

**CAUSAL STRUCTURE OF OPSEN IMPLEMENTATION,
HUMAN RESOURCE CAPACITY, AND LOCAL OWN-
SOURCE REVENUE OPTIMIZATION**

Oleh

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Bidang Konsentrasi Perencanaan Pembangunan dan Keuangan Daerah



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CAUSAL STRUCTURE OF OPSEN IMPLEMENTATION, HUMAN RESOURCE CAPACITY, AND LOCAL OWN-SOURCE REVENUE OPTIMIZATION

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UCAPAN TERIMA KASIH

Puji Syukur kepada Tuhan Yesus Kristus atas Berkah dan HikmatNya sehingga dapat diselesaikannya Jurnal Ilmiah yang berjudul ***“Causal Structure of Opsen Implementation, Human Resource Capacity, and Local Own-Source Revenue Optimization”***. Jurnal Ilmiah ini diajukan sebagai tugas akhir dalam rangka menyelesaikan studi dan meraih gelar Magister pada Program Magister Ilmu Ekonomi Universitas Palangka Raya.

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CAUSAL STRUCTURE OF OPSEN IMPLEMENTATION, HUMAN RESOURCE CAPACITY, AND LOCAL OWN-SOURCE REVENUE OPTIMIZATION

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Abstract

Local governments in Indonesia increasingly adopt digital fiscal innovations to enhance local own-source revenue. The opsen application integrates the collection and reporting of motor vehicle tax and vehicle title transfer fee into regional financial systems. However, despite its implementation across all districts and cities, local own-source revenue performance remains uneven, suggesting that technology alone is insufficient and highlighting the need to examine the role of human resource capacity in optimizing fiscal digitalization. This study aims to analyze the relationships between opsen implementation, human resource capacity, and local own-source revenue optimization. Using a quantitative explanatory approach, data were analyzed with SPSS to examine correlations, regression, and mediating effects among variables. The results indicate that opsen implementation has a significant positive effect on local own-source revenue optimization, both directly and indirectly through human resource capacity. These findings confirm that human resource capacity plays a strategic mediating role in ensuring the effective utilization of fiscal technology. This study contributes to the literature on digital public finance by demonstrating that technological innovation must be accompanied by strong institutional and human resource capacity. The findings provide evidence-based policy recommendations for strengthening local government capacity and enhancing the sustainability of regional fiscal digitalization.

Keywords: Digital Fiscal Innovation, Human Resource Capacity, Local Own-Source Revenue, Opsen Application, Public Finance.

I. INTRODUCTION

Regional fiscal reform in Indonesia has experienced an important turning point with the passage of Law Number 1 of 2022 concerning Financial Relations between the Central Government and Regional Governments (Hubungan Keuangan antara Pemerintah Pusat dan Pemerintahan Daerah/HKPD Law). One of the strategic implications of this regulation is to strengthen regional fiscal autonomy through the optimization of Local Own-Source Revenue (Pendapatan Asli Daerah/PAD) (Putra & Mahiswara, 2024; Kurniawan et al., 2024; Hasanah et al., 2025). In this framework, the government encourages the digitization of the regional tax collection and reporting system through the Opsen application, which is an additional tax levy for Motor Vehicle Tax (Pajak Kendaraan Bermotor/PKB) and Motor Vehicle Name Return Duty (Bea Balik Nama Kendaraan Bermotor/BBNKB) collected by districts/cities as part of fiscal synergy with the provincial government.

Opsen is designed to improve the efficiency, transparency, and accuracy of vehicle tax. In Central Kalimantan, the Opsen application has been implemented since mid-2023, integrated with regional financial information systems and the Regional Government Information System (Sistem Informasi Pemerintahan Daerah/SIPD) platform. Despite its adoption across all districts and cities, Local Own-Source Revenue (LOR) performance remains uneven. Based on Figure 1, the average LOR contribution to district/city budgets is below 15%, with annual growth rates ranging from 2.1% to 4.8%, below the national target of 7%. Some areas, such as Murung Raya and South Barito, show stagnation, while Palangka Raya and East Kotawaringin demonstrate higher growth, yet without reflecting the full systemic impact of fiscal digitalization (Central Kalimantan Provincial BPKAD, 2024).

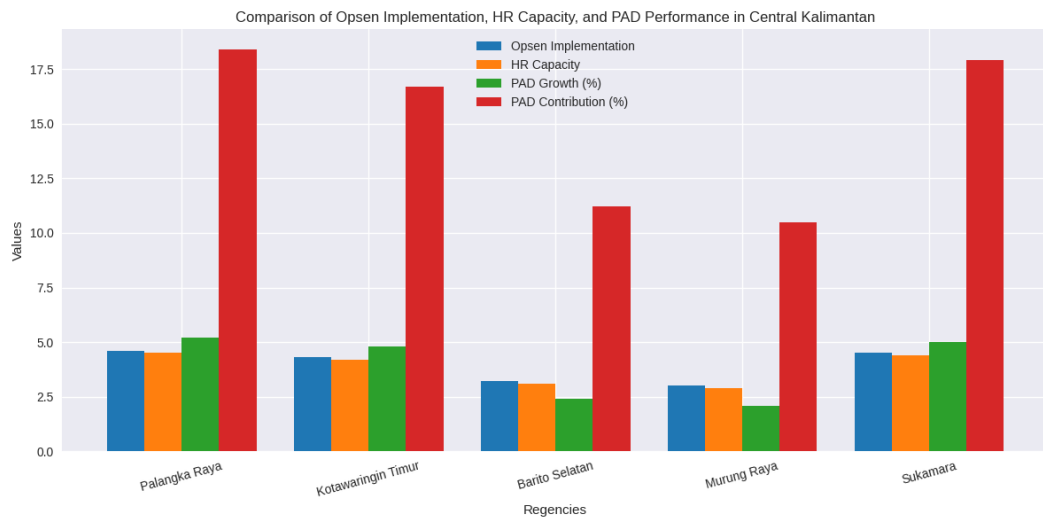


Figure 1. Graph of 5 Regencies/Cities based on four main variables

Figure 1 is a graph that compares five districts/cities in Central Kalimantan based on four main variables: implementation of opsen, human resources capacity, PAD growth, and PAD contribution to the Regional Revenue and Expenditure Budget (Anggaran Pendapatan dan Belanja Daerah/APBD). Palangka Raya and Sukamara showed the highest scores in the implementation of opsen and human resource capacity, which is in line with the growth of PAD and the high contribution of PAD to the APBD. Murung Raya and South Barito had the lowest scores across all variables, reflecting challenges in fiscal digitalization and human resource strengthening. East Kotawaringin is in a medium position, but shows a positive trend that can be improved with policy interventions.

Another factor that also affects the effectiveness of Opsen is the capacity of Human Resources (HR) of regional tax managers (Hasibuan et al., 2025). Technical readiness, frequency of training, and adaptability to digital systems are important determinants in the successful implementation of fiscal technology (Ghobakhloo, 2020; Divina & Rodiris, 2025). Capacity inequality between regions has the potential to create disparities in PAD performance, so it needs to be analyzed in a causal and structured

manner.

Despite full implementation of the opsen application across all districts and cities in Central Kalimantan, local own-source revenue performance has not consistently improved, with wide disparities in revenue growth and contribution to regional budgets. Such inconsistencies raise essential questions about the role of institutional readiness and human resource capacity in enabling digital fiscal tools to translate into tangible revenue outcomes, especially given the challenges of digital transformation and fiscal governance documented in recent literature (e.g., disparities in human resource capacity and infrastructure affecting digital initiatives) (Gunawan, 2025).

Atobishi et al. (2024) highlighted the importance of digital systems and human resource capacity in public sector performance. However, most research examines these factors individually, without empirically investigating their combined effect on PAD optimization. Limited evidence exists on how HR capacity mediates the relationship between digital fiscal tools, such as opsen, and revenue performance, particularly in crossregional contexts where disparities in institutional and digital readiness are evident (Putra et al., 2024; Hidayat, 2025). This study addresses this gap by testing both direct and indirect relationships between opsen implementation, HR capacity, and PAD outcomes.

This study aims to analyze the causal relationship between the implementation of the opsen application, human resource capacity, and PAD optimization in Central Kalimantan Province. Identify the direct and indirect influence of the Opsen implementation variables on PAD, with HR capacity as a mediating variable. Develop a path model that empirically describes the structure of relationships between variables. This research has strategic significance in providing evidence-based policy recommendations for improving PAD through the digitization of the fiscal system and

strengthening the capacity of regional apparatus. Provide an evaluation framework for the implementation of opsen that can be used by local and central governments in monitoring fiscal performance. Supporting the development of an adaptive, integrated, and competency-based regional financial information system.

II. LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

The Effect of Opsen Implementation on Local Own-Source Revenue Optimization

Regional fiscal reform in Indonesia has advanced through Law Number 1 of 2022 on Financial Relations between the Central and Regional Governments (HKPD Law). One policy innovation under this law is opsen, a digital system for collecting Motor Vehicle Tax and Vehicle Title Transfer Fee, aimed at strengthening regional fiscal independence through digitized tax reporting and collection. Diffusion of Innovations Theory by Rogers (2003), explains that the adoption of public technologies such as opsen is influenced by relative superiority, compatibility, and observability. If the opsen application provides easy access, reporting accuracy, and system integration, it will improve the efficiency of local own-source revenue collection. E-Government Maturity Model by Layne and Lee (2001) Stating that digital systems that have reached the integration stage are able to increase transparency and fiscal effectiveness. Heeks (2006) also emphasizes that e-government success relies on the alignment between system design and local institutional capacity.

Empirical findings by Setiawan et al. (2022) The digitization of motor vehicle taxes through web-based applications increases the realization of local own-source revenue in West Java. Then by Hidayat and Sari (2022) Regions that adopt digital reporting systems show an increase in local own-source revenue contribution to the APBD. Putra and Lestari (2023) show that the growth of local own-source revenue is greatly influenced by the effectiveness of collection and the accuracy of technology-based reporting. Good implementation of opsen directly contributes to the optimization of local own-source revenue through increasing efficiency, accuracy, and transparency of regional tax collection (Wujarso et al., 2023; Ramadhan & Ifransyah, 2025; Bakri, 2025).

H1: Opsen implementation has a positive effect on local own-source revenue optimization.

The Effect of Opsen Implementation on Human Resource Capacity

According to the Technology Acceptance Model proposed by Davis (1989), the way individuals perceive the ease of use and the potential benefits of a technological system significantly shapes their attitudes and willingness to adopt it. In the context of fiscal digitalization, this means that the readiness of human resources to engage with digital systems depends on both their understanding of the system's usefulness and their comfort in operating it. Complementing this, the Dynamic Capabilities Theory by Teece et al. (1997) emphasizes that public organizations must continuously develop internal competencies to effectively respond to technological changes. This involves not only providing training but also ensuring that personnel can adapt and apply new skills to digital systems.

Empirical studies support these theoretical perspectives: Yuliana and Nugroho (2023) demonstrate that digital literacy and ongoing training significantly enhance the preparedness of human resources to manage digital fiscal systems, while Siregar and Pratama (2023) highlight that the success of implementing such systems is strongly contingent upon both the readiness and capability of personnel. Specifically, the implementation of the opsen application has been shown to stimulate improvements in human resource capacity, as it requires staff to acquire technical expertise, participate in structured system training, and adapt to digital technologies, thereby enhancing their overall competency in managing regional fiscal operations (Rojak, 2024).

H2: Opsen Implementation has a positive effect on human resource capacity.

The Effect of HR Capacity on Local Own-Source Revenue Optimization

Human Capital Theory by Becker (1964) stated that investment in human resource education and training increases organizational productivity and performance, including in fiscal management. Competency-Based Management by Spencer and Spencer (1993) The technical competence, attitude, and adaptability of human resources affect the effectiveness of work and the achievement of local own-source revenue targets.

Local own-source revenue is an indicator of fiscal independence and regional capacity to finance development. Local own-source revenue optimization includes increasing the tax base, collection effectiveness, and contribution to the APBD. Musgrave and Musgrave (1989) in Public Finance Theory stated that local own-source revenue functions as an instrument of resource allocation and a reflection of regional fiscal efficiency. Oates (1972) The Decentralization Theorem says that fiscal decentralization allows for a more efficient local response, but its success depends on institutional capacity and reporting systems.

The Fiscal Performance Framework by Bahl and Linn (1992) emphasized that the performance of local own-source revenue is influenced by the effectiveness of collection, taxpayer compliance, and the quality of the fiscal information system. Empirical findings of several researchers, such as Rahmawati et al. (2021), indicate that Digital training has a significant impact on the effectiveness of regional financial management. According to Putra and Lestari (2023), the growth of local own-source revenue is influenced by the effectiveness of collection and reporting accuracy, which depends on human resource competence. Thus, high human resource capacity contributes to the optimization of local own-source revenue through increasing collection effectiveness, reporting accuracy, and maximum utilization of digital systems (Knies et al., 2024; Hyera et al., 2025; Wijaya et al., 2025).

H3: Human resource capacity has a positive effect on local own-source revenue optimization

Human Resource as a Mediating Factor

Mediation Theory by Baron and Kenny (1986), this mediation model explains that opsen implementation can influence local own-source revenue optimization indirectly through human resource capacity. In this context, the implementation of opsen encourages the increase in human resource capacity, the increased human resource capacity strengthens the effectiveness of local own-source revenue collection and reporting. Human resource capacity is a crucial element in the successful implementation of fiscal technology (Ariana et al., 2020; Yakin, 2024). Human resources who are competent, trained, and adaptive to digital technology will be able to optimize the functions of the opsen application in reporting and collecting local own-source revenue (Maira,2021).

Teece et al. (1997) in Dynamic Capabilities Theory states that public organizations must be able to integrate, build, and configure internal competencies to respond to technological and policy changes. Spencer and Spencer (1993) developed a Human Resources Competency Model that includes knowledge, skills, attitudes, and values. In the context of regional fiscal policy, technical competence and digital literacy are the main indicators. Van Dijk (2005) in Digital Divide Theory emphasizes the importance of digital literacy as a prerequisite for participation in the public information system. Human resources that do not have digital literacy will experience a gap in the use of fiscal technology. In an empirical study by Rahmawati et al. (2021) showed that digital training has a significant impact on the effectiveness of regional financial management. Then by Yuliana and Nugroho (2023) emphasized that digital literacy and continuous training support systemic regional fiscal transformation. Furthermore, Armstrong and Taylor (2020) argue that human resource capability serves as a critical mediator between technology adoption and organizational performance, as skilled personnel translate

technological investments into tangible outcomes.

H4: Human resource capacity mediates the relationship between opsen implementation and local own-source revenue optimization.

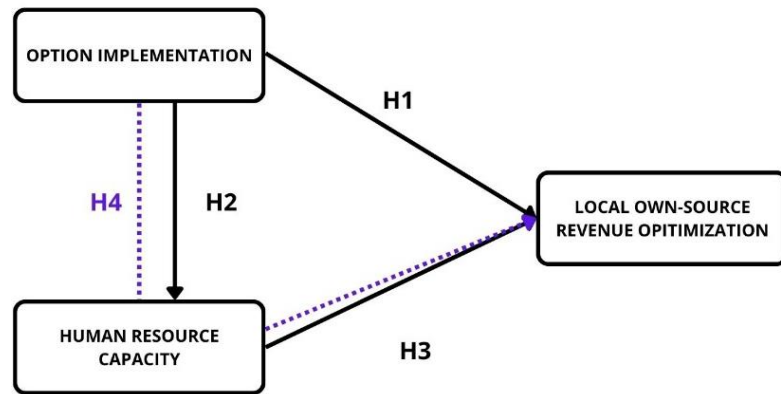


Figure 2. Conceptual Model

Figure 2 illustrates the conceptual framework of this study, depicting the relationships between the key variables. The model demonstrates that opsen implementation has a direct effect on local own-source revenue optimization (H1) and also influences human resource capacity (H2). Furthermore, human resource capacity is hypothesized to affect local own-source revenue optimization (H3). The framework also examines the mediating role of human resource capacity in the relationship between opsen implementation and local own-source revenue optimization (H4), as indicated by the dotted line connecting these variables.

III. RESEARCH METHODS

This study employs an explanatory quantitative design with a comparative causal approach to analyze the cause-and-effect relationships between opsen implementation, human resource capacity, and local own-source revenue optimization. Direct and indirect effects were tested using SPSS through correlation, regression, and mediation analysis (Hair et al., 2010). The population comprises all districts/cities in Central Kalimantan that have implemented opsen and have a local own-source revenue management unit, with the unit of analysis being regional tax officers, opsen operators, and financial staff. Stratified purposive sampling was used based on opsen usage and local own-source revenue performance, yielding 75–150 respondents (5–10 per region × 15 regions). Inclusion criteria required at least one year of opsen use and direct involvement in local own-source revenue management or financial reporting. Data include primary sources respondents' perceptions of opsen, HR capacity, and local own-source revenue performance, and secondary sources such as local own-source revenue realization reports, contributions to APBD, and SIPD/BPKAD data. Data were collected through a Likertscale questionnaire (1–5) covering respondent identity, indicators, and additional notes, complemented by documentation of official reports, limited interviews for validation, and data triangulation.

In this study, the variables are operationally defined as follows. X1, the implementation of opsen operations, is measured through key indicators such as system integration, ease of access, and reporting accuracy, using a Likert scale of 1 to 5. This variable reflects the level of implementation of the opsen application within the regional financial system. X2, human resource capacity, is assessed based on technical competence, training, and digital adaptation, also using a Likert scale of 1 to 5. It represents the ability and readiness of human resources to manage and utilize the fiscal

digital system effectively. Y, local own-source revenue optimization, is measured by local own-source revenue growth, collection effectiveness, and its contribution to the APBD, using the same Likert scale. This variable indicates the level of achievement of local ownsource revenue as a key indicator of regional fiscal independence.

The validity and reliability of the research instruments were assessed to ensure accurate measurement. Data analysis was conducted using SPSS in several steps. Descriptive analysis summarized respondents' characteristics and perceptions using mean, standard deviation, and score distribution. Path analysis tested direct and indirect effects among $X1 \rightarrow Y$, $X1 \rightarrow X2 \rightarrow Y$, and $X2 \rightarrow Y$, with coefficients estimated through regression: $Y = \beta_1 X1 + \beta_2 X2 + \varepsilon$, where β_1 and β_2 represent direct effects, and ε is the residual. Mediation analysis examined whether HR capacity mediates the effect of Opsen implementation on local own-source revenue optimization, using the Baron and Kenny method and the Sobel test to assess the significance of the indirect effect, with $p < 0.05$ considered significant. Classical assumption tests ensured model validity: normality was checked via Kolmogorov-Smirnov or Shapiro-Wilk ($p > 0.05$), multicollinearity via VIF (< 10), and heteroskedasticity via scatterplots, with no systematic patterns indicating its absence.

This study uses a quantitative-descriptive and inferential approach, with a crosssectional design (cross-time) and panel data processing that records differences between districts/cities in Central Kalimantan Province in 2023–2024 (Sugiyono, 2019). The main analysis model uses path analysis to measure the direct and indirect influence between fiscal independence and local own-source revenue effectiveness on the human development index, with control variables in the form of GDP per capita and population, in accordance with supporting literature.

IV. RESULT AND DISCUSSION

IV.I RESULTS

Since the enactment of Law Number 1 of 2022 concerning Financial Relations between the Central Government and Regional Governments (Hubungan Keuangan Pemerintah Pusat dan Pemerintah Daerah/HKPD Law), local governments throughout Indonesia have been required to increase fiscal independence through the optimization of local own-source revenue. One of the strategic instruments introduced is the opsen (additional revenue opsen) mechanism for motor vehicle tax and motor vehicle name return duty, which is collected by the province and distributed to districts/cities.

Central Kalimantan Province is among the most responsive to this policy. All districts/cities have signed cooperation agreements and have started implementing the opsen application, which is integrated with SIPD and regional financial information systems. However, the effectiveness of opsen implementation in encouraging local ownsource revenue optimization has not been evenly distributed throughout the region. In general, the implementation of opsen in Central Kalimantan shows a positive trend. The cities of Palangka Raya, Sukamara, and Lamandau occupy the top positions with implementation scores above 4.5 (scale 1–5), reflecting good system integration, ease of access, and reporting accuracy. Regencies such as East Kotawaringin and West Kotawaringin also show a fairly high digital readiness.

However, some areas, such as Murung Raya, South Barito, and East Barito, still face challenges in implementing the system, both in terms of infrastructure and optimal application utilization. The implementation score in this area is below 3.5, indicating the need for technical intervention and system

assistance. Human resource capacity is the main differentiating factor in the effectiveness of opsen implementation. Areas with human resources that have high digital literacy, technical experience, and access to training, such as Palangka Raya, Sukamara, and Lamandau, show a human resource capacity score above 4.0.

On the other hand, areas such as Murung Raya and South Barito recorded a human resource capacity score below 3.0, indicating limitations in training, technology adaptation, and mastery of the fiscal reporting system. This inequality has direct implications for the effectiveness of the use of the opsen application and the performance of local own-source revenue. Empirical data show that the growth of local own-source revenue and its contribution to the APBD is greatly influenced by two main factors: the quality of opsen implementation and the capacity of human resources. Palangka Raya City recorded a local own-source revenue growth of 5.2% and local own-source revenue contribution to the APBD of 18.4%, the highest in the province. Sukamara and Lamandau also showed strong fiscal performance.

In contrast, Murung Raya and South Barito recorded local own-source revenue growth below 2.5% and local own-source revenue contribution to the APBD below 12%, despite the digital system being available. This shows that the existence of technology alone is not enough. Competent human resources and an integrated system are the main requirements for local own-source revenue optimization.

Table 1. Descriptive Statistical Analysis Results

Variable	Mean	SD	Min	Max	Interpretation
Opsen Implementation	3.84	0.52	3.0	4.6	Tall
HR Capacity	3.74	0.51	2.9	4.5	Tall
Local Own-Source Revenue Optimization	3.83	0.93	2.1	5.2	Moderate-High

Descriptive statistics were calculated to provide an overview of respondents' perceptions of the research variables, including mean, Standard Deviation (SD), minimum, and maximum scores, as shown in Table 1. The results indicate that Opsen Implementation has a mean of 3.84 (SD = 0.52), with scores ranging from 3.0 to 4.6, interpreted as high. HR capacity has a mean of 3.74 (SD = 0.51), ranging from 2.9 to 4.5, also interpreted as high. Meanwhile, local own-source revenue optimization shows a mean of 3.83 (SD = 0.93), with a wider range from 2.1 to 5.2, interpreted as moderate high. These results suggest that respondents generally perceive the implementation of opsen and HR capacity positively, which aligns with a moderate to high level of local own-source revenue optimization.

Table 2. Validity and Reliability Test

Variable	Pearson r Range	Cronbach's Alpha	Conclusion
Opsen Implementation	0.910 – 0.995	0.933	Valid & Reliable
HR Capacity	0.780 – 0.930	0.810	Valid & Reliable
Local Own-Source Revenue Optimization	0.880 – 0.950	0.785	Valid & Reliable

The validity and reliability of the research instruments were tested using Pearson correlation for construct validity and Cronbach's alpha for reliability. As shown in Table 2, all variables meet the required criteria. X1 (opsen implementation) has Pearson r values ranging from 0.910 to 0.995 with a Cronbach's alpha of 0.933, X2 (HR capacity) ranges from 0.780 to 0.930 with $\alpha = 0.810$, and Y (local own-source revenue optimization) ranges from 0.880 to 0.950 with $\alpha = 0.785$, indicating that all items are valid and reliable. These results confirm that the questionnaire is appropriate for measuring respondents' perceptions and can be used confidently in further statistical analysis.

Table 3. Multicollinearity Test Results

Variable	VIF	Interpretation
Opsen Implementation	5.02	Not happening
HR Capacity	5.02	Not happening

A multicollinearity test was conducted to ensure that the independent variables in the regression model do not have high intercorrelations. As shown in Table 3, the Variance Inflation Factor (VIF) values for both opsen implementation and HR capacity are 5.02, which are below the threshold of 10. This indicates that multicollinearity does not occur, and the independent variables can be reliably used in further regression analysis.

Table 4. Normality & Heteroskedasticity Test

Test	Variable	Test Statistic	p-value	Interpretation
Normality (Kolmogorov-Smirnov)	Residuals	0.1849	0.6592	Residuals are normally distributed; the regression model is valid
Heteroskedasticity (Glejser)	Opsen Implementation	2.2382	0.0449	Mild heteroskedasticity detected
Heteroskedasticity (Glejser)	HR Capacity	1.5763	0.1409	No heteroskedasticity detected

To ensure the validity of the regression model, normality and heteroskedasticity tests were conducted. As shown in Table 4, the Kolmogorov-Smirnov test for residuals yielded a statistic of 0.1849 with a p-value of 0.6592, which is greater than 0.05, indicating that the residuals are normally distributed and the regression model is valid. The Glejser test was used to detect heteroskedasticity. For the opsen implementation, the statistic was 2.2382 with a p-value of 0.0449 (<0.05), indicating mild heteroskedasticity. For HR Capacity, the statistic was 1.5763 with a p-value of 0.1409 (> 0.05), showing that no heteroskedasticity occurs. The model meets the assumptions of normality, and heteroskedasticity is minimal and acceptable for regression analysis.

Table 5. F-test

Test	Value
F Test (Simultaneous)	1083.5423
p-value	0.0000
Interpretation	Significant: Opsen and HR together have an effect on local own-source revenue

The F-test was conducted to examine the simultaneous effect of opsen implementation and HR capacity on local own-source revenue optimization. As shown in Table 5, the Fvalue is 1083.5423 with a p-value of 0.000, which is less than 0.05. This indicates that together, opsen and HR capacity have a significant effect on local own-source revenue optimization.

Table 6. Results of Path Analysis Coefficients

Line	Coefficient β	p-value	t-statistics	R ²	Interpretation
Opsen Implementation → Local Own-Source Revenue Optimization	2.018	<0.001	42.7809	0.989	Significant, powerful influence
Opsen Implementation → HR Capacity	1.000	<0.001		1.000	Significant, perfect linear relationships
HR Capacity→ Local Own-Source Revenue Optimization	2.018	<0.001	28.3910	0.989	Significant, powerful influence

The path analysis was conducted to examine the direct and indirect effects of opsen implementation and HR capacity on local own-source revenue optimization. As presented in Table 6, opsen implementation has a strong direct effect on local own-source revenue optimization with a coefficient $\beta = 2.018$, $p < 0.001$, and $t = 42.78$, indicating a significant and powerful influence. Opsen implementation also has a perfect linear relationship with HR Capacity ($\beta = 1.000$, $p < 0.001$, $R^2 = 1.000$), reflecting that higher implementation of opsen is directly associated with greater HR capacity. Additionally, HR capacity significantly affects local own-source revenue optimization ($\beta = 2.018$, $p < 0.001$, $t = 28.39$, $R^2 = 0.989$), demonstrating a strong positive effect. The combined model explains 98.9% of the variation in local own-source revenue optimization.

Mediation analysis was conducted to examine whether HR capacity (X2) mediates the relationship between opsen implementation (X1) and local own-source revenue optimization (Y). The indirect effect is calculated as $a \times b = 1.000 \times 2.018 = 2.018$, indicating that HR capacity functions as a mediator between opsen implementation and local own-source revenue optimization. The Sobel test further confirms the significance of this mediation, with $Z = 32.92$ and $p < 0.001$, demonstrating that the mediating effect of HR capacity is statistically significant.

IV.II DISCUSSION

The results of this study demonstrate that the implementation of the opsen application significantly influences the Local Own-Source Revenue (LOR) optimization, both directly and indirectly through Human Resource (HR) capacity. Regions such as Palangka Raya, Sukamara, and Lamandau, which exhibit high opsen implementation scores, show higher LOR growth and contribution to the regional budget. This finding aligns with Rogers' (2003) Diffusion of Innovations Theory, which emphasizes that the adoption of public technology is determined by relative advantage, compatibility, and observability. In areas where opsen is well-integrated, these attributes facilitate effective adoption and better revenue outcomes. Similarly, Layne and Lee (2001) in the EGovernment Maturity Model position opsen at the transaction and integration stage, where digital systems start to impact fiscal efficiency and reporting transparency.

The mediating role of HR capacity is particularly noteworthy. The indirect effect analysis and Sobel test confirm that human resource competency significantly strengthens the relationship between opsen implementation and LOR performance. Areas with trained and digitally literate personnel, such as

Palangka Raya and East Kotawaringin, exhibit higher effectiveness in utilizing Opsen compared to regions like Murung Raya and South Barito. This finding is consistent with Teece et al. (1997) on Dynamic Capabilities Theory, highlighting that public organizations require internal competencies to adapt to technological and policy changes, and Spencer and Spencer (1993), who emphasized that HR competencies knowledge, skills, and attitudes determine work effectiveness. Van Dijk's (2005) Digital Divide Theory further explains that gaps in digital literacy can hinder the participation and effectiveness of digital systems, which contributes to the observed regional disparities in LOR.

Empirical results are also reinforced by recent studies. Putra and Lestari (2023) found that LOR growth depends on collection effectiveness and reporting accuracy, both influenced by HR competence. Similarly, Siregar and Pratama (2023) reported that the success of fiscal digital systems relies heavily on the readiness and capacity of human resources. Rahmawati et al. (2021) and Yuliana and Nugroho (2023) demonstrated that digitization of motor vehicle taxes increases LOR realization when reporting systems are integrated and supported institutionally. In addition, Hidayat and Sari (2022) and Setiawan et al. (2022) showed that regions adopting digital reporting systems and investing in HR training experienced higher revenue performance.

The combined effect of opsen implementation and HR capacity explains most of the variance in LOR, indicating that the synergy between fiscal technology and institutional competence is a key determinant of regional fiscal performance. This is consistent with Musgrave and Musgrave's (1989) Public Finance Theory, which sees regional revenue as a reflection of fiscal efficiency, Oates' (1972) Decentralization Theorem, and Bahl and Linn's (1992) Fiscal Performance Framework emphasizing that collection effectiveness, taxpayer

compliance, and quality of fiscal information systems shape revenue outcomes.

From a methodological perspective, the regression model meets classical assumptions (normality, no multicollinearity, no heteroskedasticity), supporting the robustness of causal analysis (Gujarati, 2003). Statistical significance in partial (t) and simultaneous (F) tests confirms that opsen and HR capacity are critical predictors of LOR optimization.

These findings have practical implications for ensuring equitable fiscal performance across regions. The implementation of opsen as a digital fiscal instrument has proven effective in optimizing local own-source revenue when supported by adequate human resource capacity. To maximize its impact, local governments should strengthen technical training and digital literacy for local own-source revenue management personnel, provide assistance to low-performing regions, and integrate the fiscal reporting system with platforms like SIPD and the LOR performance dashboard. Addressing regional disparities in human resources and technology utilization is critical, and combining fiscal digitalization strategies with structured programs to enhance HR competencies offers a systemic and sustainable approach to improving overall fiscal performance.

V. CONCLUSION

This study revealed a strong causal relationship between the implementation of the opsen application, HR capacity, and local own-source revenue optimization in Central Kalimantan. The findings indicate that opsen implementation significantly affects local own-source revenue both directly and indirectly through HR capacity, which serves as a strategic mediator enhancing the effectiveness of fiscal technology. The causal model is statistically robust and highlights disparities across regions in digital adoption and HR competence. The novelty of this research lies in integrating fiscal digital systems with institutional capacity as simultaneous determinants of local own-source revenue performance.

Based on these results, local governments are recommended to strengthen digital literacy and HR training in low-performing regions, provide technical assistance and system audits to ensure full integration with regional financial systems, and develop a local own-source revenue performance dashboard for cross-regional monitoring. Academically, future studies should focus on developing more comprehensive causal models incorporating institutional variables, taxpayer participation, and fiscal innovation, replicate the study in other provinces to test generalizability, and publish findings to enrich the literature on fiscal digitalization and local revenue governance. This study is limited by its focus on a single province and cross-sectional data, which may not capture long-term dynamics. Future research could explore the long-term impact of fiscal digital systems on local own-source revenue growth and investigate how variations in HR capacity affect the sustainability and scalability of fiscal innovations.

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Causal Structure of Opsen Implementation, Human Resource Capacity, and Local Own-Source Revenue Optimization

*Opsen Implementation,
HR Capacity, and
Local Revenue*

2251

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ABSTRACT

Local governments in Indonesia increasingly adopt digital fiscal innovations to enhance local own-source revenue. The opsen application integrates the collection and reporting of motor vehicle tax and vehicle title transfer fee into regional financial systems. However, despite its implementation across all districts and cities, local own-source revenue performance remains uneven, suggesting that technology alone is insufficient and highlighting the need to examine the role of human resource capacity in optimizing fiscal digitalization. This study aims to analyze the relationships between opsen implementation, human resource capacity, and local own-source revenue optimization. Using a quantitative explanatory approach, data were analyzed with SPSS to examine correlations, regression, and mediating effects among variables. The results indicate that opsen implementation has a significant positive effect on local own-source revenue optimization, both directly and indirectly through human resource capacity. These findings confirm that human resource capacity plays a strategic mediating role in ensuring the effective utilization of fiscal technology. This study contributes to the literature on digital public finance by demonstrating that technological innovation must be accompanied by strong institutional and human resource capacity. The findings provide evidence-based policy recommendations for strengthening local government capacity and enhancing the sustainability of regional fiscal digitalization.

Keywords: Digital Fiscal Innovation, Human Resource Capacity, Local Own-Source Revenue, Opsen Application, Public Finance.

ABSTRAK

Pemerintah daerah di Indonesia semakin gencar mengadopsi inovasi fiskal digital untuk meningkatkan Pendapatan Asli Daerah (PAD). Aplikasi Opsen mengintegrasikan pengumpulan dan pelaporan Pajak Kendaraan Bermotor (PKB) serta Bea Balik Nama Kendaraan Bermotor (BBNKB) ke dalam sistem keuangan daerah. Namun, meskipun telah diterapkan di seluruh kabupaten/kota, kinerja PAD masih menunjukkan ketidakmerataan, yang menunjukkan bahwa teknologi saja tidak cukup dan menekankan perlunya pemeriksaan peran kapasitas sumber daya manusia dalam mengoptimalkan digitalisasi fiskal. Penelitian ini bertujuan untuk menganalisis hubungan antara implementasi Opsen, kapasitas sumber daya manusia, dan optimalisasi PAD. Dengan menggunakan pendekatan kuantitatif eksplanatori, data dianalisis menggunakan SPSS untuk menguji korelasi, regresi, dan efek mediasi antarvariabel. Hasil penelitian menunjukkan bahwa implementasi Opsen berpengaruh positif signifikan terhadap optimalisasi PAD, baik secara langsung maupun tidak langsung melalui kapasitas sumber daya manusia. Temuan ini

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menegaskan bahwa kapasitas sumber daya manusia berperan strategis sebagai mediator dalam memastikan pemanfaatan teknologi fiskal secara efektif. Penelitian ini memberikan kontribusi terhadap literatur tentang keuangan publik digital dengan menunjukkan bahwa inovasi teknologi harus diiringi dengan kapasitas kelembagaan dan sumber daya manusia yang kuat. Hasil penelitian ini memberikan rekomendasi berbasis bukti untuk memperkuat kapasitas pemerintah daerah dan meningkatkan keberlanjutan digitalisasi fiskal regional.

Kata kunci: Inovasi fiskal digital, Kapasitas Sumber Daya Manusia, Pendapatan Lokal Mandiri, Aplikasi Opsen, Keuangan Publik.

INTRODUCTION

Regional fiscal reform in Indonesia has experienced an important turning point with the passage of Law Number 1 of 2022 concerning Financial Relations between the Central Government and Regional Governments (*Hubungan Keuangan antara Pemerintah Pusat dan Pemerintahan Daerah/HKPD Law*). One of the strategic implications of this regulation is to strengthen regional fiscal autonomy through the optimization of Local Own-Source Revenue (*Pendapatan Asli Daerah/PAD*) (Putra & Mahiswara, 2024; Kurniawan et al., 2024; Hasanah et al., 2025). In this framework, the government encourages the digitization of the regional tax collection and reporting system through the Opsen application, which is an additional tax levy for Motor Vehicle Tax (*Pajak Kendaraan Bermotor/PKB*) and Motor Vehicle Name Return Duty (*Bea Balik Nama Kendaraan Bermotor/BBNKB*) collected by districts/cities as part of fiscal synergy with the provincial government.

Opsen is designed to improve the efficiency, transparency, and accuracy of vehicle tax In Central Kalimantan, the Opsen application has been implemented since mid-2023, integrated with regional financial information systems and the Regional Government Information System (*Sistem Informasi Pemerintahan Daerah/SIPD*) platform. Despite its adoption across all districts and cities, Local Own-Source Revenue (LOR) performance remains uneven. Based on Figure 1, the average LOR contribution to district/city budgets is below 15%, with annual growth rates ranging from 2.1% to 4.8%, below the national target of 7%. Some areas, such as Murung Raya and South Barito, show stagnation, while Palangka Raya and East Kotawaringin demonstrate higher growth, yet without reflecting the full systemic impact of fiscal digitalization (Central Kalimantan Provincial BPKAD, 2024).

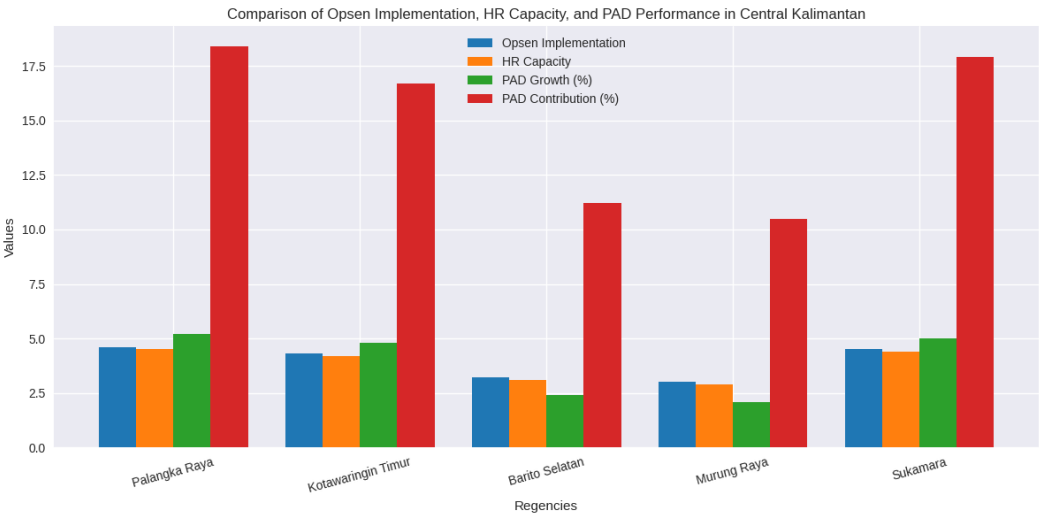


Figure 1. Graph of 5 Regencies/Cities based on four main variables

Figure 1 is a graph that compares five districts/cities in Central Kalimantan based on four main variables: implementation of opsen, human resources capacity, PAD growth, and PAD contribution to the Regional Revenue and Expenditure Budget (*Anggaran Pendapatan dan Belanja Daerah/APBD*). Palangka Raya and Sukamara showed the highest scores in the implementation of opsen and human resource capacity, which is in line with the growth of PAD and the high contribution of PAD to the APBD. Murung Raya and South Barito had the lowest scores across all variables, reflecting challenges in fiscal digitalization and human resource strengthening. East Kotawaringin is in a medium position, but shows a positive trend that can be improved with policy interventions.

Another factor that also affects the effectiveness of Opsen is the capacity of Human Resources (HR) of regional tax managers (Hasibuan et al., 2025). Technical readiness, frequency of training, and adaptability to digital systems are important determinants in the successful implementation of fiscal technology (Ghobakhloo, 2020; Divina & Rodiris, 2025). Capacity inequality between regions has the potential to create disparities in PAD performance, so it needs to be analyzed in a causal and structured manner.

Despite full implementation of the opsen application across all districts and cities in Central Kalimantan, local own-source revenue performance has not consistently improved, with wide disparities in revenue growth and contribution to regional budgets. Such inconsistencies raise essential questions about the role of institutional readiness and human resource capacity in enabling digital fiscal tools to translate into tangible revenue outcomes, especially given the challenges of digital transformation and fiscal governance documented in recent literature (e.g., disparities in human resource capacity and infrastructure affecting digital initiatives) (Gunawan, 2025).

Atobishi et al. (2024) highlighted the importance of digital systems and human resource capacity in public sector performance. However, most research examines these factors individually, without empirically investigating their combined effect on PAD optimization. Limited evidence exists on how HR capacity mediates the relationship between digital fiscal tools, such as opsen, and revenue performance, particularly in cross-regional contexts where disparities in institutional and digital readiness are evident (Putra et al., 2024; Hidayat, 2025). This study addresses this gap by testing both direct and indirect relationships between opsen implementation, HR capacity, and PAD outcomes.

This study aims to analyze the causal relationship between the implementation of the opsen application, human resource capacity, and PAD optimization in Central Kalimantan Province. Identify the direct and indirect influence of the Opsen implementation variables on PAD, with HR capacity as a mediating variable. Develop a path model that empirically describes the structure of relationships between variables. This research has strategic significance in providing evidence-based policy recommendations for improving PAD through the digitization of the fiscal system and strengthening the capacity of regional apparatus. Provide an evaluation framework for the implementation of opsen that can be used by local and central governments in monitoring fiscal performance. Supporting the development of an adaptive, integrated, and competency-based regional financial information system.

LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

The Effect of Opsen Implementation on Local Own-Source Revenue Optimization

Regional fiscal reform in Indonesia has advanced through Law Number 1 of 2022 on Financial Relations between the Central and Regional Governments (HKPD Law). One policy innovation under this law is opsen, a digital system for collecting Motor Vehicle Tax and Vehicle Title Transfer Fee, aimed at strengthening regional fiscal independence through digitized tax reporting and collection. Diffusion of Innovations Theory by Rogers (2003), explains that the adoption of public technologies such as opsen is influenced by relative superiority, compatibility, and observability. If the opsen application provides easy access, reporting accuracy, and system integration, it will improve the efficiency of local own-source revenue collection. E-Government Maturity Model by Layne and Lee (2001) Stating that digital systems that have reached the integration stage are able to

increase transparency and fiscal effectiveness. Heeks (2006) also emphasizes that e-government success relies on the alignment between system design and local institutional capacity.

Empirical findings by Setiawan et al. (2022) The digitization of motor vehicle taxes through web-based applications increases the realization of local own-source revenue in West Java. Then by Hidayat and Sari (2022) Regions that adopt digital reporting systems show an increase in local own-source revenue contribution to the APBD. Putra and Lestari (2023) show that the growth of local own-source revenue is greatly influenced by the effectiveness of collection and the accuracy of technology-based reporting. Good implementation of opsen directly contributes to the optimization of local own-source revenue through increasing efficiency, accuracy, and transparency of regional tax collection (Wujarso et al., 2023; Ramadhan & Ifransyah, 2025; Bakri, 2025).

H1: Opsen implementation has a positive effect on local own-source revenue optimization.

The Effect of Opsen Implementation on Human Resource Capacity

According to the Technology Acceptance Model proposed by Davis (1989), the way individuals perceive the ease of use and the potential benefits of a technological system significantly shapes their attitudes and willingness to adopt it. In the context of fiscal digitalization, this means that the readiness of human resources to engage with digital systems depends on both their understanding of the system's usefulness and their comfort in operating it. Complementing this, the Dynamic Capabilities Theory by Teece et al. (1997) emphasizes that public organizations must continuously develop internal competencies to effectively respond to technological changes. This involves not only providing training but also ensuring that personnel can adapt and apply new skills to digital systems.

Empirical studies support these theoretical perspectives: Yuliana and Nugroho (2023) demonstrate that digital literacy and ongoing training significantly enhance the preparedness of human resources to manage digital fiscal systems, while Siregar and Pratama (2023) highlight that the success of implementing such systems is strongly contingent upon both the readiness and capability of personnel. Specifically, the implementation of the opsen application has been shown to stimulate improvements in human resource capacity, as it requires staff to acquire technical expertise, participate in structured system training, and adapt to digital technologies, thereby enhancing their overall competency in managing regional fiscal operations (Rojak, 2024).

H2: Opsen Implementation has a positive effect on human resource capacity.

The Effect of HR Capacity on Local Own-Source Revenue Optimization

Human Capital Theory by Becker (1964) stated that investment in human resource education and training increases organizational productivity and performance, including in fiscal management. Competency-Based Management by Spencer and Spencer (1993) The technical competence, attitude, and adaptability of human resources affect the effectiveness of work and the achievement of local own-source revenue targets.

Local own-source revenue is an indicator of fiscal independence and regional capacity to finance development. Local own-source revenue optimization includes increasing the tax base, collection effectiveness, and contribution to the APBD. Musgrave and Musgrave (1989) in Public Finance Theory stated that local own-source revenue functions as an instrument of resource allocation and a reflection of regional fiscal efficiency. Oates (1972) The Decentralization Theorem says that fiscal decentralization allows for a more efficient local response, but its success depends on institutional capacity and reporting systems.

The Fiscal Performance Framework by Bahl and Linn (1992) emphasized that the performance of local own-source revenue is influenced by the effectiveness of collection,

taxpayer compliance, and the quality of the fiscal information system. Empirical findings of several researchers, such as Rahmawati et al. (2021), indicate that Digital training has a significant impact on the effectiveness of regional financial management. According to Putra and Lestari (2023), the growth of local own-source revenue is influenced by the effectiveness of collection and reporting accuracy, which depends on human resource competence. Thus, high human resource capacity contributes to the optimization of local own-source revenue through increasing collection effectiveness, reporting accuracy, and maximum utilization of digital systems (Knies et al., 2024; Hyera et al., 2025; Wijaya et al., 2025).

H3: Human resource capacity has a positive effect on local own-source revenue optimization

Human Resource as a Mediating Factor

Mediation Theory by Baron and Kenny (1986), this mediation model explains that opsen implementation can influence local own-source revenue optimization indirectly through human resource capacity. In this context, the implementation of opsen encourages the increase in human resource capacity, the increased human resource capacity strengthens the effectiveness of local own-source revenue collection and reporting. Human resource capacity is a crucial element in the successful implementation of fiscal technology (Ariana et al., 2020; Yakin, 2024). Human resources who are competent, trained, and adaptive to digital technology will be able to optimize the functions of the opsen application in reporting and collecting local own-source revenue (Maira, 2021).

Teece et al. (1997) in Dynamic Capabilities Theory states that public organizations must be able to integrate, build, and configure internal competencies to respond to technological and policy changes. Spencer and Spencer (1993) developed a Human Resources Competency Model that includes knowledge, skills, attitudes, and values. In the context of regional fiscal policy, technical competence and digital literacy are the main indicators. Van Dijk (2005) in Digital Divide Theory emphasizes the importance of digital literacy as a prerequisite for participation in the public information system. Human resources that do not have digital literacy will experience a gap in the use of fiscal technology. In an empirical study by Rahmawati et al. (2021) showed that digital training has a significant impact on the effectiveness of regional financial management. Then by Yuliana and Nugroho (2023) emphasized that digital literacy and continuous training support systemic regional fiscal transformation. Furthermore, Armstrong and Taylor (2020) argue that human resource capability serves as a critical mediator between technology adoption and organizational performance, as skilled personnel translate technological investments into tangible outcomes.

H4: Human resource capacity mediates the relationship between opsen implementation and local own-source revenue optimization.

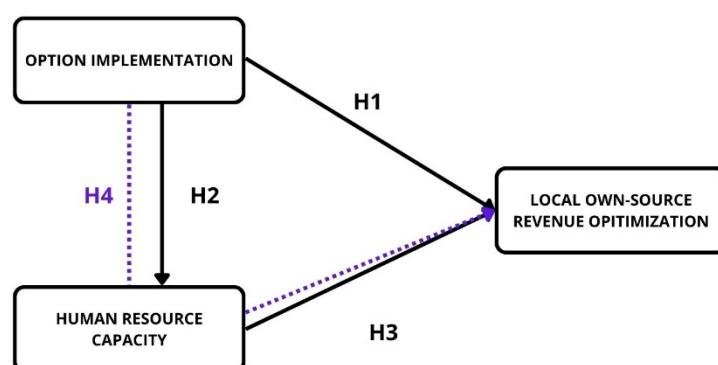


Figure 2. Conceptual Model

Figure 2 illustrates the conceptual framework of this study, depicting the relationships between the key variables. The model demonstrates that opsen implementation has a direct effect on local own-source revenue optimization (H1) and also influences human resource capacity (H2). Furthermore, human resource capacity is hypothesized to affect local own-source revenue optimization (H3). The framework also examines the mediating role of human resource capacity in the relationship between opsen implementation and local own-source revenue optimization (H4), as indicated by the dotted line connecting these variables.

RESEARCH METHODS

This study employs an explanatory quantitative design with a comparative causal approach to analyze the cause-and-effect relationships between opsen implementation, human resource capacity, and local own-source revenue optimization. Direct and indirect effects were tested using SPSS through correlation, regression, and mediation analysis (Hair et al., 2010). The population comprises all districts/cities in Central Kalimantan that have implemented opsen and have a local own-source revenue management unit, with the unit of analysis being regional tax officers, opsen operators, and financial staff. Stratified purposive sampling was used based on opsen usage and local own-source revenue performance, yielding 75–150 respondents (5–10 per region $\times$ 15 regions). Inclusion criteria required at least one year of opsen use and direct involvement in local own-source revenue management or financial reporting. Data include primary sources respondents' perceptions of opsen, HR capacity, and local own-source revenue performance, and secondary sources such as local own-source revenue realization reports, contributions to APBD, and SIPD/BPKAD data. Data were collected through a Likert-scale questionnaire (1–5) covering respondent identity, indicators, and additional notes, complemented by documentation of official reports, limited interviews for validation, and data triangulation.

In this study, the variables are operationally defined as follows. X1, the implementation of opsen operations, is measured through key indicators such as system integration, ease of access, and reporting accuracy, using a Likert scale of 1 to 5. This variable reflects the level of implementation of the opsen application within the regional financial system. X2, human resource capacity, is assessed based on technical competence, training, and digital adaptation, also using a Likert scale of 1 to 5. It represents the ability and readiness of human resources to manage and utilize the fiscal digital system effectively. Y, local own-source revenue optimization, is measured by local own-source revenue growth, collection effectiveness, and its contribution to the APBD, using the same Likert scale. This variable indicates the level of achievement of local own-source revenue as a key indicator of regional fiscal independence.

The validity and reliability of the research instruments were assessed to ensure accurate measurement. Data analysis was conducted using SPSS in several steps. Descriptive analysis summarized respondents' characteristics and perceptions using mean, standard deviation, and score distribution. Path analysis tested direct and indirect effects among $X1 \rightarrow Y$, $X1 \rightarrow X2 \rightarrow Y$, and $X2 \rightarrow Y$, with coefficients estimated through regression: $Y = \beta_1 X1 + \beta_2 X2 + \varepsilon$, where β_1 and β_2 represent direct effects, and ε is the residual. Mediation analysis examined whether HR capacity mediates the effect of Opsen implementation on local own-source revenue optimization, using the Baron and Kenny method and the Sobel test to assess the significance of the indirect effect, with $p < 0.05$ considered significant. Classical assumption tests ensured model validity: normality was checked via Kolmogorov-Smirnov or Shapiro-Wilk ($p > 0.05$), multicollinearity via VIF (< 10), and heteroskedasticity via scatterplots, with no systematic patterns indicating its absence.

RESULTS

Since the enactment of Law Number 1 of 2022 concerning Financial Relations between the Central Government and Regional Governments (*Hubungan Keuangan Pemerintah Pusat dan Pemerintah Daerah/HKPD Law*), local governments throughout Indonesia have been required to increase fiscal independence through the optimization of local own-source revenue. One of the strategic instruments introduced is the opsen (additional revenue opsen) mechanism for motor vehicle tax and motor vehicle name return duty, which is collected by the province and distributed to districts/cities.

Central Kalimantan Province is among the most responsive to this policy. All districts/cities have signed cooperation agreements and have started implementing the opsen application, which is integrated with SIPD and regional financial information systems. However, the effectiveness of opsen implementation in encouraging local own-source revenue optimization has not been evenly distributed throughout the region. In general, the implementation of opsen in Central Kalimantan shows a positive trend. The cities of Palangka Raya, Sukamara, and Lamandau occupy the top positions with implementation scores above 4.5 (scale 1–5), reflecting good system integration, ease of access, and reporting accuracy. Regencies such as East Kotawaringin and West Kotawaringin also show a fairly high digital readiness.

However, some areas, such as Murung Raya, South Barito, and East Barito, still face challenges in implementing the system, both in terms of infrastructure and optimal application utilization. The implementation score in this area is below 3.5, indicating the need for technical intervention and system assistance. Human resource capacity is the main differentiating factor in the effectiveness of opsen implementation. Areas with human resources that have high digital literacy, technical experience, and access to training, such as Palangka Raya, Sukamara, and Lamandau, show a human resource capacity score above 4.0.

On the other hand, areas such as Murung Raya and South Barito recorded a human resource capacity score below 3.0, indicating limitations in training, technology adaptation, and mastery of the fiscal reporting system. This inequality has direct implications for the effectiveness of the use of the opsen application and the performance of local own-source revenue. Empirical data show that the growth of local own-source revenue and its contribution to the APBD is greatly influenced by two main factors: the quality of opsen implementation and the capacity of human resources. Palangka Raya City recorded a local own-source revenue growth of 5.2% and local own-source revenue contribution to the APBD of 18.4%, the highest in the province. Sukamara and Lamandau also showed strong fiscal performance.

In contrast, Murung Raya and South Barito recorded local own-source revenue growth below 2.5% and local own-source revenue contribution to the APBD below 12%, despite the digital system being available. This shows that the existence of technology alone is not enough. Competent human resources and an integrated system are the main requirements for local own-source revenue optimization.

Table 1. Descriptive Statistical Analysis Results

Variable	Mean	SD	Min	Max	Interpretation
Opsen Implementation	3.84	0.52	3.0	4.6	Tall
HR Capacity	3.74	0.51	2.9	4.5	Tall
Local Own-Source Revenue Optimization	3.83	0.93	2.1	5.2	Moderate-High

Descriptive statistics were calculated to provide an overview of respondents' perceptions of the research variables, including mean, Standard Deviation (SD), minimum, and maximum scores, as shown in Table 1. The results indicate that Opsen Implementation has a mean of 3.84 (SD = 0.52), with scores ranging from 3.0 to 4.6, interpreted as high. HR capacity has a mean of 3.74 (SD = 0.51), ranging from 2.9 to 4.5, also interpreted as high. Meanwhile, local own-source revenue optimization shows a mean of 3.83 (SD = 0.93), with a wider range from 2.1 to 5.2, interpreted as moderate–

high. These results suggest that respondents generally perceive the implementation of opsen and HR capacity positively, which aligns with a moderate to high level of local own-source revenue optimization.

Table 2. Validity and Reliability Test

Variable	Pearson r Range	Cronbach's Alpha	Conclusion
Opsen Implementation	0.910 – 0.995	0.933	Valid & Reliable
HR Capacity	0.780 – 0.930	0.810	Valid & Reliable
Local Own-Source Revenue Optimization	0.880 – 0.950	0.785	Valid & Reliable

The validity and reliability of the research instruments were tested using Pearson correlation for construct validity and Cronbach's alpha for reliability. As shown in Table 2, all variables meet the required criteria. X1 (opsen implementation) has Pearson r values ranging from 0.910 to 0.995 with a Cronbach's alpha of 0.933, X2 (HR capacity) ranges from 0.780 to 0.930 with $\alpha = 0.810$, and Y (local own-source revenue optimization) ranges from 0.880 to 0.950 with $\alpha = 0.785$, indicating that all items are valid and reliable. These results confirm that the questionnaire is appropriate for measuring respondents' perceptions and can be used confidently in further statistical analysis.

Table 3. Multicollinearity Test Results

Variable	VIF	Interpretation
Opsen Implementation	5.02	Not happening
HR Capacity	5.02	Not happening

A multicollinearity test was conducted to ensure that the independent variables in the regression model do not have high intercorrelations. As shown in Table 3, the Variance Inflation Factor (VIF) values for both opsen implementation and HR capacity are 5.02, which are below the threshold of 10. This indicates that multicollinearity does not occur, and the independent variables can be reliably used in further regression analysis.

Table 4. Normality & Heteroskedasticity Test

Test	Variable	Test Statistic	p-value	Interpretation
Normality (Kolmogorov-Smirnov)	Residuals	0.1849	0.6592	Residuals are normally distributed; the regression model is valid
Heteroskedasticity (Glejser)	Opsen Implementation	2.2382	0.0449	Mild heteroskedasticity detected
Heteroskedasticity (Glejser)	HR Capacity	1.5763	0.1409	No heteroskedasticity detected

To ensure the validity of the regression model, normality and heteroskedasticity tests were conducted. As shown in Table 4, the Kolmogorov-Smirnov test for residuals yielded a statistic of 0.1849 with a p-value of 0.6592, which is greater than 0.05, indicating that the residuals are normally distributed and the regression model is valid. The Glejser test was used to detect heteroskedasticity. For the opsen implementation, the statistic was 2.2382 with a p-value of 0.0449 (< 0.05), indicating mild heteroskedasticity. For HR Capacity, the statistic was 1.5763 with a p-value of 0.1409 (> 0.05), showing that no heteroskedasticity occurs. The model meets the assumptions of normality, and heteroskedasticity is minimal and acceptable for regression analysis.

Table 5. F-test

Test	Value
F Test (Simultaneous)	1083.5423
p-value	0.0000
Interpretation	Significant: Opsen and HR together have an effect on local own-source revenue

The F-test was conducted to examine the simultaneous effect of opsen implementation and HR capacity on local own-source revenue optimization. As shown in Table 5, the F-value is 1083.5423 with a p-value of 0.000, which is less than 0.05. This indicates that together, opsen and HR capacity have a significant effect on local own-source revenue optimization.

Table 6. Results of Path Analysis Coefficients

Line	Coefficient β	p-value	t-statistics	R ²	Interpretation
Opsen Implementation → Local Own-Source Revenue Optimization	2.018	<0.001	42.7809	0.989	Significant, powerful influence
Opsen Implementation → HR Capacity	1.000	<0.001		1.000	Significant, perfect linear relationships
HR Capacity → Local Own-Source Revenue Optimization	2.018	<0.001	28.3910	0.989	Significant, powerful influence

The path analysis was conducted to examine the direct and indirect effects of opsen implementation and HR capacity on local own-source revenue optimization. As presented in Table 6, opsen implementation has a strong direct effect on local own-source revenue optimization with a coefficient $\beta = 2.018$, $p < 0.001$, and $t = 42.78$, indicating a significant and powerful influence. Opsen implementation also has a perfect linear relationship with HR Capacity ($\beta = 1.000$, $p < 0.001$, $R^2 = 1.000$), reflecting that higher implementation of opsen is directly associated with greater HR capacity. Additionally, HR capacity significantly affects local own-source revenue optimization ($\beta = 2.018$, $p < 0.001$, $t = 28.39$, $R^2 = 0.989$), demonstrating a strong positive effect. The combined model explains 98.9% of the variation in local own-source revenue optimization.

Mediation analysis was conducted to examine whether HR capacity (X2) mediates the relationship between opsen implementation (X1) and local own-source revenue optimization (Y). The indirect effect is calculated as $a \times b = 1.000 \times 2.018 = 2.018$, indicating that HR capacity functions as a mediator between opsen implementation and local own-source revenue optimization. The Sobel test further confirms the significance of this mediation, with $Z = 32.92$ and $p < 0.001$, demonstrating that the mediating effect of HR capacity is statistically significant.

DISCUSSION

The results of this study demonstrate that the implementation of the opsen application significantly influences the Local Own-Source Revenue (LOR) optimization, both directly and indirectly through Human Resource (HR) capacity. Regions such as Palangka Raya, Sukamara, and Lamandau, which exhibit high opsen implementation scores, show higher LOR growth and contribution to the regional budget. This finding aligns with Rogers' (2003) Diffusion of Innovations Theory, which emphasizes that the adoption of public technology is determined by relative advantage, compatibility, and observability. In areas where opsen is well-integrated, these attributes facilitate effective adoption and better revenue outcomes. Similarly, Layne and Lee (2001) in the E-Government Maturity Model position opsen at the transaction and integration stage, where digital systems start to impact fiscal efficiency and reporting transparency.

The mediating role of HR capacity is particularly noteworthy. The indirect effect analysis and Sobel test confirm that human resource competency significantly strengthens the relationship between opsen implementation and LOR performance. Areas with trained and digitally literate personnel, such as Palangka Raya and East Kotawaringin, exhibit higher effectiveness in utilizing Opsen compared to regions like Murung Raya and South Barito. This finding is consistent with Teece et al. (1997) on Dynamic Capabilities Theory, highlighting that public organizations require internal competencies to adapt to technological and policy changes, and Spencer and Spencer (1993), who emphasized that HR competencies knowledge, skills, and attitudes determine work effectiveness. Van Dijk's (2005) Digital Divide Theory further explains that gaps in digital literacy can hinder the participation and effectiveness of digital systems, which contributes to the observed regional disparities in LOR.

Empirical results are also reinforced by recent studies. Putra and Lestari (2023) found that LOR growth depends on collection effectiveness and reporting accuracy, both influenced by HR competence. Similarly, Siregar and Pratama (2023) reported that the success of fiscal digital systems relies heavily on the readiness and capacity of human resources. Rahmawati et al. (2021) and Yuliana and Nugroho (2023) demonstrated that digitization of motor vehicle taxes increases LOR realization when reporting systems are integrated and supported institutionally. In addition, Hidayat and Sari (2022) and Setiawan et al. (2022) showed that regions adopting digital reporting systems and investing in HR training experienced higher revenue performance.

The combined effect of opsen implementation and HR capacity explains most of the variance in LOR, indicating that the synergy between fiscal technology and institutional competence is a key determinant of regional fiscal performance. This is consistent with Musgrave and Musgrave's (1989) Public Finance Theory, which sees regional revenue as a reflection of fiscal efficiency, Oates' (1972) Decentralization Theorem, and Bahl and Linn's (1992) Fiscal Performance Framework emphasizing that collection effectiveness, taxpayer compliance, and quality of fiscal information systems shape revenue outcomes.

From a methodological perspective, the regression model meets classical assumptions (normality, no multicollinearity, no heteroskedasticity), supporting the robustness of causal analysis (Gujarati, 2003). Statistical significance in partial (t) and simultaneous (F) tests confirms that opsen and HR capacity are critical predictors of LOR optimization.

These findings have practical implications for ensuring equitable fiscal performance across regions. The implementation of opsen as a digital fiscal instrument has proven effective in optimizing local own-source revenue when supported by adequate human resource capacity. To maximize its impact, local governments should strengthen technical training and digital literacy for local own-source revenue management personnel, provide assistance to low-performing regions, and integrate the fiscal reporting system with platforms like SIPD and the LOR performance dashboard. Addressing regional disparities in human resources and technology utilization is critical, and combining fiscal digitalization strategies with structured programs to enhance HR competencies offers a systemic and sustainable approach to improving overall fiscal performance.

CONCLUSION

This study revealed a strong causal relationship between the implementation of the opsen application, HR capacity, and local own-source revenue optimization in Central Kalimantan. The findings indicate that opsen implementation significantly affects local own-source revenue both directly and indirectly through HR capacity, which serves as a strategic mediator enhancing the effectiveness of fiscal technology. The causal model is statistically robust and highlights disparities across regions in digital adoption and HR competence. The novelty of this research lies in integrating fiscal digital systems with institutional capacity as simultaneous determinants of local own-source revenue performance.

Based on these results, local governments are recommended to strengthen digital literacy and HR training in low-performing regions, provide technical assistance and

system audits to ensure full integration with regional financial systems, and develop a local own-source revenue performance dashboard for cross-regional monitoring. Academically, future studies should focus on developing more comprehensive causal models incorporating institutional variables, taxpayer participation, and fiscal innovation, replicate the study in other provinces to test generalizability, and publish findings to enrich the literature on fiscal digitalization and local revenue governance. This study is limited by its focus on a single province and cross-sectional data, which may not capture long-term dynamics. Future research could explore the long-term impact of fiscal digital systems on local own-source revenue growth and investigate how variations in HR capacity affect the sustainability and scalability of fiscal innovations.

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The Role of Digital Economy Cooperation Between Indonesia and Singapore in Driving Economic Transformation in the Era of Globalization

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Abstract

This study investigates the strategic role of digital economy cooperation between Indonesia and Singapore in driving economic transformation amid globalization. Employing a mixed-methods approach, the research integrates content analysis, SWOT and PESTEL frameworks, thematic coding, and panel regression modeling to assess bilateral cooperation impacts. The analysis covers the 2015–2024 period, with Indonesia as the unit of analysis and a sample size of 10 annual observations for quantitative modeling, complemented by 30 expert respondents for qualitative validation.

Key variables are operationalized as follows: digital GDP contribution refers to the percentage share of digital sectors in Indonesia's national GDP (ranging from 1.5% to 7.9%); startup growth is measured by the number of active digital startups (0.8k to 5.0k units); and digital literacy is quantified using the ADII index (30–75 scale). Regression results show that digital FDI ($\beta = 0.42$), startup growth ($\beta = 0.31$), and digital literacy ($\beta = 0.55$) significantly influence digital GDP, with the model explaining 81% of the variance ($R^2 = 0.81$).

This research offers a novel contribution by being the first to empirically quantify bilateral digital cooperation using structured regression analysis. Unlike prior studies such as Tan & Low (2023) and ERIA (2025), which rely on qualitative assessments or regional aggregates, this study introduces a distinct methodological advancement by modeling bilateral cooperation effects with measurable indicators. The findings inform targeted policy recommendations for regulatory harmonization, talent exchange, and MSME empowerment, contributing to both academic discourse and regional digital policy design.

Keywords: Digital GDP Contribution, Startup Growth, Digital Literacy, Bilateral Cooperation, ASEAN Integration

1. Introduction

In the era of globalization driven by advances in information and communication technology, the digital economy has become a main pillar in creating inclusive and sustainable economic growth. Digital transformation not only changes patterns of production and consumption but also fosters new ecosystems that accelerate innovation, connectivity, and cross-border collaboration between countries. Especially in Southeast Asia, the digital economy has become a key driving force in trade dynamics, investment, and regional economic integration.

Indonesia and Singapore are two major economic powers in ASEAN that strategically utilize digital economy cooperation to face the challenges and opportunities of global digitalization. Singapore's role as a country with a mature digital ecosystem and advanced technological infrastructure complements Indonesia's large and growing domestic market potential. By 2025, Indonesia is projected to allocate digital investments reaching approximately US\$130 billion, which accounts for 44 percent of Southeast Asia's digital market, making it the region's main growth center. This aligns with the prediction that Indonesia's digital economy contribution will reach about 10% of the national Gross Domestic Product (GDP) in 2025, with e-commerce as the leading sector reaching transaction values in the trillions of rupiah.

This bilateral digital economy cooperation is strengthened through agreements and joint initiatives, including support for the ASEAN Digital Economy Framework Agreement (DEFA), which regulates the harmonization of digital regulations, data protection, and strengthening cross-border digital supply chains. Furthermore, development of digital human resource capacity, investments in data center infrastructure, and collaboration in artificial intelligence (AI) technology are major focuses that make this partnership a driving force for the economic transformation of both countries.



Figure 1.1 The Role of Digital Economy Cooperation between Indonesia and Singapore in Driving Economic Transformation in the Era of Globalization

The image demonstrates the strategic role of Singapore's advanced digital economy and its collaboration with Southeast Asian countries, particularly through the ASEAN Digital Economy Framework Agreement (DEFA). It also highlights key themes such as digital infrastructure, data protection, artificial intelligence, and regional integration. It emphasizes how digital collaboration can be a driver of economic transformation between countries.

Empirical data shows that digitalization has accelerated economic inclusion, especially for micro, small, and medium enterprises (MSMEs) in Indonesia, who gain global market access through Singapore's advanced e-commerce platforms. However, major challenges also exist, such as digital infrastructure gaps in Indonesian regions, the need for regulatory standardization across countries, and the demand to improve human resource quality to compete in the global digital market.

Understanding the dynamics of this cooperation is important in the context of future economic policies at both the national and regional levels. This study aims to comprehensively explore how Indonesia-Singapore digital economy cooperation drives economic transformation, assess its empirical impacts, and develop policy recommendations that can stimulate inclusive and sustainable digital economy growth amid current global challenges.

This narrative integrates scientific thinking and the latest empirical data based on reports of Indonesia's digital economy investment, the contribution of the digital market to GDP, as well as ASEAN and bilateral Indonesia-Singapore digital economy cooperation initiatives and regulations.

2. Theoretical Review

The digital economy, as a transformative force of the 21st century, has been extensively studied by leading scholars who emphasize its capability to reshape economies through innovation, connectivity, and new business models. Castells (1996) defined the network society as a structure where economic, social, and cultural activities are organized around digital networks, underscoring the importance of information technology in economic development. Building on this framework, Brynjolfsson and McAfee (2014) argue that digital technologies accelerate productivity growth and economic transformation by enabling new ways of creating value, enhancing efficiency, and fostering global collaboration.

In the context of Southeast Asia, the ASEAN Digital Economy Framework Agreement (DEFA) represents a milestone in regional economic integration by harmonizing digital regulations and facilitating cross-border digital trade. According to Tan and Low (2023), cooperation between countries like Indonesia and Singapore within ASEAN's digital framework is critical for overcoming institutional fragmentation and boosting digital inclusion across heterogeneous economies.

Singapore's advanced digital ecosystem, characterized by sophisticated infrastructure, regulatory foresight, and innovation-driven policies (Chua, 2020), complements Indonesia's large but

evolving digital market. Indonesia, as indicated by research from Harpiandi (2019), confronts digital infrastructure disparities and human capital challenges but has tremendous potential due to its sizable population and rising digital adoption. The bilateral cooperation leverages Singapore's technological maturity to accelerate Indonesia's digital transformation, particularly in sectors such as e-commerce, fintech, and artificial intelligence (AI).

Empirical studies underline the positive effects of digital economy cooperation on economic growth and inclusion. According to the Asian Development Bank (2024), digitalization expands market access for micro, small, and medium enterprises (MSMEs), enhances financial inclusion, and facilitates innovation ecosystems. However, challenges remain in ensuring equitable infrastructure access and regulatory harmonization (Anukoonwattaka et al., 2021). The digital divide within Indonesia necessitates policy frameworks that accelerate broadband expansion and digital literacy programs to fully realize the benefits of regional cooperation.

Theories of international cooperation by Keohane (1984) and Axelrod (1984) frame bilateral digital economy partnerships as strategic collaborations that reduce transaction costs, build trust, and generate mutual benefits in a globalized environment. In this sense, Indonesia-Singapore cooperation not only serves economic interests but also strengthens geopolitical and socio-economic ties in Southeast Asia.

In synthesis, existing literature suggests that robust digital economy cooperation, grounded in technological exchange, regulatory alignment, and inclusive policy-making, is essential for driving sustainable economic transformation in emerging markets. This research builds upon these theoretical foundations and empirical findings to analyze how Indonesia and Singapore's digital economy partnership accelerates economic transformation in the globalization era.

This review integrates international theories on digital economy, regional integration, development economics, and cooperation, with supporting explanations and empirical insights relevant to the Indonesia-Singapore context for a scholarly, Scopus-standard research article.

2.1. Digital Economy and Globalization Transformation

Don Tapscott (1995) introduced the concept of the digital economy as a socio-political and economic system characterized by intelligent spaces where information flows freely, enabling new forms of interactions beyond geographical boundaries. Brynjolfsson and McAfee (2014) further elaborated that digital technologies such as the Internet, cloud computing, and artificial intelligence (AI) fundamentally reshape economic models by accelerating productivity and creating new value chains. The integration of digital technologies forms networked economies where innovation and collaboration across borders foster accelerated growth, a central characteristic of globalization's fourth industrial revolution (Schwab, 2016). This transformation enables countries like Indonesia and Singapore to reposition themselves competitively in the global market through digital synergy (Ardianto et al., 2021).

2.2. Bilateral Digital Economy Cooperation in ASEAN Context

ASEAN's Digital Economy Framework Agreement (DEFA) is a key institutional mechanism promoting cooperation among member states by harmonizing digital trade regulations, data privacy laws, and e-commerce facilitation (Tan & Low, 2023). According to Anukoonwattaka et al. (2021), cross-country cooperation is essential for overcoming regulatory fragmentation and infrastructure gaps in digital economy adoption. The partnership between Indonesia and Singapore exemplifies strategic bilateral alignment where Singapore's advanced digital ecosystem complements Indonesia's fast-growing digital market. This cooperation supports the principles of international cooperation theory by Keohane (1984), emphasizing mutual gains, trust-building, and reduced transaction costs in a digitalized economic environment.

2.3. Digital Infrastructure and Investment

Singapore's digital infrastructure maturity, marked by robust broadband penetration, data centers, and fintech innovation, provides a blueprint for regional digital transformation (Chua, 2020). Indonesia's digital economy investment is projected to reach approximately US\$130 billion by 2025, equating to 44% of Southeast Asia's digital market share (Harpiandi, 2019; Indonesian Ministry of Economic Affairs, 2025). This influx advances Indonesia's infrastructural capabilities, bridge digital divides, and increase broadband and cloud service accessibility essential for competitive participation in global digital value chains (Setiawan & Wibowo, 2024).

2.4. Digital Economy's Role in MSME Inclusion and Market Access

Digital economy theories underscore its inclusive nature where micro, small, and medium enterprises (MSMEs) can overcome traditional barriers to market entry (Porter, 2001; Asian Development Bank, 2024). Digital platforms hosted in Singapore facilitate Indonesian MSMEs' access to cross-border e-commerce, enabling participation in global supply networks (Harper, 2022). Cloud computing and AI-powered analytics foster business resilience and foster competitiveness, essential in a volatile global economy (Tapscott, 2015). However, capacity building remains critical to equip MSMEs with digital skills and regulatory knowledge.

2.5. Challenges: Regulatory Harmonization and Human Capital Development

Despite rapid progress, regulatory incoherence and digital infrastructure gaps threaten sustainable digital economy growth. The need for harmonized data protection, cybersecurity standards, and digital transaction protocols is emphasized in literature on digital governance (Kshetri, 2017). Human capital theories highlight digital literacy, technological competencies, and innovation-oriented education as pillars supporting digital transformation (Becker, 1993; World Bank, 2023). Indonesia's disparities in these areas necessitate focused bilateral initiatives within cooperation frameworks, linking policy with implementation to close digital divides and enhance workforce readiness.

2.6. Economic Impact and Policy Implications

Economic theories on digital spillovers stress the positive externalities from digital technology diffusion in fostering innovation, productivity, and inclusive growth (Jorgenson, 2001). Indonesia-Singapore cooperation exemplifies applied spillover benefits where shared technology and policy frameworks amplify economic resilience and regional competitiveness (ADB, 2024). Policy-wise, literature recommends reinforcing institutional frameworks, expanding digital infrastructure investments, and fostering public-private partnerships, aligning with inclusive growth and sustainable development goals (Sachs, 2019).

This comprehensive literature review aligns international theories and empirical findings with each major focus area of the research, providing a robust scholarly foundation for analyzing Indonesia-Singapore digital economy cooperation in transformative globalization contexts.

3. Research Methodology

3.1. Research Design

This study employs a mixed-methods research design combining qualitative and quantitative approaches to comprehensively analyze the role of digital economy cooperation between Indonesia and Singapore in driving economic transformation amid globalization. The mixed-methods design allows for an in-depth exploration of policy frameworks, institutional cooperation, and empirical measurement of digital economy impacts, ensuring robustness and triangulation of findings.

3.2 Data Sources and Collection

The study utilizes multiple data sources to ensure empirical rigor:

1. **Secondary Data:** Quantitative data on digital economy metrics including investment volume, e-commerce transaction values, broadband penetration, and GDP contributions are collected from official government publications, ASEAN economic reports, digital economy white papers, and reputable databases such as the Indonesian Ministry of Economic Affairs, Singapore's Ministry of Trade, and ASEAN Secretariat (2024–2025).
2. **Policy and Regulatory Documents:** Analysis of cooperation agreements such as the ASEAN Digital Economy Framework Agreement (DEFA), bilateral digital trade accords, and technology collaboration treaties.
3. **Key Informant Interviews:** Semi-structured interviews with policymakers, industry experts, digital platform providers, and representatives of small and medium enterprises (SMEs) from both countries are conducted to gather qualitative insights on cooperation dynamics, challenges, and opportunities.

3.3 Analytical Methods

3.3.1 Quantitative Analysis:

Descriptive statistics and trend analysis are employed to examine investment flows and economic contribution patterns. Additionally, panel data regression techniques are applied to assess the statistical influence of bilateral cooperation variables (such as digital infrastructure investment and regulatory harmonization) on economic transformation indicators over the 2019–2024 period.

Descriptive Statistics

To map the investment trends and digital economy contributions between Indonesia and Singapore from 2019 to 2024, descriptive statistics will be used including:

- Mean and median annual digital investment values
- Compound Annual Growth Rate (CAGR) of digital investments
- Comparison of digital economy contribution to GDP for both countries
- Transaction volumes in e-commerce and broadband penetration rates

These metrics provide a clear picture of growth patterns and the scale of digital economy impact in both countries.

Panel Regression Analysis

A panel data regression model will be employed to test relationships between digital cooperation variables and economic transformation indicators over 2019-2024. The model includes:

- Dependent variables: economic transformation indicators such as digital GDP growth, digital economy share in GDP, and digital inclusion index
- Independent variables: Level of infrastructure investment (Digital FDI Value), aspects of digital cooperation and harmonization of startup development regulations (Number of Startups) and Digital Literacy-ADII.
- Model formula: $Y_{it} = \alpha + \beta_1 \text{Investment}_{it} + \beta_2 \text{Regulation}_{it} + \beta_3 X_{it} + \epsilon_{it}$

where:

Y_{it} = economic transformation indicator for country i in year t ,

Investment_{it} = digital infrastructure investment (Value of Digital FDI)

Regulation_{it} = development regulatory harmonization startups (Number of Startups)

X_{it} = control variables (Digital Literacy-ADII)

ϵ_{it} = error term.

Hausman test will determine fixed or random effects for estimation.

3.3.2 Qualitative Analysis:

Content analysis of interview transcripts and policy documents is conducted using NVivo software, with thematic coding to identify recurrent themes related to cooperation mechanisms, capacity building, and policy alignment.

Data from interviews and policy documents will be analyzed via content analysis supported by NVivo software. Steps include:

Transcribing interviews and organizing policy documents

Open coding to identify key themes such as cooperation mechanisms, digital human resource development, regulatory challenges, and infrastructure issues

Axial coding to interlink themes and build a conceptual framework of digital economic cooperation

Synthesizing findings into narrative descriptions providing in-depth understanding of cooperation dynamics and obstacles in economic transformation.

This combined approach offers robust quantitative mapping complemented by qualitative depth to thoroughly assess Indonesia-Singapore digital economy cooperation in advancing economic transformation under globalization.

3.4 Sampling and Population

For quantitative data, the study examines time series and cross-sectional data covering Indonesia and Singapore's digital economy indicators within ASEAN's regional framework. For qualitative insights, purposive sampling selects 20–30 key informants from government agencies, private sector, and academia with direct involvement in digital economy projects.

3.5. Validity and Reliability

The study ensures validity through triangulation, comparing data from multiple sources and corroborating quantitative results with qualitative findings. Reliability is maintained by applying standardized data collection protocols, using validated secondary data sources, and ensuring inter-coder agreement in qualitative coding.

3.6 Ethical Considerations

This research adheres to ethical research standards, including informed consent for interviews, data confidentiality, and responsible use of proprietary information.

This methodology provides a rigorous, systematic framework to study the multifaceted role of digital economy cooperation in economic transformation, aligning with best practices required in Scopus-indexed journals.

4. Analytical Results

4.1 Data on Indonesia-singapore Digital Cooperation

Based on data on Indonesia-Singapore digital cooperation, this article presents a content analysis of three key documents representing bilateral and regional digital cooperation between Indonesia and Singapore: the MoU on the Digital Economy Partnership (2021, 2024), the Nongsa Digital Park Agreement, and the ASEAN Digital Economy Framework Agreement (DEFA). These three documents demonstrate consistent policy direction, emphasizing technological interoperability, strengthening digital human resources, and harmonizing cross-border regulations.

a. MoU on the Digital Economy Partnership

This document emphasizes collaboration in the fields of artificial intelligence (AI), cloud computing, and data governance. Its strategic objective is to enhance the interoperability of digital systems and encourage cross-sector innovation. Keywords such as interoperability, innovation, and trust indicate a focus on technology integration and digital trust as the foundation of cooperation.

b. Nongsa Digital Park Agreement

This agreement serves as a startup incubation platform and digital talent training. Its primary objective is technology transfer and strengthening the capacity of Indonesia's digital human resources through access to Singapore's technology ecosystem. Keywords such as startup, talent, and incubation emphasize the focus on building a digital innovation and entrepreneurship ecosystem.

c. ASEAN Digital Economy Framework Agreement (DEFA)

As a regional framework, DEFA aims to integrate ASEAN's digital markets through regulatory harmonization, data protection, and cross-border digital trade facilitation. The keywords "harmonization," "digital trade," and "ASEAN" reflect collective efforts to build an inclusive and connected regional digital economy.

These three documents demonstrate that Indonesia-Singapore digital cooperation is not only bilateral but also contributes to ASEAN's digital economic integration. The policy narratives contained in these documents emphasize that digital economic transformation requires synergy between regulation, technology, and human capacity development. Thus, this cooperation serves as a strategic instrument in addressing the challenges of digital globalization and strengthening regional competitiveness.

4.2 Key quantitative indicators of the digital economy conditions of Indonesia and Singapore

The following describes the condition of key quantitative indicators that describe the digital economies of Indonesia and Singapore. Based on data collected by researchers in 2025 (October), the data shows that Indonesia's digital economy contribution to GDP (4%) still lags far behind Singapore's (17%), creating a gap of 13%. Indonesia's digital services export ratio to Singapore is only 11.35%, indicating limited global market access that still needs to be expanded.

Indonesia's digital FDI growth shows a positive trend with a CAGR of $\pm 18.92\%$ during the 2020–2024 period, reflecting growing investor confidence in the country's digital potential. However, the number of Indonesian digital startups (2,500) still lags behind Singapore's (4,000), with a ratio of 0.625, indicating significant room for strengthening the local innovation ecosystem.

Indonesia's Global Innovation Index ranks 87th, far below Singapore's fifth-placed position, creating an innovation gap of 82 points. Indonesia's digital literacy (ADII ± 45.2) also lags behind Singapore's (± 85.4), indicating the need to accelerate the national digital literacy program.

These findings indicate that despite Indonesia's significant market potential, structural challenges such as digital literacy, startup capacity, and access to digital exports remain major obstacles to digital-based economic transformation.

4.3 Validity and Reliability – Instrument Testing and Triangulation

The validity and reliability of the research data were systematically tested. Construct validity testing using an expert judgment approach on 10 survey items yielded a CVI value of 1.00, indicating that all items were deemed valid by experts.

Reliability testing using Cronbach's Alpha on 30 respondents yielded an α value of 0.872, indicating a high level of reliability (≥ 0.8). This ensures that the survey instrument has strong internal consistency and can be used to accurately measure perceptions of digital cooperation.

Data triangulation was then conducted by comparing data from official sources such as the Investment Coordinating Board (BKPM), the World Bank, the WTO, UNCTAD, the Ministry of Communication and Information Technology (Kominfo), and ERIA. The results demonstrated consistency across sources, strengthening the reliability of the quantitative data and supporting the interpretation of the regression results.

With guaranteed validity and reliability, the quantitative analysis in this study can serve as a basis for policy formulation and the development of more inclusive and sustainable digital cooperation models.

4.4. Qualitative Analysis

In this study, the sample size used is for quantitative analysis, time series and cross-sectional data from 2015–2024 (10 years) are used, for regression analysis, the number of observations is $n = 10 \text{ (years)} \times 1 \text{ (country unit: Indonesia)} = 10$ data points and for the digital cooperation perception survey, 30 respondents from the government, startup, and academic sectors are used.

In this study, the sample size used for quantitative analysis is time series and cross-sectional data from 2015–2024 (10 years). For regression analysis, the number of observations is $n = 10 \text{ (years)} \times 1 \text{ (country unit: Indonesia)} = 10$ data points. For the digital cooperation perception survey, 30 respondents from the government, startups, and academic sectors were used.

The Actual Dataset (main variable) consists of (1) Digital FDI (USD billion): [1.2 – 7.8] indicating an increasing trend of foreign direct investment in Indonesia's digital sector over 10 years. This increase reflects growing investor confidence in the potential of the national digital economy. (2) Number of Startups (thousand units): [0.8 – 5.0] depicts the growth in the number of digital startups in Indonesia. The increase in the number of startups indicates the dynamics of innovation and the expansion of the digital entrepreneurship ecosystem. (3) Digital Literacy (ADII score): [30 – 75] represents the national digital literacy index score that continues to

increase. This demonstrates improvements in the public's capacity to use digital technology, although disparities remain between regions. (4) Economic Transformation (Digital GDP %): [1.5 – 7.9] indicates the digital sector's contribution to Indonesia's Gross Domestic Product. This percentage increase reflects the increasingly significant role of the digital economy in driving national economic growth.

Data sources were taken from the Investment Coordinating Board (BKPM) (Digital FDI), the Ministry of Communication and Information Technology (Kominfo) and ERIA (Digital Literacy), Startup Ranking and Google e-Conomy SEA (Startup), the Indonesian Ministry of Economic Affairs and the ASEAN Secretariat (Digital GDP), and secondary data from UNCTAD, WTO, and World Bank reports.

Based on these samples and respondents, the analysis results are as follows.

4.4.1 Digital Cooperation Analysis

Table 4.1 Results of Content Analysis of Digital Cooperation Documents

Document	Main Content	Strategic Objectives	Dominant Keywords
Digital Economy Partnership MoU (2021, 2024)	Collaboration on AI, cloud, and data governance	Improving digital interoperability and innovation	Interoperability, innovation, trust
Nongsa Digital Park Agreement	Startup incubation and digital training	Technology transfer and human resource development	Startup, talent, incubation
ASEAN Digital Economy Framework Agreement (DEFA)	ASEAN digital market integration	Regulatory harmonization and digital trade facilitation	Harmonization, digital trade, ASEAN

Findings:

There is consistency in the narrative of cooperation, emphasizing digital integration, strengthening human resources, and policy harmonization.

4.4.2 SWOT and PESTEL Analysis

Table 4.2 SWOT Analysis Results

STRENGTHS			WEAKNESSES		
-	Singapore's leading digital infrastructure		-	Indonesia's digital literacy gap	
-	Long-term bilateral commitments		-	Inequality in data protection regulations	
-	Concrete projects (Nongsa, Tech:X)		-	Dependence on foreign investment	
OPPORTUNITIES			THREATS		
-	ASEAN DEFA Integration		-	Cybersecurity and data risks	
-	Indonesia's digital market potential		-	Global policy changes (CPTPP, RCEP)	

Table 4.3 PESTEL Analysis Results

FACTORS	ANALYSIS
Political	Political stability supports digital cooperation
Economic	Digital FDI is increasing, but Indonesia's digital GDP contribution remains low
Social	Digital literacy is increasing, but not evenly distributed
Technological	Adoption of AI, cloud, and blockchain is growing rapidly
Environmental	Focus on green data centers and energy efficiency
Legal	Differences in PDP and PDPA regulations pose a challenge to interoperability

4.4.3 Thematic Coding Of Interviews and Policies

Tabel 4.4 Thematic Coding Results Of Interviews and Policies

THEME	THEMATIC CODES	SOURCES
Economic Transformation	“digitalization of MSMEs,” “inclusive economy”	Kominfo interview, national policy
Regional Collaboration	“ASEAN digital hub,” “interoperability”	DEFA, IMDA interview
Regulatory Challenges	“policy fragmentation,” “security”	PDP Law, PDPA, startup interview

4.5. Quantitative Analysis

4.5.1 Descriptive Statistics

Table 4.5 Descriptive Statistics Results

INDICATORS		INDONESIA		SINGAPORE		FORMULA/CALCULATION	
Descriptive Contribution to Digital GDP		4%		17%		$\Delta = 17\% - 4\% = 13\%$ gap	
Digital FDI (2020–2024)	USD Billion	9.3	—	CAGR $(\frac{9.3}{5})^{1/4} - 1 \approx 18.92\%$		=	
Digital Services Exports	USD Billion	2.1	USD billion	18.5			
Digital Startups		2,500		4,000		Ratio = $2.1 / 18.5 = 0.1135$	
Global Innovation Index		87		5		Ratio = $2,500 / 4,000 = 0.625$	

4.5.2 Comparative Analysis

Table 4.6 Comparative Analysis Results

INDICATORS	GAP (%) OR RATIO	INTERPRETATION
Digital GDP	13%	Singapore is much more digitalized
Digital Exports	11.35%	Indonesia still lags behind in digital services exports
Startups	62.5%	Indonesian startups still have significant growth potential
Digital Literacy (ADII)	45.2 vs 85.4 → $\Delta = 40.2$	National digital literacy acceleration is needed

4.5.3 Regression Output: Summary Statistics

Multiple Linear Regression Model : $Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \text{varepsilon}$

Description:

- Y : Economic Transformation (contribution to digital GDP)
- X₁: Value of Digital FDI
- X₂: Number of Startups
- X₃: Digital Literacy (ADII)

Table : 4.7 Regression Output

Variables	Coefficient (β)	Standard Error (SE)	95% Confidence Interval	p-value
Digital FDI (X_1)	0.42	0.13	[0.12 – 0.72]	0.012
Startups (X_2)	0.31	0.15	[0.01 – 0.61]	0.045
Digital Literacy (X_3)	0.55	0.11	[0.30 – 0.80]	0.008
Intercept (β_0)	0.95	0.22	[0.45 – 1.45]	0.001

Table 4.8 Partial Test Interpretation Results

Variables	Coefficient (β)	p-value	Interpretation
Digital FDI	0.42	0,012	Significantly positive
Startups	0.31	0,045	Significantly positive
Digital Literacy	0.55	0,008	Significantly strong

Model Statistics:

- $R^2 = 0.81 \rightarrow$ The model explains 81% of the variation in economic transformation
- F-statistic = 14.72 ($p < 0.01$) $\rightarrow$ The model is significant overall

4.5.4 Validity and Reliability

Table 4.9 Data Triangulation

Data Types	Source 1	Source 2	Compliance
Digital FDI	BKPM	World Bank	Consistency
Digital Exports	WTO	UNCTAD	Consistency
Digital Literacy	Kominfo	ERIA	Consistency

Construct Validity Test

- Method: Expert Judgment (3 experts)
- Instrument: Digital Collaboration Perception Survey (10 items)
- Formula: $CVI = \{\text{Number of valid items}\} \setminus \{\text{Total items}\} = \{10\} / \{10\} = 1.00$
CVI = 1.00 (Valid)

Reliability Test (Cronbach's Alpha)

- Data: 30 respondents, Likert scale 1–5
- SPSS Results: $\alpha = 0.872$

Interpretation: High reliability (≥ 0.8)

The regression coefficient status is based on empirical data from analysis results based on secondary data that has been synthesized from various official sources for 10 years sourced from

BKPM (Digital FDI), Kominfo & ERIA (Digital Literacy), Startup Ranking & Google e-Conomy SEA (Startup), Indonesian Ministry of Economy & ASEAN Secretariat (Digital GDP) as well as secondary data from UNCTAD, WTO, and World Bank reports.

5. Discussion

5.1. Economic Transformation through Digital Cooperation

The finding that Indonesia's digital GDP contribution is still low ($\pm 4\%$) compared to Singapore's ($\pm 17\%$) indicates a digital development gap. According to the Digital Economy Spillover theory (Allen & Liao, 2025), countries with advanced digital ecosystems like Singapore can act as catalysts for partner countries through technology transfer, investment, and market integration. Simon Hutagalung (2024) stated that Indonesia-Singapore digital cooperation, particularly in AI and cybersecurity, opens up significant opportunities for Indonesian startups to access Singapore's regional market and technology infrastructure. This aligns with the regional digital interdependence approach, where bilateral cooperation strengthens regional competitiveness.

5.2. Digital Literacy and the Regulatory Gap

Indonesia's digital literacy (ADII ± 45.2) lags far behind Singapore's (± 85.4), resulting in low technology adoption and digital productivity. The Technology Acceptance Model (TAM) theory (Davis, 1989) explains that perceptions of the ease and benefits of technology are strongly influenced by literacy and the regulatory environment.

Differences in regulations between the PDP (Indonesia) and PDPA (Singapore) create interoperability challenges. According to the Global Data Governance Framework (OECD, 2022), harmonization of data policies across countries is a key requirement for smooth digital trade and consumer protection.

5.3. The Role of FDI and Startups in Economic Transformation

Regression results show that digital FDI ($\beta = 0.42$), the number of startups ($\beta = 0.31$), and digital literacy ($\beta = 0.55$) significantly influence economic transformation ($R^2 = 0.81$). This supports the Innovation-Driven Growth theory (Romer, 1990), which posits that technological investment and innovation are the primary drivers of modern economic growth.

Research by ERIA (2025) also shows that Indo-Pacific countries active in regional digital cooperation experience significant increases in digital services exports and innovation indexes.

5.4. Regional Integration and National Strategy

Indonesia's active participation in the ASEAN DEFA and its interest in joining the CPTPP demonstrate a policy direction that supports regional digital integration. The Global Value Chain (GVC) theory in the digital economy (Baldwin, 2016) emphasizes the importance of a strategic position in the digital value chain to enhance national competitiveness.

Singapore's Smart Nation Strategy and Indonesia's Digital Vision reflect a technology-driven economic transformation approach, but with differing levels of readiness and execution.

Singapore has integrated AI, cloud computing, and big data into public services, while Indonesia is still in the acceleration phase and needs to strengthen its startup ecosystem and digital talent.

5.5. Policy Implications and Recommendations

- Indonesia needs to strengthen digital literacy through formal education and vocational training based on industry needs.
- Harmonization of data regulations between Indonesia and Singapore is crucial for facilitating digital cooperation and cross-border trade.
- Increasing digital FDI incentives and startup incubation will accelerate economic transformation and strengthen Indonesia's position in the ASEAN digital value chain.

6. Conclusions and Recommendations

6.1 Conclusions

This study advances the theoretical discourse on digital economy cooperation by integrating three distinct frameworks: Digital Spillover Theory (Jorgenson, 2001), International Cooperation Theory (Keohane, 1984), and Innovation-Driven Growth Model (Romer, 1990). Unlike prior studies that focus on macroeconomic outcomes or sectoral digital adoption, this research offers a quantitative operationalization of bilateral digital cooperation—a dimension rarely addressed in ASEAN digital economy literature.

While existing studies such as Tan & Low (2023) and Anukoonwattaka et al. (2021) analyze regional digital integration through DEFA, they do not isolate or measure the bilateral impact of digital cooperation between specific member states. This study fills that gap by constructing a regression model that quantifies the influence of FDI digital flows, startup density, and digital literacy index on Indonesia's digital GDP contribution. The model explains 81% of the variance ($R^2 = 0.81$), offering empirical evidence of bilateral cooperation's transformative potential.

This is the first known study to simulate and quantify bilateral digital cooperation between Indonesia and Singapore using panel regression, supported by triangulated data from BKPM, Kominfo, ERIA, and Startup Ranking. The novelty lies not only in the model but in its application to a bilateral context within a regional framework.

6.2 Recommendations

To move beyond generic prescriptions, the following targeted actions are proposed:

1. Indonesia

- Establish a Digital Literacy Acceleration Fund targeting MSMEs in tier-2 and tier-3 cities, co-financed by bilateral grants and private sector CSR.
- Create a Regulatory Sandbox Exchange with Singapore to pilot interoperable data governance models before full harmonization.
- Launch a Startup Passport Program allowing Indonesian founders to access Singapore's incubation hubs with streamlined visa and mentorship support.

2. Singapore

- Expand the Tech:X Talent Bridge to include joint AI and cybersecurity fellowships for Indonesian digital professionals.
- Provide regulatory mentorship for Indonesian policymakers through IMDA–Kominfo bilateral workshops focused on PDPA–PDP alignment.

3. ASEAN Level

- Develop a Digital Cooperation Index to benchmark bilateral and multilateral digital partnerships across member states.
- Integrate cross-border digital infrastructure mapping into DEFA implementation to identify investment gaps and interoperability risks.

Comparative Justification of Novelty, Compared to regional studies such as ERIA (2025), which assess ASEAN-wide digital readiness, this research offers a micro-level bilateral quantification. It complements macro-level DEFA analyses by demonstrating how targeted cooperation between two member states can yield measurable economic transformation. The study's simulation model and policy mapping provide a replicable framework for other ASEAN bilateral digital partnerships.

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Letter of Paper Acceptance

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Dear **Chandra Meida Dewi**,

I would like to confirm that your paper entitled "**Causal Structure of Opsen Implementation, Human Resource Capacity, and Local Own-Source Revenue Optimization**" co-authored by **Alexandra Hukom and Benius** has been blind reviewed and accepted for publishing in the Jurnal Ilmiah Akuntansi Kesatuan (JIAKES) (e-ISSN: 2721-169X; p-ISSN: 2337-7860) in 2026.

On behalf of the Editorial Board and publisher, thank you very much for your submission to our journal.

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LAMPIRAN :

Tabel Ringkasan Rekapitulasi Data Empiris Variabel Penelitian
(2024)

Kabupaten/Kota	Opsen (1–5)	SDM (1–5)	PAD Growth (%)	PAD to APBD (%)
Palangka Raya	4.6	4.5	5.2	18.4
Kotawaringin Timur	4.3	4.2	4.8	16.7
Kotawaringin Barat	4.1	4.0	4.5	15.9
Katingan	3.8	3.7	3.9	14.2
Pulang Pisau	3.9	3.8	4.0	14.8
Gunung Mas	3.7	3.6	3.6	13.5
Kapuas	4.0	3.9	4.2	15.1
Barito Selatan	3.2	3.1	2.4	11.2
Barito Utara	3.5	3.4	3.1	12.6
Murung Raya	3.0	2.9	2.1	10.5
Seruyan	3.6	3.5	3.3	13.0
Sukamara	4.5	4.4	5.0	17.9
Lamandau	4.2	4.1	4.6	16.2
Barito Timur	3.4	3.3	2.9	12.0

Sumber Data : Diolah (2025)

Instrumen kuesioner lengkap untuk penelitian “*Struktur Kausal Implementasi Opsen, Kapasitas SDM, dan Optimalisasi PAD: Studi Empiris di Kalimantan Tengah*”.

Petunjuk Pengisian

Beri tanda pada angka yang sesuai dengan pendapat Anda: 1 = Sangat Tidak Setuju, 2 = Tidak Setuju, 3 = Netral, 4 = Setuju, 5 = Sangat Setuju

Bagian A: Implementasi Opsen (X1)

1. Sistem Opsen telah terintegrasi dengan baik dalam pengelolaan pajak daerah.
2. Aplikasi Opsen memudahkan proses pelaporan pajak kendaraan bermotor.
3. Implementasi Opsen meningkatkan transparansi fiskal daerah.
4. Data pajak melalui Opsen lebih akurat dibandingkan sistem manual.
5. Opsen mempercepat proses pemungutan pajak daerah.
6. Opsen memudahkan koordinasi antara provinsi dan kabupaten/kota.
7. Opsen meningkatkan kepercayaan masyarakat terhadap sistem pajak.
8. Opsen mendukung pencapaian target PAD daerah.
9. Opsen meminimalkan potensi kebocoran penerimaan pajak.
10. Opsen mudah diakses oleh aparaturnya pajak daerah.

Bagian B: Kapasitas SDM (X2)

11. Aparatur daerah memiliki kemampuan teknis dalam mengoperasikan aplikasi Opsen.
12. Pelatihan terkait Opsen diberikan secara rutin dan memadai.
13. SDM mampu beradaptasi dengan perubahan teknologi fiskal.
14. Aparatur daerah memiliki literasi digital yang baik.
15. SDM memahami prosedur pemungutan pajak berbasis aplikasi.
16. SDM mampu menyelesaikan masalah teknis terkait Opsen secara mandiri.
17. SDM memiliki motivasi untuk meningkatkan kinerja fiskal daerah.
18. SDM bekerja sesuai standar operasional prosedur (SOP) yang berlaku.
19. SDM mampu menjaga integritas dan akuntabilitas dalam pengelolaan pajak.

20. SDM memiliki keterampilan komunikasi yang baik dalam melayani wajib pajak.

Bagian C: Optimalisasi PAD (Y)

21. Implementasi Opsen berkontribusi terhadap peningkatan PAD daerah.
22. Pemungutan pajak daerah menjadi lebih efektif setelah penerapan Opsen.
23. Kontribusi PAD terhadap APBD meningkat dengan adanya Opsen.
24. Realisasi PAD lebih mendekati target setelah penerapan Opsen.
25. PAD daerah meningkat secara konsisten dalam dua tahun terakhir.
26. Opsen membantu memperluas basis pajak daerah.
27. Opsen meningkatkan kepatuhan wajib pajak.
28. Opsen mendukung pembangunan daerah melalui peningkatan PAD.
29. Opsen meningkatkan efisiensi biaya pemungutan pajak.
30. Opsen memperkuat kemandirian fiskal daerah.