected Dimensions and the Meaning of Discriminant Validity

The analysis found strong correlations among several dimensions, especially environment, people, security, and energy. While these correlations challenge traditional discriminant validity criteria, they are theoretically meaningful in Quality of Life research. In daily campus life, these dimensions are not experienced as separate, but overlap through shared governance and practices.

For example, environmental sustainability initiatives are linked to energy management policies, security infrastructures affect perceptions of safety and trust, and digital awareness shapes engagement with institutional systems. These interrelationships reflect the integrated nature of institutional life, not measurement shortcomings.

Modeling Quality of Life as a higher-order construct captures shared variance without merging distinct domains into a single measure. This approach provides a more grounded representation of how interconnected institutional dimensions shape perceptions of well-being. The findings support hierarchical modeling as a way to align empirical analysis with the complexity of smart campus environments.

Implications for Smart Campus Development and Institutional Change

The findings have important implications for smart campus development and institutional approaches to digital transformation. The results indicate that Quality of Life should not be addressed through fragmented or

technology-specific initiatives. Instead, improvements are most likely when smart systems are planned and implemented as part of a coherent institutional strategy.

The central role of environmental conditions suggests that universities seeking to enhance quality should prioritize visible and experiential aspects of sustainability alongside technological innovation. Investments in green spaces, environmental quality management, and sustainable practices may yield significant benefits by shaping how campus members interpret and value other smart initiatives. As micro-scale smart cities, campuses provide opportunities to observe how digital governance, sustainability narratives, and institutional design shape everyday experience. Insights gained from smart campus contexts can therefore inform broader discussions of smart city development by illustrating how Quality of Life is produced through institutional arrangements rather than technological capability alone.

Universities operate as institutional spaces where digital transformation reshapes organizational roles, expectations, and everyday practices. Prior research on higher education institutions highlights that such transformations are mediated by institutional culture and governance structures, affecting how technological initiatives are experienced across different groups (Gumport, 2000; Scott, 2014).

Contribution to Quality of Life Research in Smart Institutional Contexts

This study contributes to Quality of Life research by empirically demonstrating that QoL is a hierarchical and institutionally embedded construct within a smart campus environment. By integrating multiple smart campus dimensions into a single framework, the study moves beyond fragmented measurement and offers a coherent framework for examining how digital transformation shapes lived experience.

The findings reinforce the view of Quality of Life as an emergent social outcome and provide a transferable analytical framework for other institutional or urban contexts. The study bridges smart city scholarship with cultural and institutional perspectives, highlighting how digital transformation reshapes everyday life in higher education.

CONCLUSION

This study examined Quality of Life (QoL) at a public university undergoing digital transformation, viewed as a micro-scale smart city. Survey data from 547 university community members show that Quality of Life is not a single result of technological progress, but a higher-order construct shaped by several interrelated aspects of institutional life. Smart Building, Smart Environment, Smart People, Smart Security, and Smart Energy together create an integrated framework that shapes how campus members experience and interpret their well-being.

The findings provide strong empirical support for the hierarchical structure of Quality of Life. Instead of acting as separate domains, the five dimensions work together to shape overall perceptions of campus life. Second-order confirmatory factor analysis shows that their shared variance can be meaningfully represented by an overarching Quality of Life construct. This result supports theories that view Quality of Life as an emergent, multidimensional phenomenon shaped by coordinated institutional conditions rather than isolated technological features.

Among the five dimensions, Smart Environment was the most influential contributor to perceived Quality of Life. This highlights the central role of environmental quality and sustainability as key reference points for evaluating institutional care and well-being. Environmental conditions such as cleanliness, green spaces, and sustainable practices shape daily experiences more directly than other smart campus elements. However, the significant contributions of the other dimensions show that Quality of Life results from the interaction of physical, social, and organizational systems, not a single factor.

Practically, the results suggest that efforts to improve Quality of Life in smart campuses and cities should go beyond fragmented or technology-focused initiatives. Universities and policymakers should adopt integrated strategies that balance digital innovation with environmental sustainability, social capacity building, security, and responsible energy management. As well-governed environments, universities provide valuable opportunities to observe how digital transformation affects daily life and to test holistic approaches to enhancing Quality of Life.

Overall, this study contributes to Quality of Life research by reframing QoL as an institutionally embedded and socially experienced construct within digitally mediated environments. By combining empirical rigor with an institutional and experiential perspective, the framework advances understanding of how smart campus development influences daily life. The findings lay a foundation for future research on Quality of Life as a form of social change, extending beyond higher education to other organizational and urban contexts undergoing digital transformation. Viewed through a cultural and institutional lens, Quality of Life in smart campuses reflects broader processes of social change, in which digitally mediated spaces are continuously produced through everyday institutional practices (Lefebvre, 1991).

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REFERENCES

Ahvenniemi, H., Huovila, A., Pinto-Seppä, I. and Airaksinen, M. (2017). What are the differences between sustainable and smart cities? *Cities*, 60, 234–245. https://doi.org/10.1016/j.cities.2016.09.009

Albino, V., Berardi, U. and Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance, and initiatives. *Journal of Urban Technology*, 22(1), 3–21. https://doi.org/10.1080/10630732.2014.942092

Bolzan Wesz, J. G., Miron, L. I. G., Delsante, I. and Tzortzopoulos, P. (2023). Urban quality of life: A systematic literature review. *Urban Science*, 7(2), 56. https://doi.org/10.3390/urbansci7020056

Caragliu, A., Del Bo, C. and Nijkamp, P. (2011). Smart cities in Europe. *Journal of Urban Technology*, 18(2), 65–82. https://doi.org/10.1080/10630732.2011.601117

Cummins, R. A. (2005). Moving from the quality of life concept to a theory. *Journal of Intellectual Disability Research*, 49(10), 699–706. https://doi.org/10.1111/j.1365-2788.2005.00738.x

Diener, E., Suh, E. M., Lucas, R. E. and Smith, H. L. (1999). Subjective well-being: Three decades of progress. *Psychological Bulletin*, 125(2), 276–302. https://doi.org/10.1037/0033-2909.125.2.276

Gumport, P. J. (2000). Academic restructuring: Organizational change and institutional imperatives. *Higher Education*, 39(1), 67–91. https://doi.org/10.1023/A:1003859026301

Hair, J. F., Hult, G. T. M., Ringle, C. M. and Sarstedt, M. (2017). *A Primer on Partial Least Squares Structural Equation Modeling (PLS-SEM)*. 2nd edn. Thousand Oaks, CA: Sage.

Hartley, K. (2023). Public perceptions about smart cities: Governance and quality of life in Hong Kong. *Social Indicators Research*, 166, 731–753. https://doi.org/10.1007/s11205-023-03087-9

Henseler, J., Ringle, C. M. and Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1), 115–135. https://doi.org/10.1007/s11747-014-0403-8

Hu, L. T. and Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, 6(1), 1–55. https://doi.org/10.1080/10705519909540118

Kitchin, R. (2014). The real-time city? Big data and smart urbanism. *GeoJournal*, 79(1), 1–14. https://doi.org/10.1007/s10708-013-9516-8

Kline, R. B. (2016). *Principles and Practice of Structural Equation Modeling*. 4th edn. New York: Guilford Press.

Lefebvre, H. (1991). *The Production of Space*. Oxford: Blackwell.

Macke, J., Casagrande, R. M., Sarate, J. A. R. and Silva, K. A. (2018). Smart city and quality of life: Citizens' perception in a Brazilian case study. *Journal of Cleaner Production*, 182, 717–726. https://doi.org/10.1016/j.jclepro.2018.02.078

Marans, R. W. and Stimson, R. J. (eds) (2011). *Investigating Quality of Urban Life: Theory, Methods, and Empirical Research*. Dordrecht: Springer. https://doi.org/10.1007/978-94-007-1742-8

Neirotti, P., De Marco, A., Cagliano, A. C., Mangano, G. and Scorrano, F. (2014). Current trends in smart city initiatives: Some stylised facts. *Cities*, 38, 25–36. https://doi.org/10.1016/j.cities.2013.12.010

Orlikowski, W. J. (2000). Using technology and constituting structures: A practice lens for studying technology in organizations. *Organization Science*, 11(4), 404–428. https://doi.org/10.1287/orsc.11.4.404.14600

Răducan, R., Lozsa, J., Vîrga, D. and Matichescu, M. (2025). New integrative model of the quality of urban life: A systematic review. *Social Indicators Research*, 179, 895–921. https://doi.org/10.1007/s11205-025-03642-6

Scott, W. R. (2014). *Institutions and Organizations: Ideas, Interests, and Identities*. 4th edn. Thousand Oaks, CA: Sage.

Yigitcanlar, T., Kamruzzaman, M., Foth, M., Sabatini-Marques, J., da Costa, E. and Ioppolo, G. (2019). Can cities become smart without being sustainable? *Sustainable Cities and Society*, 45, 348–365. https://doi.org/10.1016/j.scs.2018.11.033

