DIGITAL SERVICE RECOVERY POST-CYBERATTACK: THE INFLUENCE OF DIGITAL CRISIS MANAGEMENT AND INCENTIVE COMPENSATION ON USER LOYALTY IN CRYPTO-ASSET EXCHANGES

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ABSTRAK

Insiden peretasan yang menimpa bursa aset kripto menempatkan pemulihan layanan (*service recovery*) sebagai penentu utama keputusan pengguna untuk bertahan atau berpindah. Studi tentang *service recovery* telah matang pada sektor perbankan, telekomunikasi, dan *e-commerce*, namun masih langka pada konteks bursa aset kripto pasca-insiden peretasan nyata di pasar berkembang, khususnya menyangkut peran *Proof of Reserve* (PoR) sebagai instrumen transparansi teknis. Penelitian ini menganalisis pengaruh Manajemen Krisis Digital dan Kompensasi Insentif terhadap Loyalitas Pengguna pada bursa aset kripto yang terdampak pasca-insiden peretasan September 2024. Pendekatan kuantitatif digunakan dengan *purposive sampling* terhadap 262 pengguna aktif di Provinsi Bali yang mengetahui insiden tersebut. Data dikumpulkan melalui kuesioner berskala Likert 1–5 dan dianalisis menggunakan regresi linear berganda pada SPSS. Hasil menunjukkan Manajemen Krisis Digital (β=0,350; t=5,692; p<0,001) dan Kompensasi Insentif (β=0,454; t=8,588; p<0,001) berpengaruh positif dan signifikan terhadap loyalitas, baik secara parsial maupun simultan (F=125,166; p<0,001), dengan kontribusi 49,1% (R^2=0,491). Kompensasi Insentif menjadi prediktor dominan. Temuan ini memperkuat teori *Service Recovery Paradox* dan memposisikan transparansi berbasis PoR sebagai mekanisme pemulihan kepercayaan baru dalam industri *fintech* berbasis *blockchain*.

Kata Kunci : *Digital Service Recovery; Manajemen Krisis Digital; Kompensasi Insentif; Loyalitas Pengguna; Proof Of Reserve; Aset Kripto*

ABSTRACT

Hacking incidents on crypto-asset exchanges make service recovery a decisive factor in users' decision to stay or switch. While service recovery research is mature in banking, telecommunications, and e-commerce, it remains scarce in the context of crypto exchanges following a real hacking incident in emerging markets, particularly regarding the role of Proof of Reserve (PoR) as a technical transparency instrument. This study analyzes the effect of Digital Crisis Management and Incentive Compensation on User Loyalty of the affected crypto-asset exchange following the September 2024 hacking incident. A quantitative approach was applied using purposive sampling of 262 active users in Bali Province who were aware of the incident. Data were collected via a 1–5 Likert-scale questionnaire and analyzed using multiple linear regression in SPSS. Results show that Digital Crisis Management (β=0.350; t=5.692; p<0.001) and Incentive Compensation (β=0.454; t=8.588; p<0.001) have a positive and significant effect on loyalty, both partially and simultaneously (F=125.166; p<0.001), explaining 49.1% of the variance (R^2=0.491). Incentive Compensation is the dominant predictor. These findings reinforce the Service Recovery Paradox theory and position PoR-based transparency as a novel trust-recovery mechanism in the blockchain-based fintech industry.

Keywords : *Digital Service Recovery; Digital Crisis Management; Incentive Compensation; User Loyalty; Proof Of Reserve; Crypto Assets*

INTRODUCTION

The growth of crypto-asset investment in Indonesia has accelerated significantly, transforming from a niche community into a mainstream investment sector. Bali has emerged as a strategic hub for the regional digital ecosystem, characterized by an active investor community and the hosting of global events such as Coinfest Asia. The regulatory reinforcement through Law Number 4 of 2023 on the Development and Strengthening of the Financial Sector (UU P2SK) has shifted the regulatory authority of digital financial assets from Bappebti to the Financial Services Authority (OJK), thereby enhancing legal certainty and investor confidence. Consistent with the study by Agustina and Sudrajat (2026) published in SEIKO, regulatory frameworks and price transparency are vital determinants in shaping consumer purchase intention and long-term commitment.

However, amidst this growth, platform security remains the most critical aspect. Within the digital financial ecosystem, system security is a primary determinant of user risk perception before deciding to maintain loyalty toward a platform. Failure to mitigate cyber risks not only results in financial loss but also collectively erodes digital trust. A critical phenomenon occurred on September 11, 2024, when a pioneer national crypto-asset exchange that had been operational since 2014 suffered a server breach connected to its hot wallet.

Such incidents place the concept of service recovery at the forefront. When a digital financial platform experiences a service failure due to cyberattacks, user expectations plummet, and the potential for switching to global exchanges increases. Literature indicates that an effective recovery strategy can enhance loyalty beyond pre-disruption levels—a phenomenon known as the *Service Recovery Paradox*.

Empirical studies on service recovery have matured within the banking, telecommunications, and e-commerce sectors. However, its application in the context of crypto-asset exchanges following actual hacking incidents remains limited, particularly in emerging markets like Indonesia. Specifically, there are two gaps. First, most studies position service recovery within conventional service relationships, whereas recovery of trust in high-value, irreversible digital assets remains under-researched. Second, the technical transparency mechanism unique to the crypto industry, namely *Proof of Reserve* (PoR)—an audit verifying the availability of users' digital asset reserves—has not been empirically tested as a component of crisis management influencing loyalty. This research fills these gaps by positioning Digital Crisis Management (including PoR publication) and Incentive Compensation as two pillars of digital service recovery.

Based on these gaps, this study aims to quantitatively analyze the influence of Digital Crisis Management and Incentive Compensation on User Loyalty in crypto-asset exchanges in Bali, both partially and simultaneously. Theoretically, this study enriches the *digital service recovery* literature with evidence from the blockchain-based fintech industry and introduces PoR as a trust-recovery mechanism. Practically, these findings provide guidance for local crypto exchanges in designing effective crisis communication protocols and compensation schemes to retain users amid global exchange competition.

METHODS

This research employs a quantitative approach with an explanatory research design to examine the causal relationships between variables. The research population focuses on active crypto-asset exchange users in Bali Province whose platforms were affected by the hacking incident in September 2024. The sample determination in this study employs a non-probability sampling technique using the *purposive sampling* method based on specific criteria: respondents must be domiciled in Bali, possess an active account on the affected exchange, and be aware of the security breach. Since the exact number of users specifically in Bali Province is not officially published by the corporation (an unknown population), the minimum sample size was determined referring to the theory proposed by Hair et al. (2014). According to Hair et al., a representative sample size for multivariate research is 5 to 10 times the number of indicators. Given that the research instrument contains a total of 18 indicators, the minimum sample size calculation is 18 multiplied by 10, resulting in 180 respondents. Based on the distribution process, an actual sample of 262 respondents was obtained, which exceeds the minimum requirement and is considered highly representative for measuring the effectiveness of post-crisis *service recovery* strategies.

Primary data collection was conducted through an online questionnaire. The research instruments were measured using a 5-point Likert scale, ranging from "Strongly Disagree" to "Strongly Agree." This instrument was designed to measure three primary variables: Digital Crisis Management (incorporating indicators such as *Proof of Reserve* publication and response speed) and Incentive Compensation (in the form of fee waivers or asset bonuses) as independent variables, and User Loyalty as the dependent variable. All questionnaire instruments underwent validity and reliability testing to ensure the feasibility and consistency of the measuring tools before further data processing.

Data analysis was performed quantitatively using the *Statistical Package for the Social Sciences* (SPSS) software. The primary data analysis technique applied was multiple linear regression to calculate the direction and magnitude of the influence of the independent variables on the dependent variable. The analysis sequence includes classical assumption testing, followed by hypothesis testing through the t-test to determine partial effects, and the F-test to measure simultaneous effects. Additionally, the coefficient of determination (R^2) test was utilized to evaluate the percentage contribution of digital crisis management strategies and incentive compensation toward user loyalty.

Types and Sources of Data

This study utilizes two types of data to obtain accurate and relevant information: primary and secondary data. Primary data refers to information obtained directly from the original source without intermediaries. In this research, primary data was acquired through the distribution of online questionnaires to respondents who are active users of the affected crypto-asset exchange. Secondary data serves as supporting information obtained indirectly or through pre-existing sources to strengthen the theoretical foundation and provide a real-world context. Examples of secondary data used in this study include prior literature discussing crypto investor behavior, credible news articles regarding the security incident timeline, and official *Proof of Reserve* reports published directly on the exchange's website to demonstrate asset transparency.

Data Collection Methods

The population in this study focuses on active crypto-asset exchange users in Bali Province whose platforms were affected by the hacking incident. The sample determination employs a non-

probability sampling technique using the *purposive sampling* method based on specific criteria: respondents must be domiciled in Bali, possess an active account on the affected exchange, and be aware of the security breach. Since the exact number of users specifically in Bali Province is not officially published by the corporation (an unknown population), the minimum sample size was determined referring to the theory proposed by Hair et al. (2014). According to Hair et al., a representative sample size for multivariate research is 5 to 10 times the number of indicators. Given that the research instrument contains a total of 18 indicators, the minimum sample size calculation is 18 multiplied by 10, resulting in 180 respondents. Based on the distribution process, an actual sample of 262 respondents was obtained. The primary data was collected using a structured questionnaire distributed online via social media and crypto investor community networks. The instrument was measured using a 5-point Likert scale, ranging from 1 ("Strongly Disagree") to 5 ("Strongly Agree"), to measure Digital Crisis Management (X1), Incentive Compensation (X2, and User Loyalty (Y).

Data Analysis Methods

Data analysis was performed quantitatively using the *Statistical Package for the Social Sciences* (SPSS) software. Before conducting further analysis, the research instruments were tested for feasibility. The validity test utilized the Pearson Correlation, where an item is declared valid if the r-count is greater than the r-table (Ghozali, 2021). The reliability test was measured using Cronbach's Alpha, with a standard acceptable value of > 0.60 (Sugiyono, 2022). Following the instrument tests, classical assumption tests were conducted to ensure the regression model met fundamental statistical requirements. This included the Normality test using the Kolmogorov-Smirnov method (significance > 0.05), the Multicollinearity test (Tolerance > 0.10 and VIF < 10), and the Heteroscedasticity test using the Glejser test (Ghozali, 2021).

The primary data analysis technique applied was multiple linear regression to calculate the direction and magnitude of the influence of the independent variables on the dependent variable. The regression model formulated is:

$$Y = a + b_1X_1 + b_2X_2 + e$$

Hypothesis testing was systematically conducted through three stages: the t-test (partial test) to determine the individual significance of each independent variable on the dependent variable; the F-test (simultaneous test) to measure the combined effect of the independent variables; and the Coefficient of Determination (R^2) test to evaluate the extent of the model's ability to explain variations in the dependent variable (Ghozali, 2021).

RESULT AND DISCUSSION

Multiple Linear Regression Analysis

Multiple linear regression analysis is used in this study to determine the direction and magnitude of the influence of the independent variables, namely Digital Crisis Management (X1) and Incentive Compensation (X2), on the dependent variable, namely User Loyalty (Y). Based on the data processing using statistical software, the multiple linear regression equation obtained is presented in Table 1 below.

Table 1. Multiple Linear Regression Results

Variable	Coefficient B	Standard Error
Constant	4.906	1.063
Digital Crisis Management (X1)	0.350	0.062
Incentive Compensation (X2)	0.454	0.053

Source: Primary Data Processed, 2026

Referring to Table 1 above, the multiple linear regression equation can be formulated as follows:

$$Y = 4.906 + 0.350X_1 + 0.454X_2 + e$$

From the multiple linear regression equation above, the interpretation of each coefficient can be detailed as follows:

1. **A constant value (a) of 4.906:**
   This indicates that if the independent variables, namely Digital Crisis Management (X1) and Incentive Compensation (X2), are valued at 0 (zero) or assumed constant (experiencing no change), then the value of User Loyalty (Y) formed is 4.906 units.
2. **The Regression Coefficient for Digital Crisis Management (X1) is 0.350:**
   This demonstrates that the Digital Crisis Management variable has a positive direction of influence on User Loyalty. It means that every 1 (one) unit increase in Digital Crisis Management, assuming other independent variables remain constant, will result in an increase in User Loyalty by 0.350 units.
3. **The Regression Coefficient for Incentive Compensation (X2) is 0.454:**
   This indicates that the Incentive Compensation variable also has a positive direction of influence on User Loyalty. It means that every 1 (one) unit increase in Incentive Compensation, assuming other independent variables remain constant, User Loyalty will experience an increase of 0.454 units.

Hypothesis Testing Hypothesis testing in this study is conducted to empirically prove the truth of the tentative assumptions formulated in the previous chapter, as well as to assess the feasibility of the regression model. To answer these hypotheses, data analysis stages were carried out through 3 (three) types of statistical tests. The three tests include: the Model Feasibility Test (F-Test) to assess the feasibility of the model and the simultaneous influence of independent variables; the Significance Test (t-Test) to determine the magnitude of the partial influence of independent variables; and the Coefficient of Determination Test (R^2) to measure the percentage magnitude of the independent variables' ability to explain variations in the dependent variable. The recap of the results from these three tests is presented completely in Table 2 below:

Table 2. Hypothesis Testing Results

Variable	t-statistic	Sig.	Description
Digital Crisis Management (X1)	5.692	< 0.001	Significant

Incentive Compensation (X2)	8.588	< 0.001	Significant
F-statistic	125.166	R	0.701
F Sig.	< 0.001	R Square	0.491

Source: Primary Data Processed, 2026

The Influence of Digital Crisis Management on User Loyalty

This study demonstrates that proactive digital crisis management is a vital foundation for retaining users following fatal service failures. This result aligns with the theory of digital trust, which asserts that in an ecosystem of irreversible digital assets, response speed and information transparency are crucial. In the context of the crypto industry, the publication of *Proof of Reserve* (PoR) acts as an effective technical transparency mechanism to mitigate market panic (panic withdrawal). This empirical evidence complements previous research by showing that users do not merely assess the speed of a system returning online; rather, they prioritize cryptographic proof that their assets are truly secure. This emphasizes that institutional responses are critical, as noted by Purnomo et al. (2026) in SEIKO, who highlight that operational pressure must be managed effectively to sustain performance.

The Influence of Incentive Compensation on User Loyalty

This study finds that incentive compensation is the most dominant predictor in restoring loyalty. These findings address the research problem by confirming that corporate apologies are insufficient without tangible *atonement*. Providing incentives, such as fee waivers or zero-fee transactions for a specific period post-hack, acts as a concrete service recovery strategy. This confirms theories from previous studies stating that the psychological losses and anxieties resulting from security system failures (service failure) can only be neutralized through financial compensation that benefits the user. Furthermore, this is aligned with the research by Handoyo et al. (2026) in SEIKO, which emphasizes that compensation and motivational factors are fundamental in maintaining long-term commitment within an organization.

Simultaneous Influence and the Service Recovery Paradox

Overall, the integration of digital crisis management (based on technical evidence publications like PoR) and beneficial incentive compensation is proven to simultaneously create a *buffer* against user switching to global competitors. These findings strongly confirm the *Service Recovery Paradox* phenomenon within the blockchain-based fintech industry. When a crypto-asset exchange is able to transform a hacking crisis into a momentum to demonstrate system resilience, full accountability, and relevant incentives, users demonstrate levels of loyalty and trust that potentially exceed pre-hacking conditions. This strategic approach to service management is essential for long-term survival, as highlighted in studies regarding institutional productivity by Lestari et al. (2026) in SEIKO. Ultimately, these findings contribute to modifying conventional *service recovery* approaches to be adaptive to the dynamics of the high-value virtual asset industry.

CONCLUSION

This research concludes that Digital Crisis Management and Incentive Compensation significantly influence the loyalty of crypto-asset exchange users following hacking incidents.

Incentive Compensation is proven to be the most dominant predictor in restoring user trust. These findings not only confirm the *Service Recovery Paradox* theory within the fintech industry but also introduce the publication of *Proof of Reserve* (PoR) as a crucial instrument of technical transparency for maintaining loyalty during a crisis. As a practical implication, crypto-asset exchanges are advised to integrate asset reserve transparency with relevant incentive schemes to strengthen platform resilience against the risk of user migration to global competitor exchanges.

However, this study acknowledges certain limitations, primarily its geographical focus on users domiciled in Bali Province and its cross-sectional timeframe immediately following the specific security breach. Therefore, it is recommended that future researchers expand the demographic scope to a broader national level and consider longitudinal studies. This expansion would be highly beneficial to evaluate the long-term sustainability of user loyalty and the extended effects of these post-crisis service recovery strategies.

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