



A Competitive Intelligence Framework for Sustainable Urban Visual Advertising Governance: Public Preference Intelligence and Strategic Decision Support

Uma Estrutura de Inteligência Competitiva para a Governança Sustentável da Publicidade Visual Urbana: Inteligência de Preferências Públicas e Apoio à Decisão Estratégica

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ABSTRACT | Purpose: To develop and evaluate a resident-centered competitive-intelligence framework that converts multidimensional assessments of urban visual advertising into strategic governance priorities. **Methodology/approach:** The analysis combined 600 complete urban-resident profiles, 45 core measurement items, and 2,400 repeated evaluations of eight advertising scenarios. Reliability, convergent and discriminant validity, HC3-robust standardized regressions, 3,000-resample bootstrap mediation, cross-validated prediction, generalized estimating equations, repeated-measures priority testing, and stability-checked segmentation were used. **Originality/Relevance:** The framework integrates aesthetic fit, contextual congruence, informational value, environmental sustainability, clutter, safety, accessibility, privacy, transparency, legitimacy, public preference, and governance support within one decision architecture. **Key findings:** Governance transparency and trust was the strongest antecedent of perceived public value and legitimacy ($\beta = .320$), and legitimacy was the strongest direct predictor of public preference evaluation ($\beta = .244$). Public preference and governance transparency jointly explained 34.0% of policy-support variation. Approval was highest for context-sensitive, safeguarded scenarios and lowest for high-brightness, cluttered, and sensitive-location installations. Ten hypotheses were supported; the adjusted direct privacy path and scenario heterogeneity hypothesis were not supported. **Theoretical/methodological contributions:** The study positions legitimacy as the principal conversion mechanism through which public value, sustainability, and institutional

transparency become preference intelligence, and it links attitudinal evidence to scenario evaluation, intervention ranking, and resident profiles without treating cross-sectional associations as causal effects.

Keywords | Competitive intelligence. Public value. Urban governance. Digital out-of-home advertising. Resident preferences. Strategic decision support

RESUMO | Objetivo: Desenvolver e avaliar um framework de Inteligência Competitiva centrado nos residentes, capaz de converter avaliações multidimensionais da publicidade visual urbana em prioridades estratégicas de governança. **Metodologia/Abordagem:** A análise combinou 600 perfis completos de residentes urbanos, 45 itens centrais de mensuração e 2.400 avaliações repetidas de oito cenários publicitários. Foram utilizados testes de confiabilidade, validade convergente e discriminante, regressões padronizadas robustas HC3, mediação por *bootstrap* com 3.000 reamostragens, predição com validação cruzada, equações de estimação generalizadas (GEE), testes de prioridade com medidas repetidas e segmentação com verificação de estabilidade. **Originalidade/Relevância:** O framework integra adequação estética, congruência contextual, valor informacional, sustentabilidade ambiental, poluição visual, segurança, acessibilidade, privacidade, transparência, legitimidade, preferência pública e apoio à governança em uma única arquitetura de decisão. **Principais Resultados:** A transparência e a confiança na governança constituíram o antecedente mais forte do valor público percebido e da legitimidade ($\beta = 0,320$), enquanto a legitimidade foi o preditor direto mais forte da avaliação da preferência pública ($\beta = 0,244$). A preferência pública e a transparência da governança explicaram conjuntamente 34,0% da variação no apoio às políticas. A aprovação foi maior para cenários sensíveis ao contexto e dotados de salvaguardas, e menor para instalações caracterizadas por alta luminosidade, poluição visual e localização em áreas sensíveis. Dez hipóteses foram confirmadas; a relação direta ajustada referente à privacidade e a hipótese de heterogeneidade entre os cenários não foram confirmadas. **Contribuições Teóricas/Metodológicas:** O estudo posiciona a legitimidade como o principal mecanismo de conversão por meio do qual o valor público, a sustentabilidade e a transparência institucional se transformam em inteligência sobre as preferências dos residentes. Além disso, relaciona evidências atitudinais à avaliação de cenários, à priorização de intervenções e aos perfis dos residentes, sem interpretar associações transversais como efeitos causais. **Palavras-chave** | Inteligência Competitiva. Valor público. Governança urbana. Publicidade digital *out-of-home*. Preferências dos residentes. Suporte à decisão estratégica.

1. INTRODUCTION

The urban visual advertising now consists of a variety of forms, including static billboards, transport media, building wrapping, digital screens, projections, interactive street furniture to sensor-enabled installations. Although they may facilitate patterns of commerce, wayfinding, emergency communication, and place activation, they may also create conflicts over the aesthetics of a visual environment, neighbourhood identity, energy consumption, artificial illumination, road safety, pedestrian accessibility and privacy, and legitimacy of permitting by municipal regulations. It is not how advertisements are supposed to advertise, but where, when and how they can be accommodated within the objectives of the public space.

This is a dynamic issue with digital transformation. The displays that are driven by data will be able to refresh the information fairly quickly, personalize the content to the crowd and the place, and combine commercial information with traffic and emergency information. The biological diversity of their work may be utilized to create social value, yet they may also lead to unclear data cultures, excessive optimism, rapid animation, and biased effects in the residential, heritage, school, healthcare and transport spheres. Studies on the topic of digital transformation and digital

government concentrate on organizational capability, accountability and institutional design, as well as technology adoption, because it is the organizational elements that promote the value of technology, but not technology itself (Hanelt et al., 2021; Kraus et al., 2021; Tangi et al., 2021; Verhoef et al., 2021). There is evidence of lack of responsibility adoption factors in the public sector, too, that include organizational preparedness, administrative ability, accountability, and stakeholder trust (Madan and Ashok, 2023; van Noordt and Misuraca, 2022; Zuiderwijk et al., 2021). Further, the responsible urban-innovation research emphasizes the context-based governance and the local institutional capacity (Yigitcanlar et al., 2021).

On top of these requirements are environmental, spatial, social and institutional requirements as regards to sustainability. Materials, energy, façade space and data are added elements, which are utilized in urban advertising more and more and attract visual attention. This fact is that digital-sustainability research would not be merely about making sure that it failed to violate the environmental or societal protection, but actually a strategy and a governance approach (Del Río Castro et al., 2021; Feroz et al., 2021; George et al., 2021). Its visual advertising considerations are energy efficiency, dimming, recyclable, sensitive site controls, transparent authorization, accessible and responsible data resources. Institutional changes and environmental responsibility have been linked to smart city research (Allam et al., 2022; Bibri, 2021; Bibri & Krogstie, 2021). The relation between the quality of the built environment and subjective well-being, as well as the impact of governance on the quality of the built environment, is also unveiled in evaluation researches in the urban context (Mouratidis, 2021; Sharifi, 2021).

Competitive Intelligence is the organizing logic which transforms these scattered signals to relevant knowledge needed for decision-making. In the present work, the procedure of gathering resident assessments is made into intelligence via constructs that are validated, merge with concrete situations and distinct risks, and are turned into ranked governance interventions, shared with the units who execute the interventions, and provided with feedback. This is a single consultation, but incorporates the environmental scanning, analysis, decision support, implementation and monitoring.

The existing research has given limited insights for the issues of digital signage, visual clutter, artificial light, data governance, smart city technology, public sector AI, sustainability and quality of life in cities. Such streams in reality are not often found in a single, well-defined decision architecture that connects positive design characteristics with perceived harms, transparency of governance, legitimacy of the public, preference of the public, approval of the scenario, priority of intervention, organizational implementation and feedback. So the non-existence of research on urban advertising and digital governance per se is not the problem; it's the lack of a new Research + Digital Governance configuration that can be managed within a governed Competitive Intelligence Cycle that can support repeated municipal decisions.

This study seeks to provide answers to five questions. RQ1 explores the analytical profiles' work on the design, public-value and harm and governance aspects. RQ2 identifies the most pertinent factors that can be used for Public Preference Evaluation. RQ3 explores the relationship between Perceived Public Value and Legitimacy between the informational value, sustainability, and governance trust and preference. In this case, RQ4 is concerning comparisons of approvals in various

contexts of advertising. RQ5 pinpoints interventions and resident profiles on which interventions are most likely to offer a basis for strategic decision support.

There are four contributions of the study. First, it proposes an intertwined measurement system which separates the design and the public value from the visual, safety, accessibility, and privacy issues. Secondly, it provides a public value and public legitimacy as the route to introduce the governance and sustainability properties to a public preference intelligence. Thirdly it is a combination of Attitudinal Modelling, Scenario based Approval and Governance Priority Analysis. The fourth is that it brings about these outputs into a governed Competitive Intelligence Cycle which facilitates implementation, monitoring and feedback.

2. THEORETICAL FRAMEWORK

The theoretical framework integrates Competitive Intelligence, sustainable urban governance, public value, and public preference. It does not transfer a private-sector market model unchanged into municipal decision-making. Instead, it adapts Competitive Intelligence as an ethical and evidence-based organizational capability in which the principal criteria are public value, legitimacy, accountability, and sustainable decision quality.

2.1 Competitive Intelligence, Intelligence Governance, and Strategic Urban Decision Support

Competitive Intelligence is defined in the present study as a controlled organizational process that channels external signals, receives, validates, analyzes and disseminates results which are then used and reevaluated for strategic decision making. It has intellectual roots in Jonathan Calof, Craig Fleisher, John Prescott, Jan Herring, Leonard Fuld, Paul Dishman and René Pellissier. To keep the manuscript's boundary of recent references, that lineage is addressed through contemporary syntheses of Competitive Intelligence as an organizational capability, which are modular, process-based and analytics-driven (Madureira et al., 2021; Ranjan & Foropon, 2021; Talaoui & Kohtamäki, 2021).

This Competitive Intelligence Cycle consists six related stages. Intelligence direction specifies the decisions that the municipality needs to be informed about, and the subject areas of the key intelligence items. Resident evaluations, neighborhood conditions, ads, scenario responses, governance priorities, complaints and contextual risks are gathered in environmental scanning and collection. Validation and analysis evaluates information quality and transforms the evidence by using the measurement validation, powerful modelling, mediation analysis, scenario comparison, priority ranking and profile analysis. Dissemination is the process of converting statistical results into useable products of intelligence such as scenario-approval estimates, intervention ranking, importance-performance maps etc. These products are translated into permit decisions, sensitive-site controls, brightness limits, safety assessment, privacy safeguards, the complaint process, and enforcement actions in the organization as decisions and implementation. Outcomes of monitoring and feedback are returned to the next intelligence cycle including everything from complaints to compliance failures, appeals, and updated preferences.

Intelligence Governance is carried out throughout the cycle. It defines who can gather and have access to information, how the provenance and data quality are recorded, what types of analyses are acceptable, who is responsible for making the decisions, how to communicate uncertainty and how to review and challenge the decisions. This governance layer will be particularly significant when it comes to public space advertising with sensors and audience estimation, personalization and automated content selection. Intelligence if not suitably structured can reduce governance visibility and accountability, and introduce institutional opacity without proper decision rights, audit trails, transparency and accountability requirements. This need is confirmed by recent organizational research indicating that readiness, analysis ability and the interplay between automated and human decision making influence the value creation of data intensive systems (Jöhnk et al., 2021; Mikalef & Gupta, 2021; Raisch & Krakowski, 2021).

The framework also takes into account information asymmetry. People may be unaware of the ownership of displays, the types of permits and associated data collection, complaint procedures and municipal decision making criteria. Regulators may not have a systematic understanding of context-specific preferences and of cumulative visual burdens. Advertisers may have poor intelligence about design and governance of installations which will be accepted as acceptable. These asymmetries can be mitigated by allowing disclosure, public notices, clear criteria, preference intelligence and documented feedback, which provides information to those affected by decisions that is relevant for the decision.

Sustainable competitive advantage is not something which one city can claim to be better than another, but it is regarded as an enduring organizational capability. The benefit to public authorities is the ongoing ability to identify emerging risks, gauge stakeholders' expectations, pool evidence, be able to fine-tune regulatory tools and not have to suffer from the same governance failures again. For responsible advertisers and display operators, acceptance that is tied to the ability to design contextually, demonstrate your environmental performance, provide transparency about data usage and meet the regulations can be more sustainable than quick visibility gained through intrusive installations.

This interpretation is given when it comes to Competitive Intelligence as compared to one-off consultation. Consultation records perceptions at a specific time while intelligence is a system that continually transforms the signals from the environment into organizational response and assesses the outcomes of the response. The framework thus goes through a continuous sequence of advertising attributes and perceived risks, public value and legitimacy, preference, scenario evidence, governance decisions and implementation outcomes, and so on, providing feedback for the next intelligence cycle.

2.2 Sustainable urban visual advertising governance

Sustainable governance is about addressing environmental, spatial, social and institutional performance all together. The space and attention available for urban visual advertising is limited, the scale, brightness, animation, duration, cumulative density, location and content will all affect the effects of visual advertising. A proportionate sign set up on a commercial street is therefore not

equivalent to a high-brightness animated display set up next to a residential street, when both are legally defined as advertising.

Energy demand, material and operating hours, and artificial lighting are issues related to environmental sustainability. Spatial sustainability is about displays, architecture, heritage, public views and the wayfinding. Social sustainability covers issues of access, vulnerable user exposure and distribution of visual burdens. Institutional sustainability includes issues of clarity, consistency, reviewability and enforceability of the rules for the permits. International urban-governance evidence also points to the need to have integrated environmental and accountability regimes, rather than optimization of individual functions, for building resilient and inclusive urban futures (UN-Habitat, 2022). Of course, a key reason that cumulative artificial light needs to be considered a governance rather than a single-issue permit problem is that there are signs that many stars are becoming increasingly less visible in the sky through citizen-science observations.

There are two tendinous points for governance that are presented in the literature. A control approach to advertising sees it primarily as a size and placement, illumination and legal issue. A public-value approach involves considering the contribution of an installation to useful information, consideration of place identity, equitable distribution of environmental burden, and accountability to impacted communities. The first method is easier to administer, but may fail to consider cumulative, data-related and legitimacy effects. The second is more detailed and more demanding in terms of intelligence, interdepartmental cooperation, and open and neutral decisionmaking. The current system is based on the public-value perspective, but still includes physical and safety restrictions that are enforceable.

In literature, there are two conflicting governance trends. In a control oriented approach, there is an emphasis on advertising as a size, place, light and legality matter. A public-value approach will consider whether an installation provides relevant information, considers place identity, is equitable in the distribution of environmental costs and is held accountable to those affected by it. The first one is simpler to administer, but might neglect data related and cumulative effects, and legitimacy effects. The second is more specific and requires that the intelligence functions are more powerful, inter-departmental co-ordination and more open decision criteria. The current system is a public value system that has physical and safety controls that are enforceable.

2.3 Public preference intelligence

Public Preference Intelligence understands that the residents make judgments about advertising in the city on numerous criteria; not an all or none basis. Aesthetic Integration (AI) is an aesthetic embrace of fit by architecture and streetscape. Contextual and Cultural Congruence (CCC) is an appreciation of neighborhood identity and heritage. Informational Public Value (IPV) encompasses a range of contributions to wayfinding, emergency, transport, community and truthful information. Environmental Sustainability (ES) is a form of support for energy efficiency, reusability of materials and the environmental considerations associated with permits.

There are some perceived harms that are distinct: Visual Intrusiveness and Clutter (VIC), Safety and Accessibility Risk (SAR), and Digital Privacy and Manipulation Concern (DPMC). Separation is

necessary since a display could be visually coordinated but distract road users, or to present useful information but use opaque sensing. The following conditions of legitimacy have been found to be central in contemporary public-sector and trustworthy-AI research for data-enabled systems in public settings: (Aoki, 2021; Kaur et al., 2022; UNESCO, 2021). A risk-based approach to accountability, clear business messaging and enacting legal protections are highlighted in European AI and digital-services scholarship (European Union, 2022; Floridi, 2021; Veale & Zuiderveen Borgesius, 2021).

Governance Transparency and Trust (GTT) looks to whether citizens know the rules under which permits are granted, who is responsible for permits, if complaints are heard, and if they can be involved in permitting decisions that involve “sensitive” activities. Perceived Public Value and Legitimacy (PVL) reflects the benefits and social and visual costs perceived and whether rules are applied fairly. The primary acceptance outcome is Public Preference Evaluation (PPE) and a second outcome is Policy Support and Civic Participation (PGC), which is a willingness to support enforceable controls and participate in oversight.

Unlike a traditional satisfaction survey, Public Preference Intelligence is not just about the level of satisfaction, but is about linking validated evaluations to a specific strategic decision. Preference evidence is then intelligence when it is known and uncertainty is reported, contextual and scenario information is added on, and findings are communicated to those who can take action based on them. The framework, however, doesn't assume that all expressed preferences are policy instructions; it tests whether the patterns are reliable, are of practical importance, are analytically stable, are legally, safely, environmentally and equitably feasible.

2.4 Public value, legitimacy, and governance support

Legitimacy is conceptually different from liking. Residents may prefer a particular design but still consider its approval process opaque, or dislike a commercial message while accepting a fair and consistent regulatory system. Public value and legitimacy therefore provide the institutional interpretation through which design, sustainability, and transparency become broader preference. This distinction also prevents the outcome from being defined by the same items used as predictors.

Transparency does not automatically create legitimacy, and legitimacy is not equivalent to popularity. A transparent procedure may still be considered unfair if affected groups cannot contest it, while a popular installation may remain institutionally problematic if authorization standards are inconsistently applied. The model therefore treats governance transparency as an antecedent and legitimacy as an evaluative mechanism. This distinction allows the analysis to test whether information, sustainability, and governance attributes become acceptable because the overall arrangement is interpreted as procedurally fair and publicly valuable.

The framework expects positive design and value attributes to strengthen preference directly or through legitimacy, whereas perceived visual and safety harms should weaken preference. Privacy concern is expected to matter, although its effect may depend on whether safeguards are concrete and visible. Governance transparency should strengthen legitimacy and independently support policy participation. Public preference should, in turn, increase support for enforceable governance action.

2.5 Conceptual model and hypotheses

Figure 1 presents the governed Competitive Intelligence Cycle before the hypotheses are stated. The cycle links intelligence direction, environmental scanning and collection, validation and analysis, dissemination, organizational decision and implementation, and monitoring and feedback. Intelligence Governance surrounds the cycle, while the attitudinal and scenario modules supply the evidence translated into strategic decisions.

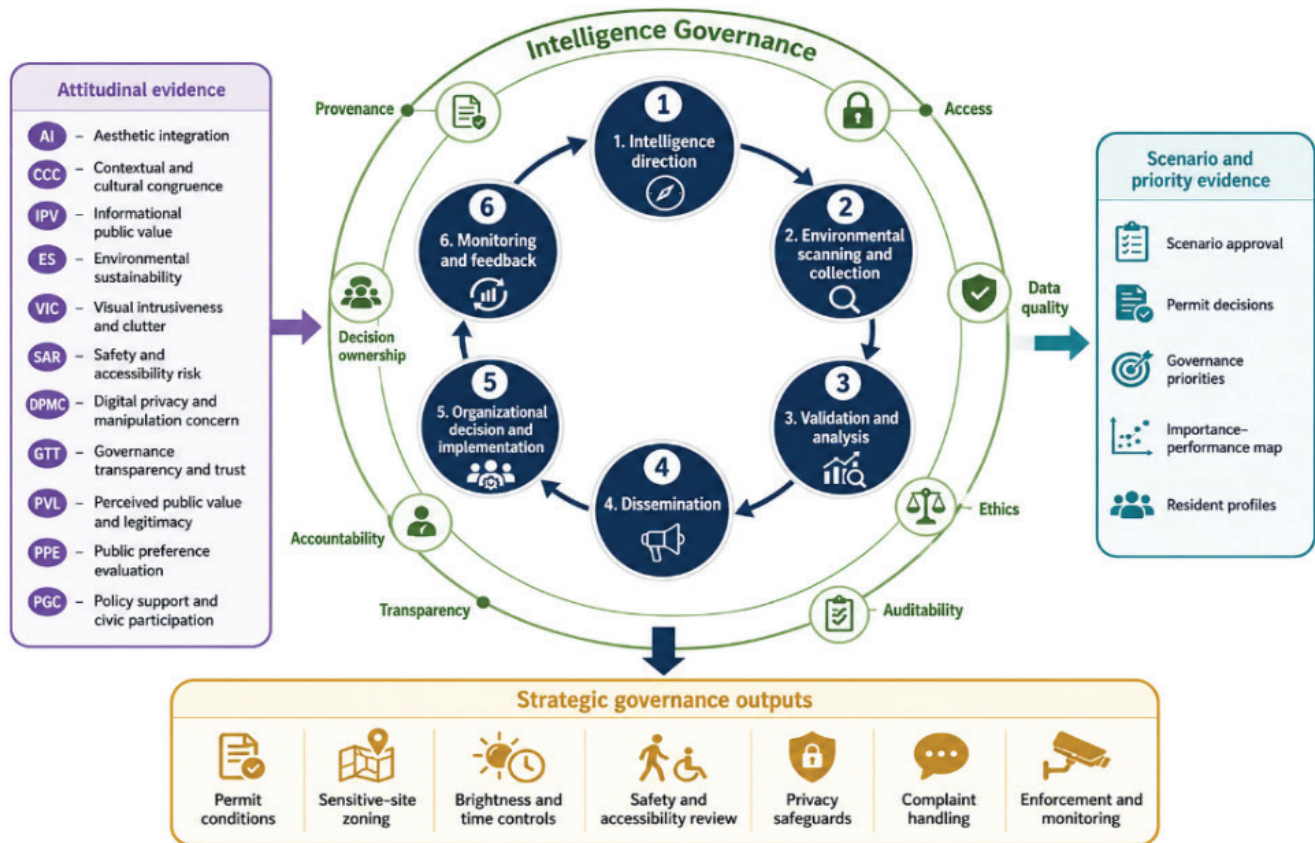


Figure 1. Integrated competitive-intelligence framework for urban visual advertising governance.

- H1: Aesthetic integration is positively associated with public preference evaluation.
- H2: Contextual and cultural congruence is positively associated with public preference evaluation.
- H3: Informational public value is positively associated with perceived public value and legitimacy.
- H4: Environmental sustainability is positively associated with perceived public value and legitimacy.
- H5: Visual intrusiveness and clutter are negatively associated with public preference evaluation.
- H6: Safety and accessibility risk are negatively associated with public preference evaluation.

- H7: Digital privacy and manipulation concern are negatively associated with public preference evaluation.
- H8: Governance transparency and trust are positively associated with perceived public value and legitimacy.
- H9: Perceived public value and legitimacy are positively associated with public preference evaluation.
- H10: Public preference evaluation is positively associated with policy support and civic participation.
- H11: Perceived public value and legitimacy mediate the relationships of informational value, sustainability, and governance trust with public preference evaluation.
- H12: Scenario effects differ across resident preference segments or urban contexts.

3. METHOD

The method was developed to ensure that the fixed title, constructs, scenarios and strategic outputs remain aligned with each other. The study materials included a 600-complete-profile, wide-format matrix and a long-format file of 2,400 evaluations of scenarios. The numerical data were provided as a methodological demonstration data set and are not actual respondents gathered and analyzed independently. Thus results are interpreted as an analytical proof of the proposed framework instead of a population estimate on the basis of a probability sample.

3.1 Research design and analytical architecture

The design combines a cross-sectional latent-variable survey architecture with a repeated scenario module. The cross-sectional component estimates associations among design attributes, perceived risks, governance trust, legitimacy, preference, and policy support. The scenario component compares stated acceptability and permit decisions across eight advertising configurations. Cross-sectional coefficients are interpreted as standardized associations and predictive contributions; stronger causal language is reserved for contrasts attributable to the assigned scenario conditions.

The analytical records were designed to reproduce the proposed measurement and decision-support workflow and were not obtained through independent probability-based recruitment. Consequently, statistical significance, confidence intervals, and predictive measures describe relationships within the supplied analytical dataset; they do not establish prevalence, population parameters, or subgroup distributions in a real municipal population. External validity is therefore not established. Transfer to an actual city requires field administration, documented sampling, ethics approval where applicable, nonresponse assessment, measurement-invariance testing, and replication of the structural and scenario results.

The absence of independently recruited respondents also limits interpretation of demographic and geographical distributions. Named city or district categories must not be treated as evidence

of real coverage unless their provenance is independently documented. No conclusion regarding a specific city, district, or national population is drawn from the current records.

A further limitation concerns distributional realism. Although the records support reliability, validity, structural modelling, scenario comparison, and decision-support demonstration, they may not reproduce the full heterogeneity, missingness, acquiescence, nonresponse, social-desirability effects, or institutional conditions found in field surveys. Future validation must assess whether the factor structure, effect sizes, scenario ordering, and profiles remain stable in independently collected samples.

3.2 Analytical sample and data screening

The matrix contained 600 profiles, and the scenario file contained 2,400 evaluations, equivalent to four scenarios per profile. Screening identified no duplicate identifiers, eligibility failures, attention-check failures, missing core items, or missing priority ratings. All profiles and scenario evaluations were retained, and no imputation was required.

3.3 Instrument and construct scoring

The instrument contained 45 core items distributed across 11 constructs. AI, CCC, IPV, ES, VIC, SAR, DPMC, GTT, PVL, and PGC each contained four items, while PPE contained five. All used a seven-point agreement scale. Ten additional items measured governance priorities, and each scenario was evaluated for acceptability, public value, harm, trust, and permit decision. Positive and risk constructs were retained separately; no global all-item score was calculated.

$$CS_{ir} = (1 / m_r) \sum_{j=1}^{m_r} x_{ijr}$$

Equation 1: CS_{ir} is respondent i 's score on construct r , x_{ijr} is the response to item j , and m_r is the number of valid items in the construct. The planned rule required at least 75% valid items; all supplied records were complete.

3.4 Measurement assessment

Measurement quality was assessed before structural relationships were estimated. Diagnostics included item loadings, Cronbach's alpha, McDonald's omega, composite reliability, average variance extracted (AVE), heterotrait-monotrait ratios (HTMT), the Kaiser-Meyer-Olkin statistic, Bartlett's test of sphericity, construct correlations, and the variance explained by the first unrotated factor. These procedures evaluate internal consistency, convergent validity, and discriminant validity before structural paths are interpreted (Hair et al., 2021; Kline, 2023). Comparisons of covariance-based and variance-based modelling further indicate that estimator choice should follow the research objective, measurement specification, and inferential requirements rather than methodological fashion (Dash & Paul, 2021; Sarstedt et al., 2022).

$$CR_r = (\sum \lambda_{jr})^2 / [(\sum \lambda_{jr})^2 + \sum \theta_{jr}]$$

Equation 2: CR_r is composite reliability, λ_{jr} is the standardized loading of item j , and θ_{jr} is its error variance.

$$AVE_r = \sum \lambda_{jr}^2 / m_r$$

Equation 3: AVE_r is average variance extracted for construct r and m_r is its number of indicators.

3.5 Structural, mediation, and predictive analysis

Standardized construct scores were entered into three ordinary least-squares equations estimated with HC3 heteroskedasticity-robust standard errors. Indirect effects through PVL were evaluated with 3,000 nonparametric bootstrap resamples. Explanatory performance was summarized with R^2 and adjusted R^2 , while ten-fold cross-validation produced Q^2 predict and cross-validated root mean square error. Cohen's f^2 represented local effect size, and variance inflation factors assessed collinearity. Bootstrap inference was used because indirect effects are products of coefficients and need not follow a normal sampling distribution (Hayes, 2022).

$$PPE_i = \beta_0 + \beta_1 AI_i + \beta_2 CCC_i + \beta_3 PVL_i - \beta_4 VIC_i - \beta_5 SAR_i - \beta_6 DPMC_i + \varepsilon_i$$

Equation 4: PPE is public preference evaluation; the remaining abbreviations correspond to the measured constructs; ε_i is the disturbance term.

3.6 Scenario, priority, and segmentation analysis

Repeated scenario ratings were analyzed with respondent-clustered, population-averaged models. Permit approval was evaluated with binomial generalized estimating equations using an exchangeable working correlation. Governance-priority differences were tested with Friedman's repeated-measures test. Standardized construct scores were segmented with k-means solutions from two to six clusters, and the silhouette coefficient guided solution selection. Scenario-by-segment and scenario-by-neighborhood interactions were tested with respondent-clustered Wald tests.

$$Y_{is} = \gamma_0 + \sum_{k=1}^K \gamma_k Z_{ks} + u_i + \varepsilon_{is}$$

Equation 5: Y_{is} is profile i 's rating of scenario s , Z_{ks} represents coded scenario attributes, u_i captures respondent-level dependence, and ε_{is} is the observation-level error.

3.7 Competitive-intelligence decision algorithm

Algorithm 1 converts the analytical outputs into a governance decision sequence. It is designed to prevent strategic recommendations from being detached from measurement quality, effect uncertainty, or scenario evidence.

Algorithm 1. Competitive-Intelligence Decision-Support Pipeline for Urban Visual Advertising Governance

Input: construct items, profile variables, priority ratings, scenario evaluations, contextual indicators, and monitoring information.

1. Define the municipal decision and corresponding key intelligence topics.
 2. Establish Intelligence Governance rules for provenance, access, quality, ethics, auditability, and decision accountability.
 3. Conduct environmental scanning across resident, spatial, technological, environmental, and regulatory sources.
 4. Screen records using eligibility, attention, duplication, and missingness rules.
 5. Calculate construct scores using the valid-item threshold.
 6. Establish reliability, convergent validity, and discriminant validity.
 7. Estimate positive, risk, legitimacy, preference, and governance relationships.
 8. Test indirect effects through public value and legitimacy.
 9. Estimate repeated scenario effects with respondent-level dependence controls.
 10. Rank governance interventions and construct the importance-performance map.
 11. Identify defensible preference profiles and test scenario stability.
 12. Match priority problems to context-sensitive governance responses.
 13. Disseminate intelligence to planning, permitting, enforcement, and public-participation units.
 14. Record the decision, its evidential basis, responsible authority, and review procedure.
 15. Monitor compliance, complaints, appeals, brightness, energy, accessibility, and other objective outcomes.
 16. Return monitoring evidence to the next intelligence-planning cycle and revise key intelligence topics when required.
- Output: validated preference intelligence, scenario contrasts, governance priorities, organizational actions, monitoring indicators, and feedback for the next Competitive Intelligence Cycle.

3.8 Software and decision thresholds

Analyses were performed in Python 3.13 using pandas 2.2.3, NumPy 2.3.5, SciPy 1.17.0, statsmodels 0.14.6, and scikit-learn 1.8.0. Two-sided p values below .05 were treated as statistically significant. Confidence intervals, effect sizes, predictive performance, and practical governance relevance were considered alongside p values.

4. RESULTS AND DISCUSSION

he findings follow the analytical pipeline: sample profile, measurement quality, structural relationships, mediation, scenario evaluation, intervention priorities, importance-performance positioning, segmentation, and hypothesis decisions. Each subsection relates the numerical result to its theoretical, Competitive Intelligence, and governance implications without converting cross-sectional associations into causal claims.

4.1 Analytical profile and exposure context

Table 1 presents the analytical profile. The records were distributed across five location categories. Because the records were not obtained through independently documented field recruitment, these categories describe only the supplied analytical structure and are not interpreted as representative geographical estimates. The largest age group was 25–34 years, women and men were almost equally represented, and bachelor-level education was the most frequent category. Residential and mixed-use neighborhoods accounted for almost two thirds of the records, while more than two thirds indicated daily or more frequent exposure to urban visual advertising.



Table 1. Analytic profile of urban-resident records (n = 600)

Characteristic	Category	n	%
City	Nanjing (Xuanwu District)	178	29.7
	Nanjing (Jianye District)	175	29.2
	Nanjing (Qinhuai District)	103	17.2
	Nanjing (Yuhuatai District)	86	14.3
	Nanjing (Gulou District)	58	9.7
Age group	25–34	197	32.8
	18–24	142	23.7
	35–44	106	17.7
	45–54	85	14.2
	55–64	48	8.0
	65+	22	3.7
Gender	Woman	292	48.7
	Man	291	48.5
	Prefer not to say	13	2.2
	Non-binary/another identity	4	0.7
Education	Bachelor	276	46.0
	Master	124	20.7
	Diploma	84	14.0
	Secondary or below	78	13.0
	Doctorate	24	4.0
	Other	14	2.3
Employment	Employed	255	42.5
	Student	116	19.3
	Self-employed	91	15.2
	Unemployed	50	8.3
	Retired	48	8.0
	Other	40	6.7
Neighborhood	Residential	226	37.7
	Mixed-use	163	27.2
	Commercial core	82	13.7
	Transport-oriented	77	12.8
	Other	27	4.5
	Heritage-cultural	25	4.2
Exposure	Daily	245	40.8
	Many times daily	172	28.7
	Several times weekly	113	18.8
	Weekly	70	11.7

4.2 Measurement quality and construct distinctness

The measurement system was highly factorable. The KMO statistic was .918, and Bartlett's test was significant, $\chi^2(990) = 13,328.37$, $p < .001$. The first unrotated factor explained 24.5% of item variance, which does not indicate that one general response tendency dominated the instrument. All item loadings exceeded .69. As shown in Table 2, alpha and composite reliability exceeded .82 for all constructs, and AVE ranged from .505 to .628. No item was removed after inspection.

Table 2. Descriptive statistics, reliability, and convergent validity

Code	Construct	Items	M	SD	Loading	α	CR	AVE
AI	Aesthetic Integration	4	4.80	0.87	.712–.783	.842	.842	.572
CCC	Contextual/Cultural Congruence	4	4.75	0.91	.756–.797	.861	.861	.609
IPV	Informational Public Value	4	4.73	0.91	.748–.808	.863	.864	.613
ES	Environmental Sustainability	4	4.77	0.87	.753–.782	.853	.854	.593
VIC	Visual Intrusiveness/Clutter	4	4.80	0.82	.727–.748	.827	.827	.544
SAR	Safety/Accessibility Risk	4	4.73	0.89	.764–.803	.862	.862	.610
DPMC	Digital Privacy/Manipulation	4	4.79	0.90	.751–.791	.851	.851	.589
GTT	Governance Transparency/Trust	4	4.79	0.91	.778–.825	.871	.871	.628
PVL	Public Value/Legitimacy	4	4.75	0.87	.756–.780	.850	.850	.585
PPE	Public Preference Evaluation	5	4.78	0.76	.690–.731	.836	.836	.505
PGC	Policy Support/Civic Participation	4	4.78	0.85	.733–.769	.839	.839	.565

Note: CR = composite reliability; AVE = average variance extracted. Omega values were identical, to three decimal places, to the reported CR values.

Discriminant validity was also strong. Every HTMT ratio was below .85; the maximum was .654 between GTT and PVL. The corresponding construct correlation was $r = .563$. This relationship is theoretically coherent because transparent governance should inform legitimacy, but it remains below a level that would imply empirical redundancy. The evidence answers the measurement component of RQ1: respondents differentiated design quality, public value, sustainability, harm, governance, legitimacy, preference, and policy support rather than expressing one undifferentiated favorable tendency.

4.3 Explanatory and predictive performance

Table 3 summarizes model performance. The antecedents explained 44.7% of PVL, 20.6% of PPE, and 34.0% of PGC. All Q^2 predict values were positive, indicating out-of-sample improvement over an intercept-only benchmark. The moderate PPE R^2 is substantively plausible because overall acceptance depends on factors beyond the measured constructs, including content, personal exposure history, enforcement credibility, and local development conditions.

Table 3. Explanatory and predictive performance of endogenous models

Outcome	R ²	Adjusted R ²	Q ² predict	CV RMSE	F	p
PVL	.447	.443	.439	.748	112.47	< .001
PPE	.206	.198	.186	.901	25.47	< .001
PGC	.340	.338	.333	.816	158.81	< .001

Note: CV = ten-fold cross-validation; RMSE = root mean square error.

4.4 Direct structural relationships

Table 4 and Figure 2 address RQ2. Governance transparency and trust was the strongest antecedent of PVL ($\beta = .320$, $p < .001$). IPV, ES, and AI also contributed positively. Within the PPE equation, PVL had the largest positive coefficient ($\beta = .244$), followed by CCC ($\beta = .188$) and AI ($\beta = .183$). SAR ($\beta = -.165$) and VIC ($\beta = -.138$) reduced preference. The adjusted DPMC coefficient was negative but narrowly crossed zero ($\beta = -.076$, $p = .061$). PPE and GTT made substantial independent contributions to PGC.

Table 4. Standardized direct effects, robust uncertainty, effect sizes, and collinearity

Outcome	Predictor	β	Robust SE	95% CI	p	f ²	VIF
PVL	IPV	.220	.032	[.156, .283]	< .001	.070	1.25
PVL	ES	.216	.039	[.139, .294]	< .001	.059	1.44
PVL	GTT	.320	.038	[.245, .394]	< .001	.125	1.47
PVL	AI	.138	.037	[.064, .211]	< .001	.027	1.29
PPE	AI	.183	.042	[.101, .266]	< .001	.029	1.46
PPE	CCC	.188	.043	[.104, .272]	< .001	.031	1.43
PPE	VIC	-.138	.041	[-.219, -.058]	< .001	.019	1.25
PPE	SAR	-.165	.040	[-.243, -.086]	< .001	.028	1.23
PPE	DPMC	-.076	.041	[-.156, .004]	.061	.007	1.09
PPE	PVL	.244	.043	[.159, .328]	< .001	.056	1.33
PGC	PPE	.386	.034	[.320, .453]	< .001	.216	1.04
PGC	GTT	.364	.034	[.298, .431]	< .001	.193	1.04

Note: HC3 robust standard errors. VIF = variance inflation factor.

Figure 2 makes the uncertainty structure visible. Every hypothesized direct path except DPMC → PPE excluded zero. The result does not show that privacy is irrelevant. It indicates that a broad privacy/manipulation attitude did not add a statistically distinct direct contribution after legitimacy, design, clutter, and safety were controlled. Privacy may operate more strongly through scenario-specific safeguards, as later results indicate.

For Competitive Intelligence, the GTT coefficient identifies governance transparency as the strongest signal associated with legitimacy rather than merely another favorable attitude. Planning and permitting units should therefore pair technical design improvements with permit disclosure,

complaint handling, decision traceability, and clear responsibility. Appropriate feedback indicators include the proportion of permits publicly traceable, complaint-response time, appeal frequency, and resident awareness of the responsible authority.

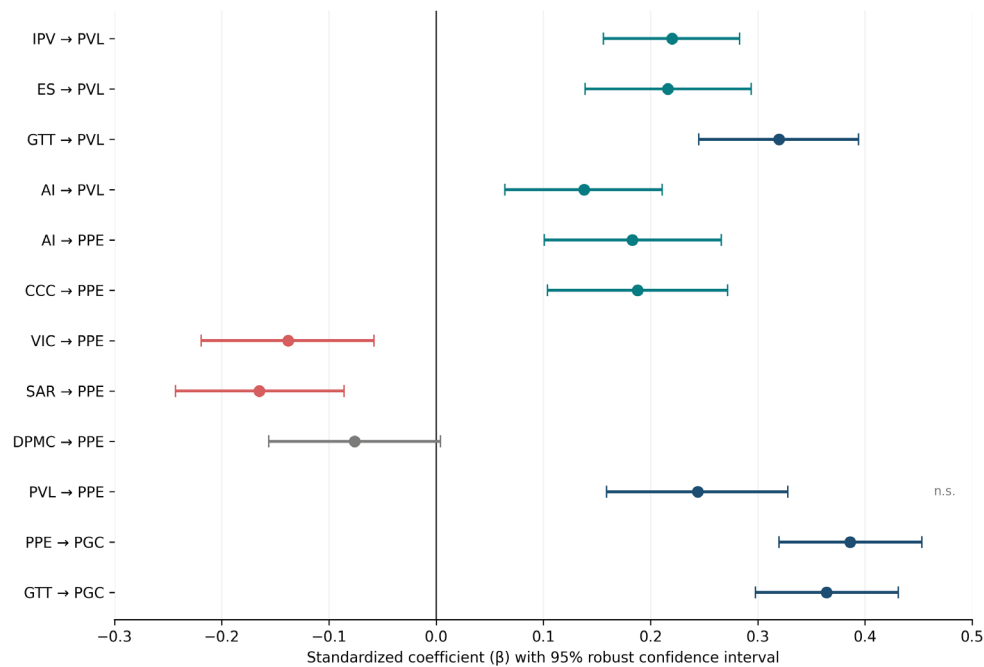


Figure 2. Standardized structural coefficients with 95% robust confidence intervals.

4.5 Legitimacy as a mediation mechanism

Table 5 answers RQ3. IPV, ES, and GTT each had a significant positive indirect effect on PPE through PVL. The largest indirect effect was observed for GTT (.074), followed by IPV (.051) and ES (.050). In all cases, the bootstrap interval excluded zero. The evidence supports legitimacy as the principal conversion mechanism through which informational usefulness, environmental responsibility, and institutional transparency become overall public preference.

Table 5. Bootstrap indirect effects through perceived public value and legitimacy

Antecedent	a path	b path	Indirect	Bootstrap 95% CI	Direct	Decision
IPV	.220	.232	.051	[.028, .078]	.029	Supported
ES	.216	.232	.050	[.025, .080]	-.037	Supported
GTT	.320	.232	.074	[.043, .112]	.035	Supported

Note: Indirect effects used 3,000 nonparametric bootstrap resamples.

This result has strategic importance. An intervention does not become acceptable merely because it is technically efficient or information-rich. The arrangement must also be perceived

as legitimate: public benefits should outweigh visual and social costs, decision criteria should be transparent, and standards should be applied consistently. For Competitive Intelligence, legitimacy is therefore the conversion mechanism through which analyzed information becomes actionable support. Public managers should monitor whether information-rich or sustainable installations also improve perceived fairness, complaint outcomes, and trust in permit decisions.

4.6 Advertising-scenario evaluation

Table 6 and Figure 3 answer RQ4. Approval was conditional rather than uniform. The most acceptable scenarios combined contextual fit, visible safeguards, public information, environmental restraint, or limited duration. The least acceptable scenarios concentrated excessive brightness, residential intrusion, cumulative clutter, or dominance near a sensitive site. The similarity between V1 and V3 is strategically important: a conventional static sign and a digital transport-hub display received comparable approval when both were contextually integrated and visibly governed.

Table 6. Repeated evaluation of urban advertising scenarios

Code	Scenario	n	Accept.	Value	Harm	Trust	Approve %
V1	Integrated static commercial-street sign	313	5.65	5.35	2.81	5.08	95.2
V2	High-brightness residential digital billboard	289	3.34	3.53	4.89	3.47	1.4
V3	Dimmed transport-hub display with safeguards	302	5.76	5.76	2.96	5.35	93.4
V4	Large heritage-area wrap without consultation	302	4.48	4.82	4.03	4.25	36.4
V5	Interactive street furniture with notice/opt-out	290	5.17	5.40	3.58	4.77	71.4
V6	Cumulative shopfront clutter affecting wayfinding	287	3.87	4.11	4.55	3.92	9.1
V7	Temporary low-energy cultural projection	322	5.59	5.36	3.16	5.13	89.4
V8	Dominant school-adjacent billboard	295	3.61	3.77	4.52	3.56	6.4

Note: Ratings use seven-point scales. Approval is the percentage approved as described.

The binomial generalized estimating equation used V1 as the reference. V3 did not differ significantly from V1 (OR = .685, 95% CI [.335, 1.400], $p = .299$), while V7 remained highly approved but was lower than V1 (OR = .408, $p = .004$). All other scenarios had sharply lower approval odds. These contrasts support context-sensitive regulation rather than a simple static-versus-digital distinction. The governance quality of the installation mattered more than format alone.

For public-policy implementation, the scenario ordering can be used as a structured pre-permit intelligence instrument. Transport, heritage, education, planning, and privacy units can compare proposed installations with the tested configurations and document which safeguards alter approval. Post-implementation complaint rates, brightness measurements, accessibility incidents, and permit modifications should then be compared with predicted acceptability to create a feedback record for later decisions.

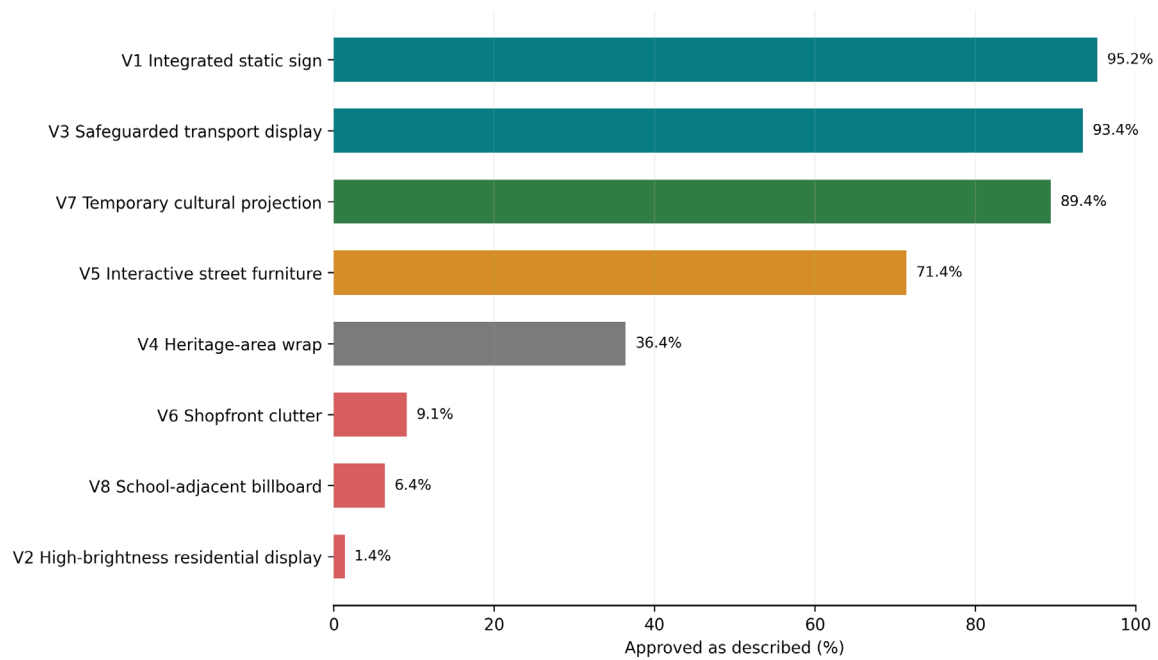


Figure 3. Percentage of scenario evaluations approved as described.

4.7 Governance priorities and strategic decision support

Residents differentiated among the ten interventions, Friedman $\chi^2(9) = 54.42$, $p < .001$. Table 7 and Figure 4 answer the priority component of RQ5. The leading group consisted of automatic dimming and nighttime restrictions, controlled zones near sensitive sites, independent complaint and enforcement mechanisms, restrictions on sensors and personalized targeting, and formal safety/accessibility review. All means exceeded the midpoint, indicating support for a multi-instrument governance package rather than reliance on one isolated rule.

Table 7. Ranked governance-intervention priorities

Rank	Code	Intervention	M	SD	Rated 6–7 (%)
1	PRI2	Automatic dimming and nighttime restrictions	5.27	0.95	40.5
2	PRI3	Controlled zones near sensitive sites	5.26	0.91	40.0
3	PRI8	Independent complaint/enforcement mechanism	5.26	0.95	40.8
4	PRI7	Restrictions on sensors/personalized targeting	5.26	0.92	39.0
5	PRI4	Safety and accessibility review	5.22	0.97	39.3
6	PRI10	Context-specific design guidelines	5.17	0.96	37.7
7	PRI1	Advertising-density limits	5.12	0.95	34.2
8	PRI5	Energy efficiency/recyclable materials	5.12	0.94	33.0
9	PRI9	Public consultation for high-impact installations	5.09	0.93	32.7
10	PRI6	Permit and ownership disclosure	5.08	0.93	32.8

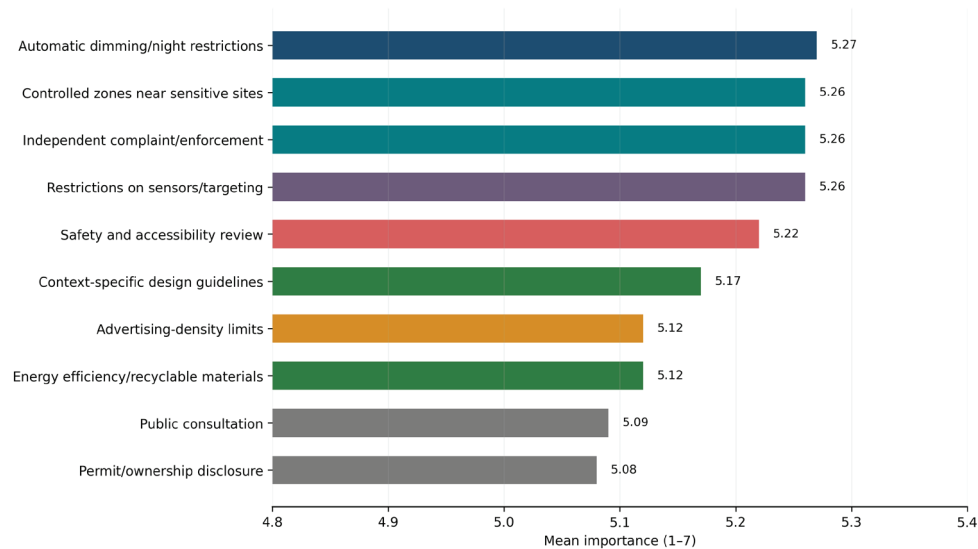


Figure 4. Mean importance of governance interventions on the seven-point scale.

The importance–performance map in Figure 5 adds strategic direction. PVL combined the highest importance with favorable performance and should therefore be protected. AI and CCC also occupied the high-importance/high-performance quadrant. SAR and VIC had lower favorable performance, placing them in the priority-improvement region. DPMC had the smallest adjusted direct coefficient, but scenario and priority evidence showed that visible notices, opt-out mechanisms, and restrictions on sensing remained decision-relevant.

The priority map converts statistical importance into organizational sequencing. Safety, accessibility, and clutter should be assigned to immediate improvement programs led by planning, transport, and enforcement units, whereas legitimacy, aesthetic integration, and contextual congruence require maintenance through transparent standards and consistent permit review. International governance evidence similarly supports coordinated rather than single-instrument responses to complex urban risks (UN-Habitat, 2022; World Health Organization [WHO], 2023).



Figure 5. Importance–performance decision map for public-preference drivers.

4.8 Resident preference segmentation

The two-cluster solution had the highest silhouette coefficient among the tested alternatives (silhouette = .195). Because separation was modest, the profiles are interpreted as practical decision-support groupings rather than natural resident types. Table 8 and Figure 6 show that the high-engagement governance-demanding profile scored higher on both benefits and risks. This pattern represents active evaluation rather than uncritical acceptance: stronger support coexisted with stronger demands for safeguards.

Table 8. Resident preference segment profiles

Segment	n	%	AI	CCC	VIC	SAR	GTT	PVL	PPE	PGC
Moderate-engagement evaluators	271	45.2	4.25	4.16	4.45	4.36	4.22	4.17	4.49	4.36
High-engagement governance-demanding	329	54.8	5.24	5.23	5.08	5.03	5.26	5.23	5.02	5.13

Note: Segment labels are descriptive. The silhouette coefficient was .195.

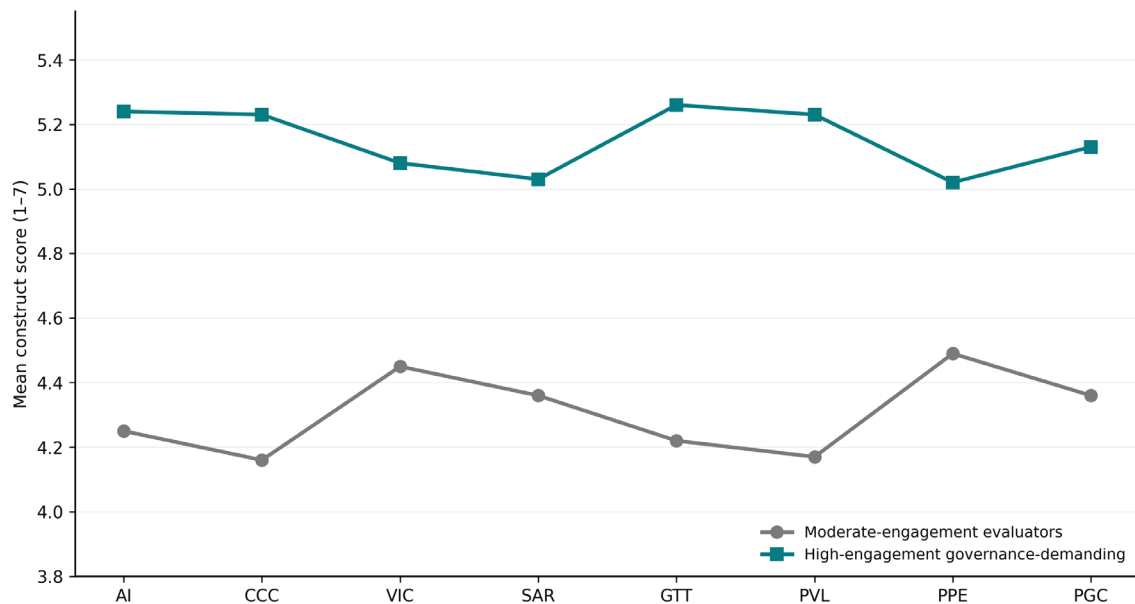


Figure 6. Mean construct profiles for the two resident preference segments.

Scenario effects did not differ significantly by preference segment, $\chi^2(7) = 6.73$, $p = .458$, or neighborhood context, $\chi^2(35) = 29.59$, $p = .727$. The ranking of scenarios was therefore broadly stable across the tested groups. This result weakens H12 but strengthens the strategic usefulness of the core scenario ordering: safeguards, contextual fit, and limited harm were valued consistently rather than by one narrow profile.

4.9 Hypothesis decisions

Table 9 consolidates the hypothesis tests. H1–H6 and H8–H11 were supported. H7 was not supported because the adjusted DPMC interval crossed zero, and H12 was not supported because scenario interactions were nonsignificant. Reporting both unsupported hypotheses is important for avoiding selective interpretation.

Table 9. Consolidated hypothesis decisions

Hypothesis	Relationship	β	p	Decision
H1	AI $\rightarrow$ PPE	.183	< .001	Supported
H2	CCC $\rightarrow$ PPE	.188	< .001	Supported
H3	IPV $\rightarrow$ PVL	.220	< .001	Supported
H4	ES $\rightarrow$ PVL	.216	< .001	Supported
H5	VIC $\rightarrow$ PPE	-.138	< .001	Supported
H6	SAR $\rightarrow$ PPE	-.165	< .001	Supported
H7	DPMC $\rightarrow$ PPE	-.076	.061	Not supported
H8	GTT $\rightarrow$ PVL	.320	< .001	Supported
H9	PVL $\rightarrow$ PPE	.244	< .001	Supported
H10	PPE $\rightarrow$ PGC	.386	< .001	Supported
H11	Indirect effects through PVL	—	—	Supported
H12	Scenario heterogeneity	—	.458	Not supported

Note: H12 also included a nonsignificant neighborhood-context interaction, $p = .727$.

4.10 Integrated theoretical interpretation

The results provide a denial both to accepting and rejecting the urban visual advertising in general. The more aesthetically integrated, culturally congruent, institutionally legitimate and related to the value of the people, the greater the preference. Preference was down when installations caused safety and accessibility issues, or were intrusive. Based on the scenario evidence, the same conclusion was reached when considering concrete scenarios: regulated, safeguarded, and temporary configurations were accepted, while high brightness residential, cluttered, and school adjacent were rejected.

The main method for conversion was legitimacy. There was a higher association with PVL in GTT compared to other variables and a higher direct association with PPE than in other variables. The factor of informational value and environmental sustainability had an impact on preference mostly via legitimacy. This means that design and governance attributes can be strategically helpful when construed as testament that social benefits exceed visual and social costs. The outcome is in line with the research into digital transformation which focuses on redesigning institutions and organizations rather than just implementing technology (Kraus et al., 2022).

Immediate intervention priorities were Safety and Clutter. They both possessed negative significant coefficients, a low level of good performance and a scenario counterpart. There is a shift

in current guidance on road safety to more proactively managing environmental hazards, instead of relying on individual behaviours (WHO, 2023). As an argument to advertising regulation, the argument justifies brightness regulation, animation, sightlines, pedestrian access consideration and cumulative density rules.

The concrete measures provided better protection for privacy than a generalised adapted attitude. The DPMC route just went through zero, but the interactive situation was quite satisfactory when there was a noticeable trigger, and a way to opt-out, and limits on sensing and personalized targeting were among the most popular interventions. This approach is consistent with the current digital governance landscape, which prioritizes responsible data usage, with elements of transparency, purpose restriction, and user control. The pattern reflects the notion of contemporary digital governance, where the key principles of responsible data usage are shared such as transparency, limiting uses, and giving users control over their data (European Union, 2024).

The segment analysis provides some depth but not artificially generated resident segments. Evaluators of high engagement were more likely to have positive preferences and more concerns. City officials must not thus see support as a call to deregulation. The profile implies that residents might be receptive to the advertising, while also being demanding for strict protection, clear policing and complaint or review process.

4.11 Practical governance framework

The combined evidence supports a sequenced governance strategy. First, sites should be classified by sensitivity rather than governed by one citywide threshold. Second, high-impact installations should be subject to dimming, operating-hour limits, safety and accessibility review, and protected wayfinding. Third, permit ownership, authorization status, complaint channels, and enforcement outcomes should be publicly visible. Fourth, transport, emergency, wayfinding, and community information should be treated as public-value features. Fifth, data-enabled displays should provide explicit notices, purpose limitation, opt-out procedures, and restrictions on biometric or inferred targeting. Sixth, preference intelligence should be updated periodically so that governance responds to technological and neighborhood change.

4.12 Competitive Intelligence Contributions and Organizational Implementation

The findings add to Competitive Intelligence in that it shows how resident reviews can proceed through a full organizational decision cycle as opposed to descriptive results of surveys. The constructs and scenarios are used as inputs of environmental-scanning; measurement validation is used to determine the quality of information; structural and scenario models are used to transform inputs into analyzed intelligence; priority rankings and the importance-performance map can be used to disseminate information; and governance recommendations can be used to transform intelligence into permitting, monitoring, and enforcement decisions.

It is also revealed in the results as to why Intelligence Governance is essential. The best antecedent of perceived legitimacy was Governance Transparency and Trust and the best predictor of public preference was legitimacy. Intelligence value then is not merely on the accuracy of the analytical process, but also on the ability to explain, review, apply consistently and relate the decision process to a responsibility that can be identified. Municipal intelligence products are to record sources of evidence, analytical uncertainty, decision criteria, authorities responsible as well as review procedures.

The framework has the ability to alleviate many types of information asymmetry. The uncertainty over responsibility and authority of residents can be decreased by the public permit registers and disclosure of ownership. Uncertainty about sensing and personalization can be minimized by providing data notices and opt-out processes. Preference analysis can help minimize the uncertainty of regulators of the acceptability of proposals in a specific context, whereas transparent design criteria can minimize the uncertainty of advertisers of when a proposal is likely to be accepted.

This needs to be implemented throughout the policy cycle. In the process of setting agenda, the framework determines the main intelligence issues and sensitive places. In the process of designing a policy, the brightness standards and operating hours, density limits, and review of safety, data protection, and consultation requirements are informed by scenario and priority evidence. In the process of permit assessment, the framework will facilitate a systematic comparison of proposed installations. Feedback is given during monitoring in terms of the frequency of complaints, failures in compliance, energy performance, brightness measurements, access incidents, and appeals.

A permit should not be issued and the cycle end. The municipal feedback system must juxtapose the anticipated acceptability to post-implementation complaints, compliance history, objective environmental measures, and revised appraisals. The real time discrepancy in materials must lead to a new intelligence cycle such as update of significant intelligence subjects, collection tools, analytical assumptions and permit conditions. This is how the framework is transformed into an organizational capability, which is adaptive.

The connection between sustainable competitive advantage is the one of capabilities. To the public authorities, the long-term ability to identify arising issues, coordinate evidence-based across departments, ease information asymmetry, and modify the policies without compromising legitimacy is beneficial. To the responsible advertiser, context sensitivity, transparent, safe and environmentally credible formats has the advantage of being more likely to maintain both the acceptance of the people and the regulatory bodies in the long run. These are just suggestions that field validation must be made, and are not assertions of long term performance seen.

5. FINAL CONSIDERATIONS

The paper has created a Competitive Intelligence model of translating multitemensional analyses of city visual advertising to strategic governance advice and was resident-centered. The analytical architecture differentiated between positive design and public-value dimensions and visual, safety, accessibility, and privacy dimensions and related these dimensions to governance

transparency, perceived legitimacy, and popularity, as well as policy support, scenario approval, and intervention priorities.

The main analytical result was the fact that the acceptance was based on the quality of governance and contextual suitability and not on the advertising format. The best antecedent of Perceived Public Value and Legitimacy was Governance Transparency and Trust and legitimacy was the best predictor of Public Preference Evaluation. The aesthetic integration and the contextual congruence were also strongly related to preference, and the visual intrusiveness and the risk of safety/accessibility had negative relationships. There was also a tendency of the scenario comparisons to prefer integrated, secure, information-fomenting, time-restrained installations as opposed to high-brightness, clutter-filled and sensitive-location setups.

The scientific advancement has been to bring together streams of streams which are usually studied independently. The framework integrates the urban structure, sustainability, perceived harm, legitimacy, institutional trust, scenario appraisal and governance prioritization on a single analytical framework. It also clears up the difference between legitimacy and general preference and demonstrates how the informational value, environmental sustainability, and transparency in governance can impact preference via an ordinary institutional process.

Operationalization of complete and controlled intelligence cycle is the contribution to Competitive Intelligence. The inputs of the environmental-scanning are resident evaluation and contextual information; the inputs of measurement assessment are the quality of information; the outputs of the interpreted intelligence are statistical and scenario analysis, the inputs of the priority maps and scenario comparisons are the outputs of dissemination, and the inputs of the permit, design, privacy, safety, and enforcement tools are the outputs of organizational action. The feedback loop is further facilitated by monitoring, complaints, compliance information, appeals and repeated preference measurement, and Intelligence Governance, which come with rules of provenance, access, ethics, auditability, transparency, and accountability of decisions.

The implications to management involve how the city decision-making may be practically organized. To ensure high-impact installations are approved through scenario based assessment, the public managers ought to develop critical intelligence subjects on sensitive sites and emerging technologies, have open permit and ownership registers, integrate planning and enforcement data and apply scenario-based assessment. Controls on brightness and operating hours, safety and access reviews, sensitive-site zoning, privacy notices, limitations on biometric or inferred targeting, complaint process, and context-sensitive design requirements are not to be handled as individual rules, but as a package of coordinated rules.

There are significant weaknesses in the evidence. The attitudinal associations are cross-sectional and fail to build up temporal causality. Records that were provided were created to demonstrate the methodology, and were not created by previously documented, probability-based recruitment. The results thus have an analytical coherence and decision support potential although it cannot be interpreted as population estimates of a particular city or country. Scenario outcomes are reported acceptability, and allow decisions to be made not based on observed behavior, environment, economic or safety impacts. A little separation was also present in the profile solution and it must be approached in an exploratory manner.

Future studies ought to administer the instrument to independently sampled samples, also ensuring measurement invariance across cities and regulatory systems and also ensnaring information about preferences with permit data, complaints, compliance results and objective data on brightness, energy consumption, accessibility and road safety. The changes in preferences and legitimacy over time following policy implementation should be measured using longitudinal studies and the suggested feedback mechanism in the conditions of real organizations should be measured using field experiments and post-implementation monitoring.

Declaration of AI-assisted support: OpenAI's ChatGPT was used to support language editing, translation, document organization, grammatical revision, and the presentation of selected tables and figures. It was not used to recruit participants, collect data, independently execute the reported statistical models, or autonomously determine the scientific conclusions. The authors reviewed the analytical outputs, checked the manuscript content, verified the cited sources to the extent possible, and accept full responsibility for the accuracy, interpretation, and integrity of the final manuscript.

Data availability statement: The analytical workbook, questionnaire, coding framework, and reproducible result materials are available from the corresponding author as supplementary research materials. No public repository identifier was available when the manuscript was prepared. The materials must be described according to their documented provenance and must not be represented as independently collected field observations.

Ethics statement: The supplied numerical records were prepared for methodological demonstration and did not involve recruitment, intervention, or collection of identifiable information from human participants. Institutional ethics approval was therefore not applicable to the present analytical demonstration. Any future field administration of the questionnaire should obtain the approvals required by the relevant institution and jurisdiction.

Informed consent statement: No human participants were recruited for the supplied analytical dataset; informed consent was therefore not applicable. The questionnaire includes a consent and eligibility section for future field administration.

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