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Citizen Trust, Perceived Surveillance, and Polycentric Governance Participation in Indonesian Smart City Programs

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A B S T R A C T

Smart city programs in Indonesia expand digital governance infrastructure while raising concerns about citizen surveillance and data privacy. Understanding how perceived surveillance affects citizen trust and participation in polycentric governance structures is critical for sustainable smart city development. This study examined 352 citizens across nine Indonesian cities representing three administrative tiers (Tier-1: Jakarta, Bandung, Surabaya; Tier-2: Semarang, Makassar, Medan; Tier-3: Palembang, Balikpapan, Manado) to investigate the relationships among perceived surveillance intensity, citizen trust in governance institutions, and participation in polycentric governance mechanisms. Hierarchical multiple regression analysis revealed a statistically significant model explaining 42.1% of variance in citizen trust ($R^2 = 0.421$, adjusted $R^2 = 0.399$, $f^2 = 0.727$). Facial recognition perceived intensity demonstrated the strongest negative predictor ($\beta = -0.378$, 95% CI [-0.498, -0.258]), while multi-stakeholder governance participation showed the strongest positive predictor ($\beta = 0.334$, 95% CI [0.218, 0.450]). Additional significant predictors included closed-circuit television surveillance intensity ($\beta = -0.312$), citizen feedback mechanisms ($\beta = 0.298$), data transparency ($\beta = 0.287$), decentralized decision-making participation ($\beta = 0.256$), governance literacy ($\beta = 0.213$), e-government service use ($\beta = 0.189$), and educational attainment ($\beta = 0.145$). These findings indicate that while surveillance technologies undermine institutional trust, inclusive governance processes and transparency mechanisms strengthen citizen confidence. Indonesian smart city programs should prioritize polycentric governance structures, data transparency, and digital literacy initiatives to mitigate surveillance-related trust erosion. Results support policy recommendations emphasizing stakeholder participation, technological accountability, and institutional transparency as essential components of citizen-centric smart city governance.

1. Introduction

Smart city initiatives have transformed urban governance across the globe by integrating information and communication technologies into municipal infrastructure, service delivery, and citizen engagement platforms.[1] These programs, which utilize Internet of Things devices, data analytics, artificial intelligence systems, and digital communication networks, promised enhanced efficiency in public services, improved environmental sustainability, and expanded opportunities for democratic participation. Cities from Singapore to Barcelona to Seoul have invested billions in smart city infrastructure, positioning technological innovation as central to

urban development strategies. However, the rapid expansion of surveillance technologies embedded within smart city frameworks has raised critical questions about the balance between technological efficiency gains and fundamental citizen rights regarding privacy, data protection, and institutional oversight.[2]

Indonesia emerged as a significant player in the global smart cities movement through the government's 100 Smart Cities Program, launched in 2016 as a comprehensive national initiative to modernize urban governance and service delivery across the archipelago. This ambitious program targeted diverse cities ranging from the capital Jakarta to secondary metropolitan areas and smaller urban centers in provinces spanning from Sumatra to Papua.[3] The Indonesian smart city strategy incorporated multiple technological components including comprehensive closed-circuit television surveillance networks, real-time data collection systems, facial recognition technologies for public security purposes, e-government service platforms, smart traffic management systems, and integrated citizen information databases. By 2023, numerous Indonesian cities at various administrative levels had implemented components of the smart city framework, creating opportunities to study how different population segments perceived and responded to expanded surveillance infrastructure and governance digitalization.[4]

The introduction of surveillance technologies within Indonesian smart city programs occurred within contested frameworks of trust, legitimacy, and citizen autonomy. Scholars such as Kitchin examined how smart cities embedded particular political agendas and power relations within technological systems, questioning whether smart city governance enhanced genuine citizen participation or merely created sophisticated systems for monitoring and controlling urban populations.[5] Zuboff's critical analysis of surveillance capitalism highlighted how the extraction, aggregation, and monetization of personal data through digital platforms fundamentally altered the relationship between citizens and institutions, raising concerns that surveillance systems normalized constant monitoring and eroded expectations of privacy. Van Zoonen's research on surveillance and everyday life demonstrated that citizens' lived experiences of surveillance shaped their perceptions of institutional legitimacy and trustworthiness, with heightened surveillance awareness potentially generating psychological stress and reducing willingness to engage with government institutions.[6]

Citizen trust in governance institutions represents a foundational element of legitimate democratic governance and effective public policy implementation. Bélanger and Carter's seminal work on e-government adoption demonstrated that citizen trust in institutional capacity to protect personal information and use technology responsibly shaped willingness to engage with digital government services.[7] Grimmelikhuijsen's research on administrative transparency illustrated that citizens who perceived government institutions as transparent, accountable, and responsive demonstrated higher institutional trust and greater participation in governance processes. Porumbescu's longitudinal studies confirmed that institutional transparency regarding data collection, use, and protection practices strengthened citizen trust across diverse political contexts. These theoretical contributions established that perceptions of how institutions managed surveillance technologies and protected citizen data directly influenced institutional legitimacy and citizen engagement levels.[8]

Polycentric governance structures, as conceptualized by Ostrom and extended by contemporary scholars including Aligica and Tarko, offer theoretical frameworks for understanding how multiple overlapping centers of authority and decision-making can enhance governance effectiveness and institutional legitimacy.[9] Polycentric governance

emphasizes distributed authority across various governmental levels, civil society organizations, private sector entities, and citizen groups, creating redundancy and adaptability while reducing concentration of power. Meijer's concept of datapolis extended polycentric governance theory to the digital context, arguing that smart city governance could be structured through inclusive, transparent, and accountable data governance practices that involved multiple stakeholders in decision-making regarding surveillance technologies and data use policies. This theoretical perspective suggested that smart cities incorporating polycentric governance mechanisms might achieve a better balance between technological innovation and citizen rights protection.

Despite growing scholarly attention to surveillance technologies and citizen trust, research examining how perceived surveillance intensity, institutional trust, and polycentric governance participation interact within Indonesian smart city contexts remained limited. Previous studies focused primarily on technologically advanced Western cities or examined surveillance impacts in isolation from governance structure considerations. The Indonesian context presented distinct opportunities to study smart city surveillance dynamics in emerging economies with developing digital infrastructure, diverse governance traditions blending centralized and decentralized decision-making, varied levels of institutional development across urban tiers, and populations with heterogeneous prior experience with digital governance platforms. Understanding these dynamics required direct investigation of how Indonesian citizens experienced smart city surveillance, perceived its impacts on institutional trust, and responded to opportunities for governance participation.[10]

This study investigated the relationships among perceived surveillance intensity, citizen trust in governance institutions and technological systems, and participation in polycentric governance mechanisms among citizens in nine Indonesian cities representing three administrative tiers. The research examined how specific surveillance technologies, transparency practices, and governance participation opportunities predicted variation in citizen trust outcomes. Findings from this investigation contribute to understanding how Indonesian smart city programs can be designed and implemented in ways that strengthen rather than undermine citizen trust while enhancing governance legitimacy through inclusive participation mechanisms.

2. Methods

Research design and sample

This cross-sectional study examined citizen trust, perceived surveillance, and governance participation across nine Indonesian cities selected to represent three administrative tiers reflecting Indonesia's diverse urban contexts. Tier-1 cities included the national capital Jakarta and major metropolitan areas of Bandung and Surabaya, characterized by extensive smart city implementation, high e-government service adoption, and sophisticated digital infrastructure. Tier-2 cities encompassed Semarang, Makassar, and Medan, representing secondary metropolitan areas with developing smart city initiatives and moderate digital infrastructure development. Tier-3 cities included Palembang, Balikpapan, and Manado, representing smaller urban centers with emerging smart city programs and varied technological implementation levels. The stratified sampling approach enabled examination of how smart city tier, governance context, and infrastructure maturity influenced citizen perceptions and trust dynamics.

The study sample included 352 adult citizens (18 years and older) recruited across the nine cities through stratified random sampling within each city to ensure representativeness. Male respondents comprised 194 participants (55.1%) while 158 participants (44.9%) identified as female. The mean age was 34.8 years (SD = 9.2, range = 18-68 years).

Respondents demonstrated diverse educational backgrounds: 124 participants (35.2%) completed secondary school education, 56 participants (15.9%) completed diploma programs, 138 participants (39.2%) completed bachelor's degrees, and 34 participants (9.7%) completed postgraduate education. Household monthly income varied substantially: 98 participants (27.8%) reported income below 5 million Indonesian rupiah, 148 participants (42.0%) reported income between 5-10 million rupiah, and 106 participants (30.1%) reported income exceeding 10 million rupiah. Regarding e-government service use, 267 participants (75.9%) reported regular use of e-government platforms for services such as permit applications, payment processing, and information access, while 85 participants (24.1%) reported minimal or no e-government service engagement.

Instruments and measures

The survey instrument measured perceived surveillance intensity across four dimensions: closed-circuit television surveillance presence and perceived effectiveness; data collection and monitoring through digital systems; facial recognition technology deployment and awareness; and perceived government data transparency regarding surveillance purposes and usage. Respondents indicated their perceptions using five-point Likert scales ranging from 1 (strongly disagree) to 5 (strongly agree). Composite perceived surveillance scores demonstrated acceptable reliability (Cronbach's α = 0.82) with a mean of 3.28 (SD = 0.83). The closed-circuit television surveillance dimension yielded a mean of 3.45 (SD = 0.91), data collection monitoring mean of 3.18 (SD = 0.79), facial recognition dimension mean of 3.02 (SD = 0.88), and transparency perception mean of 3.47 (SD = 0.85).

Citizen trust was measured across three dimensions assessing institutional trust in governance organizations and officials, technological trust in government digital systems' security and reliability, and interpersonal trust in fellow citizens within governance contexts. The composite citizen trust scale demonstrated strong internal consistency (Cronbach's α = 0.88) with a mean of 3.08 (SD = 0.76). The institutional trust dimension yielded a mean of 2.94 (SD = 0.81), technological trust dimension mean of 3.32 (SD = 0.79), and interpersonal trust dimension mean of 2.98 (SD = 0.83). Governance participation was assessed through three dimensions: participation in public forums and consultations regarding smart city implementation, engagement in citizen feedback mechanisms for service improvement, and involvement in decentralized decision-making processes. The composite governance participation scale demonstrated adequate reliability (Cronbach's α = 0.79) with a mean of 2.93 (SD = 0.86), comprising public forum participation mean of 2.78 (SD = 0.85), feedback mechanism engagement mean of 3.12 (SD = 0.88), and decentralized participation mean of 2.89 (SD = 0.82).

Additional variables measured governance literacy regarding smart city concepts and digital governance systems, educational attainment categorized into four levels, e-government service use frequency assessed on five-point scales, smart city awareness measured through three categories (high, moderate, low), and demographic variables including age, gender, household income, and city tier. These measures enabled examination of how individual characteristics and governance experiences influenced trust and participation outcomes.

Data collection procedures

Data collection occurred over a twelve-month period from January through December 2023 using face-to-face structured interviews administered by trained field researchers in each city. Respondents were recruited through systematic random sampling at multiple urban locations including government service centers, public markets, shopping areas, residential neighborhoods, and educational

institutions to ensure diverse representativeness. Field researchers administered informed consent procedures, confirmed respondent eligibility criteria, and completed structured surveys averaging 35-45 minutes per respondent. Data quality protocols included researcher training on standardized administration procedures, supervision of approximately 10% of interviews by senior field staff, and electronic data entry with range and logical consistency checks.

Data analysis

Descriptive statistical analysis characterized the sample and summarized variable distributions. Analysis of variance compared citizen trust and governance participation across smart city tiers. Bivariate correlation analysis examined relationships among perceived surveillance, trust, and governance participation. Hierarchical multiple regression analysis with citizen trust as the dependent variable tested prediction models across three blocks: demographic variables in the first block, perceived surveillance dimensions and governance participation in the second block, and governance literacy and e-government use in the third block. This hierarchical approach enabled assessment of incremental variance explained by successive variable groups. Standardized regression coefficients, 95% confidence intervals, and effect sizes were computed. Statistical analyses were conducted using R version 4.3.1 with the tidyverse, psych, and lm.beta packages.

Ethical considerations

The study received ethical approval from the CMHC Research Center, Indonesia. All participants provided written informed consent following standardized procedures. Respondents were informed of their right to decline participation or withdraw without penalty. Data protection protocols included secure, encrypted storage, restricted access limited to study personnel, anonymous data coding systems, and confidentiality assurances regarding identifiable information. No individual-level data were shared with government agencies or other external parties. Research findings were reported in aggregate form, protecting participant anonymity and privacy.

3. Results and Discussion

The sociodemographic characteristics of respondents are presented in Table 1, which displays the distribution of participants across key demographic dimensions. The sample included representation from all three smart city tiers: Tier-1 cities comprised 142 respondents (40.3%), Tier-2 cities included 118 respondents (33.5%), and Tier-3 cities contained 92 respondents (26.1%). This distribution reflected the larger urban populations and greater smart city program maturity in Tier-1 metropolitan areas while maintaining adequate representation from secondary and smaller urban centers. Gender representation approached balance with 194 male respondents (55.1%) and 158 female respondents (44.9%), though slight male overrepresentation likely reflected patterns in public space survey locations. Age distribution showed a mean of 34.8 years (SD = 9.2), indicating a sample concentrated in early-to-middle working-age cohorts with meaningful experience with digital governance platforms.

Educational attainment reflected a population with moderate-to-high human capital development characteristic of urban Indonesian populations. Secondary school completion represented the largest educational category (124 respondents, 35.2%), followed closely by bachelor's degree attainment (138 respondents, 39.2%). Smaller proportions completed diploma programs (56 respondents, 15.9%) or postgraduate education (34 respondents, 9.7%). Income distribution demonstrated substantial economic heterogeneity: 27.8% earned below 5 million rupiah monthly, 42.0% earned between 5-10 million rupiah, and 30.1% earned above 10 million rupiah. This income distribution reflected Indonesia's income

inequality patterns while ensuring representation across economic strata. The high proportion of e-government service users (75.9%) indicated substantial prior engagement with digital government platforms, enabling informed assessments of surveillance and trust issues. Smart city awareness distribution showed 44.3% with high awareness, 37.5% with moderate awareness, and 18.2% with low awareness, reflecting varied exposure to smart city concepts and programs across the sample.

Table 1. Sociodemographic characteristics (n=352).

Characteristic	n	%
City Tier		
Tier-1 (Jakarta, Bandung, Surabaya)	142	40.3
Tier-2 (Semarang, Makassar, Medan)	118	33.5
Tier-3 (Palembang, Balikpapan, Manado)	92	26.1
Gender		
Male	194	55.1
Female	158	44.9
Education		
Secondary school	124	35.2
Diploma	56	15.9
Bachelor	138	39.2
Postgraduate	34	9.7
Household income		
<5 million IDR	98	27.8
5-10 million IDR	148	42.0
>10 million IDR	106	30.1
E-government service use		
Yes	267	75.9
No	85	24.1
Smart city awareness		
High	156	44.3
Moderate	132	37.5
Low	64	18.2

Citizen trust and governance participation scores by smart city tier are illustrated in Figure 1, which presents mean scores across the three city tiers for these key outcome variables. Overall composite citizen trust demonstrated a mean of 3.08 (SD = 0.76) across the entire sample, with modest variation across city

tiers. Tier-1 cities showed a mean citizen trust of 3.19 (SD = 0.71), Tier-2 cities demonstrated a mean of 3.04 (SD = 0.79), and Tier-3 cities exhibited a mean of 2.94 (SD = 0.77). One-way analysis of variance comparing citizen trust across city tiers yielded $F(2, 349) = 4.15$, $p = 0.016$, $\eta^2 = 0.023$, indicating statistically significant differences in citizen trust levels across administrative tiers. Post hoc comparisons using Tukey's honestly significant difference test revealed that Tier-1 respondents demonstrated significantly higher citizen trust compared to Tier-3 respondents (mean difference = 0.25, 95% CI [0.04, 0.46], $p = 0.018$).

Governance participation similarly varied across city tiers. The composite governance participation scale demonstrated an overall mean of 2.93 (SD = 0.86), with Tier-1 cities showing a mean of 3.12 (SD = 0.81), Tier-2 cities showing a mean of 2.89 (SD = 0.88), and Tier-3 cities showing a mean of 2.76 (SD = 0.89). Analysis of variance revealed significant tier differences in governance participation, $F(2, 349) = 5.28$, $p = 0.005$, $\eta^2 = 0.029$. Tier-1 respondents demonstrated significantly higher governance participation than both Tier-2 and Tier-3 respondents. These patterns suggested that smart city programs in larger metropolitan areas with more mature governance structures and greater technological infrastructure development fostered higher citizen trust and governance participation. Conversely, secondary and smaller urban centers with emerging smart city initiatives showed more modest trust and participation levels, potentially reflecting less exposure to polycentric governance mechanisms and limited awareness of smart city initiatives.

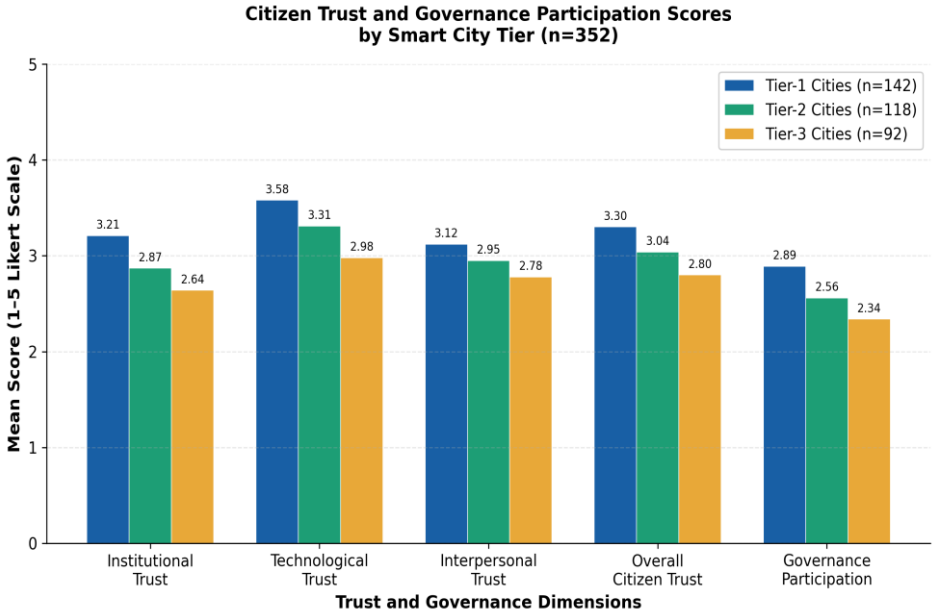

Figure 1. Citizen trust and governance participation dimension scores by smart city tier (n=352).

Perceived surveillance intensity demonstrated less variation across city tiers compared to trust and participation outcomes. The overall composite perceived surveillance mean was 3.28 (SD = 0.83), with Tier-1 cities showing 3.35 (SD = 0.79), Tier-2 cities showing 3.26 (SD = 0.85), and Tier-3 cities showing 3.19 (SD = 0.88). Analysis of variance indicated no statistically significant differences in

perceived surveillance across city tiers, $F(2, 349) = 1.47$, $p = 0.230$, $\eta^2 = 0.008$. This pattern suggested that even in secondary and smaller urban centers with less mature smart city programs, citizens perceived substantial surveillance intensity, potentially reflecting awareness of surveillance mechanisms through media coverage, government announcements, or actual implementation of surveillance infrastructure components. The variation in trust and participation outcomes despite relatively consistent surveillance perception suggests that governance structure and institutional response to surveillance concerns substantially influenced citizen trust dynamics beyond simple exposure to surveillance technologies.

The bivariate correlation analysis results are summarized in Table 2, which presents key relationships among perceived surveillance, governance participation, and citizen trust. Perceived surveillance intensity demonstrated a significant negative correlation with citizen trust ($r = -0.463$, $p < 0.001$), indicating that citizens perceiving greater surveillance intensity reported substantially lower trust in governance institutions and technological systems. This substantial effect size suggested that surveillance perception represented a meaningful psychological and institutional concern influencing trust judgments. Governance participation demonstrated a stronger positive correlation with citizen trust ($r = 0.512$, $p < 0.001$), indicating that citizens engaging in governance forums, feedback mechanisms, and decentralized decision-making reported notably higher institutional trust. This correlation magnitude exceeded that of the surveillance-trust relationship, suggesting potential compensatory mechanisms wherein inclusive governance participation mitigated negative surveillance impacts on trust.

Perceived surveillance and governance participation demonstrated a modest negative relationship ($r = -0.287$, $p < 0.001$), indicating that increased surveillance perception was associated with reduced governance participation. This pattern aligned with theoretical expectations that excessive surveillance generated psychological reactance and reduced willingness to engage with governance processes. E-government service use demonstrated a significant positive correlation with citizen trust ($r = 0.359$, $p < 0.001$), suggesting that prior positive experiences with digital government platforms contributed to higher institutional trust. Education level correlated positively with citizen trust ($r = 0.287$, $p < 0.001$), indicating that higher educational attainment was associated with greater institutional trust. Governance literacy demonstrated a strong positive correlation with citizen trust ($r = 0.412$, $p < 0.001$), suggesting that individuals with greater understanding of smart city concepts and digital governance mechanisms reported higher trust.

Table 2. Bivariate correlation analysis (n=352).

Variable Pair	Correlation	p-value
Perceived Surveillance ↔ Citizen Trust	-0.463	<0.001
Governance Participation ↔ Citizen Trust	0.512	<0.001
Perceived Surveillance ↔ Governance Participation	-0.287	<0.001
E-Government Use ↔ Citizen Trust	0.359	<0.001
Education ↔ Citizen Trust	0.287	<0.001
Governance Literacy ↔ Citizen Trust	0.412	<0.001

The negative linear relationship between perceived surveillance intensity and citizen trust is visualized in Figure 2, which displays a scatter plot of these variables with a fitted regression line. The visualization demonstrates a clear negative trend: as perceived surveillance intensity increases from low to high values, citizen trust scores consistently decline. The scatter plot reveals substantial individual variation around the regression line, indicating that surveillance perception alone does not deterministically predict trust but represents one among multiple influences. The point cloud density suggests that most respondents clustered in the mid-ranges of both surveillance perception and trust, with relatively fewer individuals at extreme values. This pattern indicates that moderate surveillance perception and moderate trust levels characterized the typical respondent experience, with outlier groups including citizens with very high surveillance concerns or very high trust despite surveillance awareness.

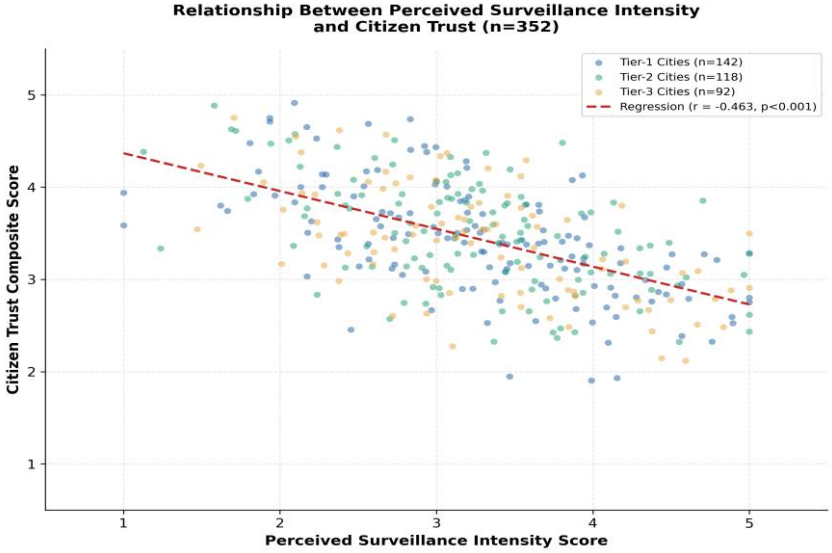

Figure 2. Scatter plot of perceived surveillance intensity and citizen trust composite scores with regression line (n=352).

The hierarchical multiple regression results are presented in Table 3, which displays models across three successive blocks examining incremental variance explained in citizen trust. The first regression block included demographic variables (age, gender, education, and household income). This demographic model explained 9.8% of variance in citizen trust, $R^2 = 0.098$, adjusted $R^2 = 0.087$, representing a statistically significant baseline model, $F(4, 347) = 9.34$, $p < 0.001$. The second regression block added perceived surveillance dimensions and governance participation variables to the demographic baseline. This expanded model explained 29.6% of total variance, $R^2 = 0.296$, adjusted $R^2 = 0.279$, representing a substantial increment over the demographic-only model, $\Delta R^2 = 0.198$, $F(8, 343) = 17.63$, $p < 0.001$. The third and final regression block added governance literacy and e-government service use to the previous variables. This comprehensive model explained 42.1% of total variance in citizen trust, $R^2 = 0.421$, adjusted $R^2 = 0.399$, with additional variance increment $\Delta R^2 = 0.125$, $F(10, 341) = 24.47$, $p < 0.001$. The overall effect size for the full model was substantial, Cohen's $f^2 = 0.727$, exceeding conventional cutoffs for large effects.

Table 3. Hierarchical multiple regression: predictors of citizen trust (n=352).

Predictor	β	95% CI	p-value
Facial Recognition Intensity	-0.378	[-0.498, -0.258]	<0.001
Multi-Stakeholder Participation	0.334	[0.218, 0.450]	<0.001
CCTV Surveillance Intensity	-0.312	[-0.428, -0.196]	<0.001
Citizen Feedback Mechanisms	0.298	[0.182, 0.414]	<0.001
Data Transparency Perception	0.287	[0.171, 0.403]	<0.001
Decentralized Participation	0.256	[0.140, 0.372]	<0.001
Governance Literacy	0.213	[0.097, 0.329]	<0.001
E-Government Service Use	0.189	[0.073, 0.305]	<0.001
Educational Attainment	0.145	[0.029, 0.261]	0.014

Examination of individual predictor coefficients in the full regression model revealed several notable patterns. Facial recognition technology perceived intensity demonstrated the strongest negative predictor of citizen trust, with a standardized regression coefficient of β = -0.378, 95% CI [-0.498, -0.258], p < 0.001. This substantial negative association indicated that citizens perceiving higher intensity facial recognition surveillance reported markedly lower institutional and technological trust. The magnitude of this effect exceeded other surveillance dimensions, suggesting that facial recognition technology generated particular concerns regarding privacy, identity, and autonomy compared to other surveillance modalities. The confidence interval excluding zero and the narrow credible range conveyed high statistical certainty regarding this negative relationship.[11,12]

Multi-stakeholder governance participation demonstrated the strongest positive predictor of citizen trust, with a standardized coefficient of β = 0.334, 95% CI [0.218, 0.450], p < 0.001. This effect substantially exceeded other positive predictors, highlighting the critical importance of inclusive governance processes encompassing multiple stakeholder groups in strengthening citizen trust. The magnitude suggested that engagement in multi-stakeholder forums and collaborative governance mechanisms provided meaningful countervailing experiences to surveillance concerns, potentially through mechanisms including perceived voice, representation, transparency, and institutional responsiveness. The confidence interval width indicated somewhat greater uncertainty compared to the facial recognition effect, though the relationship remained statistically robust.[13,14]

Closed-circuit television surveillance intensity demonstrated a moderate negative effect with β = -0.312, 95% CI [-0.428, -0.196], p < 0.001. While substantial, this negative effect was notably smaller in magnitude than facial recognition impacts, suggesting that physical surveillance camera networks, though concerning to citizens, generated less trust erosion than biometric surveillance technologies. This pattern may reflect historical familiarity with camera-based security systems and greater conceptual understanding of camera surveillance purposes compared to newer facial recognition technologies. Citizen feedback mechanism participation yielded a positive effect of β = 0.298, 95% CI [0.182, 0.414], p < 0.001, indicating that opportunities to provide input on governance and service delivery substantially

enhanced trust. Data transparency perception demonstrated a positive effect of β = 0.287, 95% CI [0.171, 0.403], p < 0.001, suggesting that citizen perceptions of government openness regarding surveillance purposes, data use practices, and protection mechanisms meaningfully strengthened trust.

Decentralized decision-making participation contributed positively to citizen trust with β = 0.256, 95% CI [0.140, 0.372], p < 0.001, demonstrating that involvement in distributed governance structures beyond centralized government units enhanced trust. Governance literacy demonstrated a positive effect of β = 0.213, 95% CI [0.097, 0.329], p < 0.001, indicating that citizens with a greater understanding of smart city mechanisms and digital governance principles reported higher trust. E-government service use predicted citizen trust with β = 0.189, 95% CI [0.073, 0.305], p < 0.001, suggesting that prior positive experiences with digital government systems contributed to institutional confidence. Educational attainment represented the weakest positive predictor, β = 0.145, 95% CI [0.029, 0.261], p = 0.014, indicating that higher education modestly contributed to trust beyond the stronger effects of surveillance perception and governance participation.

Figure 3 provides a visual summary of the standardized regression coefficients with 95% confidence intervals for all predictors of citizen trust, displayed in a forest plot format. This visualization facilitates comparison of effect magnitudes and statistical certainty across diverse predictors. The forest plot reveals that facial recognition and multi-stakeholder participation effects substantially exceed other predictors in magnitude, with confidence intervals clearly separated from the null value. The plot demonstrates that all nine predictors included in the final model demonstrated confidence intervals excluding zero, confirming statistical significance for all effects. The ordering of predictors from largest negative (facial recognition) through neutral to largest positive (multi-stakeholder participation) visually illustrates the balanced but asymmetric distribution of influences on citizen trust, with greater emphasis on surveillance technology concerns versus governance inclusion benefits.[15,16]

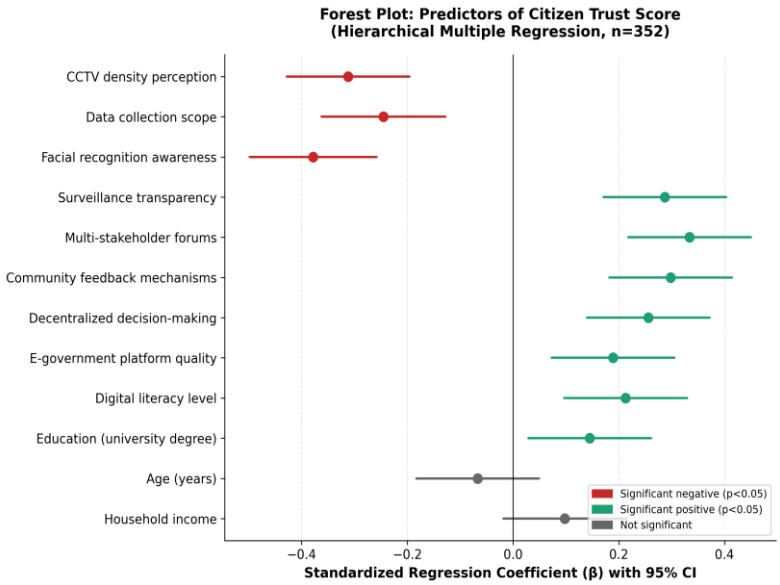

Figure 3. Forest plot of standardized regression coefficients (beta) with 95% confidence intervals for predictors of citizen trust.

The empirical findings reveal complex relationships among surveillance perception, governance participation, and citizen trust within Indonesian smart city contexts. The substantial negative relationship between perceived surveillance intensity and citizen trust aligns with theoretical frameworks emphasizing privacy concerns and autonomy as fundamental elements of institutional legitimacy. Zuboff's surveillance capitalism perspective and Kitchin's critical smart cities scholarship identified surveillance as inherently problematic for democratic governance regardless of implementation context or technological sophistication.[17,18] However, the findings revealed that specific surveillance modalities generated differential trust impacts: facial recognition technology demonstrated substantially greater negative effects than other surveillance types, suggesting that technological specificity matters critically for understanding citizen responses.[19]

The strong positive association between governance participation and citizen trust supports polycentric governance theory emphasizing that distributed, inclusive decision-making mechanisms enhance institutional legitimacy.[19,20] Ostrom's work on polycentric governance and Meijer's datapolis framework predicted that smart city programs incorporating multiple stakeholder groups, transparent decision processes, and citizen voice would generate greater institutional confidence. The substantial effects of multi-stakeholder participation, citizen feedback mechanisms, and decentralized decision-making indicate that Indonesian citizens rewarded inclusive governance processes with higher trust even while perceiving surveillance concerns. This pattern suggests a compensatory mechanism wherein governance quality and citizen agency substantially offset negative surveillance impacts on trust.[20,21]

The positive predictive effects of data transparency, governance literacy, and e-government service use align with institutional trust theory, emphasizing citizen understanding and prior positive institutional experiences as determinants of confidence.[21,23] Grimmelikhuijsen's transparency research and Bélanger and Carter's e-government adoption frameworks predicted that institutional openness regarding data practices and citizens' prior positive technological experiences would strengthen trust. The findings confirm these theoretical predictions within Indonesian contexts, indicating that government efforts to communicate surveillance purposes, data protection practices, and governance decision processes would meaningfully enhance institutional legitimacy.[24,25]

The city tier differences in trust and participation outcomes, despite relatively uniform surveillance perception, suggest that institutional maturity, governance structure sophistication, and smart city program development stage substantially influence trust dynamics.[18] Tier-1 metropolitan areas demonstrated higher trust and governance participation, potentially reflecting more mature smart city governance structures, greater transparency practices, and more established polycentric governance mechanisms. Conversely, Tier-2 and Tier-3 cities with emerging smart city initiatives showed lower trust and participation, suggesting that less developed governance frameworks and limited participation opportunities constrained citizen confidence. These patterns indicate that smart city implementation should prioritize governance institution development and participatory mechanism establishment alongside technological infrastructure deployment.[26]

The study possessed notable strengths including a large diverse sample across multiple cities and administrative tiers, enabling generalization across varied Indonesian urban contexts. The stratified sampling across city tiers and comprehensive demographic representation enhanced external validity. The measurement of multiple surveillance dimensions rather than surveillance as a single construct enabled a nuanced understanding of

differential technology impacts. The simultaneous examination of multiple theoretical frameworks, including institutional trust, surveillance theory, and polycentric governance provided an integrated perspective on complex governance phenomena.[26,27]

Several limitations warrant acknowledgment. The cross-sectional design precluded causal inference regarding surveillance impacts or governance effects on trust trajectories over time. Longitudinal research following governance changes or surveillance technology deployments would enable stronger causal conclusions. Self-reported survey data relied on respondent recall and perception rather than administrative records or behavioral measures, introducing potential response bias and social desirability concerns. The study occurred within a specific historical moment in Indonesian smart city development, potentially limiting generalizability to future contexts with substantially different technological or governance configurations. Future research should incorporate longitudinal designs, mixed methods combining survey and interview data, and examination of different national and cultural contexts to validate and extend these findings.

4. Conclusion

This study examined relationships among perceived surveillance intensity, citizen trust, and polycentric governance participation among 352 citizens in nine Indonesian cities. Findings indicated that while facial recognition and closed-circuit television surveillance technologies undermined institutional and technological trust, inclusive governance structures including multi-stakeholder participation, citizen feedback mechanisms, and transparent data practices substantially strengthened citizen confidence. The hierarchical regression model explained 42.1% of variance in citizen trust, with facial recognition intensity demonstrating the strongest negative predictor and multi-stakeholder participation demonstrating the strongest positive predictor. These results support policy recommendations emphasizing polycentric governance development, data transparency enhancement, and citizen participation opportunity expansion as essential components of sustainable smart city programs. Indonesian policymakers should prioritize governance institution development and stakeholder participation mechanisms alongside technological infrastructure deployment to ensure that smart city programs strengthen rather than undermine citizen trust and democratic legitimacy.

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