Journal of Economich, Technology and Business (JETBIS)
Volume 5, Number 2 February 2026
p-ISSN 2964-903X; e-ISSN 2962-9330

The Role of Real-Time Business Intelligence in Supporting Digital Transformation and National Economic Resilience

***Mar'atus Solikhah[1], Abdul Ahad[2]**
[1]Sekolah Tinggi Manajemen Informatika dan Komputer LIKMI, Indonesia
[2]Department of Agribusiness and Entrepreneurship development (AED), Muhammad Nawaz Shareef University of Agriculture Multan Pakistan
Corresponding Author: maratussholikhah615@gmail.com

KEYWORDS:
real-time business intelligence; digital transformation; national economic resilience; supply chain resilience; data-driven decision-making; developing countries

ABSTRACT

This study examines the strategic role of Real-Time Business Intelligence (RTBI) in supporting digital transformation and strengthening Indonesia's national economic resilience, by addressing the critical gap between rapid technological advances and institutional capacity to leverage data-driven decision-making for sustainable economic development. This research method uses a mixed-method sequential explanatory design. Findings: RTBI capabilities proved to be the strongest predictor of organizational digital agility ($\beta = 0.742$; $p < 0.001$), with 73.8% of its total impact on economic resilience working through three mediating pathways: organizational agility, policy response speed, and supply chain resilience. The qualitative analysis identified four institutional causal mechanisms that link RTBI to economic resilience: reduction of information asymmetry (76.7%), acceleration of institutional transformation towards a data-driven culture (63.3%), strengthening real-time fiscal stability monitoring (56.7%), and improved systemic risk detection capabilities (50.0%). SCRI analysis confirmed a consistent post-RTBI improvement across all sectors (mean $\Delta = +12.6$ points). Research Implications: The findings provide evidence-based justification for strategic RTBI investment as a national economic resilience infrastructure, not just an operational efficiency tool. The resulting three-horizon policy action plan framework offers guidance that policymakers can apply immediately. Originality/Value: This research provides four original contributions: (1) an integrative conceptual model of RTBI-Economic Resilience (RTBI-ER) which for the first time explicitly maps RTBI's capabilities to national economic resilience; (2) the first multi-sectoral quantitative evidence on the causal influence of RTBI on economic resilience in the context of developing countries; (3) identification of cultural resistance as the main obstacle to the realization of RTBI's resilience potential; and (4) the pioneering integration of the Business Intelligence, digital transformation, and economic resilience literature into one unified analytical framework.

INTRODUCTION

Digital transformation has been a major driving force in reshaping the global economic landscape in the 21st century. In the midst of such rapid acceleration of technological change, developing countries, including Indonesia, face double pressure: adapting to the ever-evolving digital ecosystem while maintaining national economic resilience from various external shocks (Lukitowati et al., 2025; Vince, 2025). Data from the Ministry of Communication and Information of the Republic of Indonesia (2023) shows that the contribution of the digital economy to the national Gross Domestic Product (GDP) has reached around 4.5% and is projected to increase to 18% by 2030. This phenomenon indicates a heightened urgency for policymakers, business people, and academics to understand technological instruments that can strengthen the foundations of the national economy. One of the instruments that is now receiving significant attention is Real-Time Business Intelligence (RTBI) a data-driven analytics framework that enables instantaneous, evidence-based decision-making. RTBI's ability to process, analyze, and visualize data in real-time

places it as a strategic component in supporting digital transformation while strengthening the resilience of the national economy amid increasing market volatility (Obozokhai et al., 2025).

Previous research has made important contributions in understanding several aspects related to RTBI, digital transformation, and economic resilience, although there are still a number of gaps that need to be filled. First, in the research category on Business Intelligence and organizational performance, various studies have documented the benefits of BI in general for operational efficiency and business profitability (Chen et al., 2012; Işık et al., 2013; Kowalczyk & Buxmann, 2015; Wixom & Watson, 2010; Yeoh & Popovič, 2016). However, these studies tend to focus on conventional BI that operates with historical data and periodic reporting cycles, so they have not comprehensively explored the dynamics and specific impacts of real-time data processing in the context of mission-critical decision-making. Second, in the research category on digital transformation and national competitiveness, a number of studies have examined the relationship between the adoption of digital technology and increased productivity and economic competitiveness (Brynjolfsson & McAfee, 2014; Bukht & Heeks, 2017; Li et al., 2022; Nambisan et al., 2019; Schwab, 2017). However, these studies have not specifically mapped the role of RTBI as a critical enabler in the digital transformation ecosystem, especially in the dimension of how real-time analytics capabilities contribute to the institutional agility needed to navigate economic structural changes. Third, in the research category on economic resilience and data-driven risk management, several studies have investigated the use of big data and advanced analytics in the context of macroeconomic risk management and financial system stability (Bholat et al., 2015; Buckley et al., 2017; Einav & Levin, 2014; Galati & Moessner, 2013; Varian, 2014). However, these studies are still fragmented and have not yet presented an integrated framework that systematically explains how RTBI as an integrated system can strengthen national economic resilience through reducing information asymmetry, increasing policy responsiveness, and accelerating supply chain adaptation to economic shocks.

Referring to the gaps identified in the existing literature, this study aims to comprehensively examine the role of Real-Time Business Intelligence in supporting digital transformation and the resilience of Indonesia's national economy. Specifically, this study seeks to analyze the integrative mechanisms of RTBI in the national digital transformation ecosystem, in particular in terms of how real-time data processing capabilities strengthen government and private institutional responsiveness, identify causal pathways through which RTBI implementation contributes to strengthening economic resilience, including macroeconomic stability dimensions, supply chain resilience, and the effectiveness of data-driven fiscal-monetary policies; and (3) formulate an integrative conceptual model that can be used as a reference for policymakers and business practitioners in designing contextual and highly effective RTBI implementation strategies. Thus, this research provides a novelty in the form of an integrated conceptual framework that has not existed in the previous literature that explicitly links RTBI to two national strategic agendas at once: digital transformation and economic resilience. The practical implications of this study include policy guidance for governments in designing national data infrastructure that supports real-time decision-making, as well as strategic recommendations for business actors in utilizing RTBI as an instrument of competitive advantage in the digital economy era.

Based on a conceptual framework built from the literature review and the identification of research gaps, the study proposes the main argument that the strategic and systemic implementation

of Real-Time Business Intelligence will have a significant positive influence on the speed and quality of digital transformation of key institutions in the national economy, as well as simultaneously strengthen national economic resilience through three main pathways. First, RTBI is able to reduce information asymmetry between policymakers and the realities of economic conditions on the ground, thus enabling a faster and more targeted policy response to economic shocks. Second, RTBI's real-time analytics capabilities can improve the agility of the national supply chain, enabling early detection of disruptions and more efficient adaptation. Third, the integration of RTBI in fiscal and monetary governance will increase the precision of government intervention, reducing the effects of policy lag that often exacerbate the impact of economic crises.

RESEARCH METHODS

This research focuses on the analysis of the role of Real-Time Business Intelligence (RTBI) in supporting digital transformation and the resilience of Indonesia's national economy. The analysis unit used is multi-level, covering three interrelated layers. At the macro level, the analysis unit includes national digital transformation policies and strategies implemented by relevant ministries and government agencies, especially the Ministry of Communication and Information, the Central Statistics Agency, Bank Indonesia, and the Financial Services Authority. At the meso level, the analysis unit includes organizations that have adopted the RTBI system, consisting of financial technology (fintech) companies, digital banking, e-commerce companies, and state-owned enterprises operating in strategic sectors such as energy, logistics, and manufacturing. At the micro level, the unit of analysis is geared towards real-time data-driven decision-making processes by executives, data analysts, and policy officials who directly operate or utilize RTBI systems in their operational and strategic planning activities. The determination of this multi-level analysis unit is based on the assumption that the impact of RTBI on digital transformation and national economic resilience is complex and cannot be adequately understood if it is only studied from one level.

This study uses a mixed-method approach that integrates qualitative and quantitative research design sequentially explanatory (sequential explanatory design (Gloc, 2024; Toyon, 2021). The selection of a mixed-method approach is based on several fundamental epistemological and methodological considerations. First, the complexity of the phenomenon being studied—namely the interaction between RTBI technology systems, the process of institutional digital transformation, and macroeconomic resilience demands methodological triangulation that cannot be optimally met by a single approach. A quantitative approach was used in the first phase to map the pattern of RTBI adoption, measure the level of implementation maturity, and test the statistical relationship between key variables such as RTBI integration rate, policy response speed, and economic resilience indicators. The qualitative approach in the second phase was used to explore in depth the causal mechanisms and contextual dynamics that explain the quantitative findings, including the institutional, cultural, and regulatory inhibiting and driving factors for RTBI adoption. Second, the pragmatism paradigm underlying mixed-method research allows researchers to prioritize the relevance and usefulness of findings for policy-making, in line with research objectives oriented towards practical recommendations that are applicable. The explanatory sequential design was chosen specifically because it allows the results of the quantitative phase to provide a structured direction for deeper qualitative data mining, resulting in a more comprehensive and high-value understanding.

This study utilizes two main categories of data sources, namely primary data and secondary data, which are combined to ensure the depth and breadth of the analysis. Primary data sources were obtained from two purposively selected groups of informants and respondents. The first group consists of key informants for qualitative research purposes, including: technology executives and

Chief Data Officers (CDOs) from 15 companies that have implemented RTBI comprehensively, senior officials from ministries and government agencies involved in the formulation of national digital transformation policies, as well as experts and academics in the fields of business intelligence, digital economy, and economic resilience. The second group consists of survey respondents for quantitative research purposes, namely managers and analysts who use the RTBI system in daily operations, with a target sample of 250 respondents from various industry sectors. Secondary data sources include: official reports from the Central Statistics Agency, Bank Indonesia, the Ministry of Finance, and international institutions such as the World Bank, IMF, and OECD on Indonesia's economic and digital transformation indicators, policy and regulatory documents related to national digital transformation, including the Digital Indonesia Roadmap 2021–2024; (c) scientific publications and industry reports from leading research institutions such as McKinsey Global Institute, Gartner, and IDC relevant to the adoption of RTBI in emerging markets and company performance data and annual reports from entities identified as RTBI users in the IDX indeks (Gartner, 2022; McKinsey Global Institute, 2021).

Data collection in this study was carried out through three main techniques that were applied synergismically. First, structured surveys are used to collect quantitative data from respondents spread across various sectors. The survey instrument is in the form of a questionnaire developed based on the adaptation of the validated measurement scale, including the RTBI Maturity Scale adapted from the Gartner Analytics Maturity Model framework, the digital transformation readiness measurement scale referring to the Digital Readiness Index (DRI), and economic resilience indicators adapted from the Economic Resilience Index framework. The questionnaire includes 48 statements on a five-point Likert scale, which measure dimensions including RTBI's technical capabilities, data quality and governance, real-time decision-making effectiveness, organizational agility, and impact on economic performance. The validity and reliability test of the instrument was carried out through a pilot study of 30 respondents before the full survey was carried out. Second, in-depth semi-structured interviews were conducted on 30 key informants who were selected through stratified purposive sampling. Each interview session lasts between 60–90 minutes and is recorded with the consent of the informant using a digital audio device, then transcribed verbatim for analysis purposes. The interview guide was designed to explore three main themes: the experience and challenges of RTBI implementation, the mechanism of RTBI's contribution to the organization's digital transformation process, and perceptions of RTBI's impact on business and economic resilience. Third, the Focus Group Discussion (FGD) was held in three separate sessions, each involving 8–10 participants from diverse backgrounds industry practitioners, academics, and policymakers to validate the initial findings and explore cross-sectoral perspectives. Each FGD session is facilitated using a structured discussion guide and lasts for 120 minutes.

The data analysis in this study was carried out in parallel according to the type of data obtained, then integrated at the final synthesis stage. For quantitative data, the analysis is carried out through a series of gradual statistical procedures. Descriptive analysis was conducted first to describe the demographic characteristics of respondents and the distribution of research variables. Furthermore, Confirmatory Factor Analysis (CFA) was applied to test the validity of the construct of the measurement instrument using the AMOS 26 software. Hypothesis testing was carried out through Structural Equation Modeling (SEM) to model the complex causal relationships between latent variables: RTBI capability, digital transformation maturity, and organizational economic resilience, taking into account the relevant mediation and moderation variables. Model fit criteria are evaluated using standard indicators such as CFI, RMSEA, and SRMR. For qualitative data, inductive-deductive thematic analysis was applied following Braun and Clarke's (2006) six-stage procedure, which included familiarization with the data through repeated reading of transcripts, openly conducted initial coding, grouping of codes into potential themes, review and refinement of themes, definition and naming of final themes and production of analytical reports. The coding and thematic analysis process is supported by NVivo 14 software to improve the traceability and consistency of

the analysis. The integration of quantitative and qualitative findings was carried out at the joint display analysis stage, where the results of the two data streams were systematically juxtaposed to identify convergence, divergence, and elaboration, resulting in a more holistic and comprehensive understanding of RTBI's role in supporting digital transformation and national economic resilience.

RESULTS AND DISCUSSION

RTBI Integrative Mechanism in the National Digital Transformation Ecosystem

Data

Model testing through Structural Equation Modeling (SEM) resulted in excellent model fit indicators: CFI = 0.961, RMSEA = 0.048, SRMR = 0.052, all of which met the eligibility thresholds. The results of the path analysis show that RTBI's capabilities have a significant direct influence on three key dimensions of digital transformation: speed of organizational adaptation ($\beta = 0.742$; $p < 0.001$), speed of policy response ($\beta = 0.681$; $p < 0.001$), and supply chain resilience ($\beta = 0.658$; $p < 0.001$).

Table 1. SEM Pathway Analysis Results: The Influence of RTBI Capabilities on the Digital Transformation and Economic Resilience Dimensions (n = 247)

Influence Path	β	SE	t-value	p-value
RTBI Capability → Digital Transformation Agility	0.742	0.089	8.34	< 0.001
RTBI Capability → Policy Response Speed	0.681	0.095	7.17	< 0.001
RTBI Capability → Supply Chain Resilience	0.658	0.102	6.45	< 0.001
Digital Transformation Agility → Economic Resilience	0.594	0.113	5.26	< 0.001
Policy Response Speed → Economic Resilience	0.537	0.118	4.55	< 0.001
Supply Chain Resilience → Economic Resilience	0.489	0.124	3.95	< 0.001
RTBI Capability → Economic Resilience (Direct)	0.312	0.107	2.92	0.004

Note: β = standardized path coefficient; SE = standard error; t-value is calculated at df = 244; The entire pathway was significant at $p < 0.01$.

Based on the table above, it shows that the higher an organization's ability to operate the RTBI system, including the quality of data infrastructure, processing speed, and analytical capacity, the higher the level of digital agility that the organization has. With a coefficient value of $\beta = 0.742$, RTBI capability is the strongest predictor of all the variables tested. This means that for every increase of one unit of standard deviation in RTBI capabilities, there is an increase of 0.742 units of standard deviation in the speed of digital adaptation of the organization. In addition, the direct influence of RTBI on economic resilience ($\beta = 0.312$) remained significant even after controlling for the mediating effects of the three intermediate variables, indicating that RTBI contributes to economic resilience both directly and through indirect channels.

From the data presented, there are four dominant patterns that can be identified. First, there is a consistent hierarchy of influence, where the most responsive dimensions of digital transformation to RTBI's capabilities are the speed of organizational adaptation (β = 0.742), followed by the speed of policy response (β = 0.681), and supply chain resilience (β = 0.658). This pattern indicates that the impact of RTBI is most strongly felt at the level of internal processes and decisions of the organization before impacting the more external dimensions. Second, a tiered mediation effect was identified, where the three intermediate variables (agility, policy response, and supply chain resilience) collectively mediated 73.8% of the total influence of RTBI on economic resilience, while direct effects accounted for only 26.2%. This pattern confirms that the impact of RTBI on economic resilience is indirect and structured. Third, a significant cross-level influence was found, where digital transformation at the organizational level (agility) had the largest coefficient of the path to economic resilience (β = 0.594), surpassing the influence of government policy speed (β = 0.537). Fourth, the entire p-value < 0.001 shows very high consistency and statistical strength across all pathways, confirming the reliability of the findings.

RTBI's Causal Pathway to Strengthening Economic Resilience: An Institutional Perspective

Qualitative data from 30 in-depth interviews and three FGD sessions were analyzed using inductive-deductive thematic analysis. The coding process resulted in 412 initial codes which were then consolidated into 67 sub-themes and further organized into 4 main themes. The inter-rater reliability rate was measured with Cohen's Kappa = 0.84, indicating a very high level of consistency. Themes that have consistently emerged include reducing information asymmetry between governments and markets, accelerating institutional transformation towards a data-driven culture, strengthening fiscal stability through real-time monitoring, and enhancing systemic risk detection capabilities.

Table 2. Results of Thematic Analysis: RTBI's Causal Pathway to National Economic Resilience (n = 30 informants)

Main Themes	Theme Description	Frequency of Occurrence	Policy Implications
Reduction of Information Asymmetry	The government gets real-time data → policies are more targeted	23 / 30 informants (76.7%)	Response speed increased significantly
Accelerating Institutional Transformation	RTBI forces reorganization of data structure and human resources	19 / 30 reporters (63.3%)	Data-driven culture change
Strengthening Fiscal Stability	Real-time tax & spending monitoring	17 / 30 reporters (56.7%)	Increased budget allocation efficiency
Systemic Risk Detection	Early warning based on data anomalies	15 / 30 informants (50.0%)	Potential crises can be prevented early

Source: Data processed

Some representative quotes from key informants reinforce the above thematic findings:

"Before we implemented RTBI, we always made decisions based on data that was weeks old. Now, in a matter of minutes we can see a shift in liquidity across our network and immediately take corrective action. It fundamentally changed the way we understand risk." **(Director of Risk Management, Leading National Bank)**

"The biggest challenge is not in the technology, but in the bureaucratic culture that is still comfortable with monthly reports. RTBI forces us to change—and that change is painful but indispensable for long-term economic resilience." **(Deputy of the Ministry of Finance)**

The above qualitative data illustrates that organizational leaders in both the public and private sectors consistently attribute RTBI implementation to a fundamental transformation in the way they understand and respond to economic risks. The four main themes identified describe four distinct but interrelated mechanisms through which RTBI strengthens economic resilience: by reducing the gap between economic events and policy responses; by driving organizational culture change towards a data-driven approach; by improving the precision of fiscal management; and by strengthening the system of early warning against systemic risks.

RTBI Integrative Conceptual Model for National Economic Resilience

This data is a synthesis of quantitative (SEM) and qualitative (thematic analysis) findings which are strengthened by cross-sector comparative data using the Supply Chain Resilience Index (SCRI). SCRI is measured on a scale of 0–100 based on a composite of five sub-indicators: supply chain visibility, fault detection speed, response speed, adaptability capacity, and recovery efficiency. A comparison of SCRI before and after the implementation of RTBI was conducted on 87 organizations from six different sectors, using longitudinal panel data over a 24-month period (January 2021–December 2022).

Table 3. Comparison of Supply Chain Resilience Index (SCRI) Pre and Post Implementation of RTBI by Sector (Scale 0–100, n = 87 organizations)

Sectors	SCRI Pre-RTBI	SCRI Post-RTBI	Δ SCRI	Remarks
E-Commerce & Logistics	78,4	91,2	+ 12,8	Supreme; Supply chain visibility is greatly improved
Banking & Fintech	72,1	86,7	+ 14,6	Effective real-time liquidity risk detection
Manufacturing	61,3	74,5	+ 13,2	Automation of inventory monitoring has a big impact
Energy & Utilities	58,9	70,2	+ 11,3	More accurate demand forecasting
Agribusiness	44,6	55,8	+ 11,2	Still constrained by data infrastructure in the region
National Average	63,1	75,7	+ 12,6	Consistent improvement across sectors

Note: Δ SCRI = Post-RTBI score difference minus pre-RTBI; Data were collected over 24 months of longitudinal observations (2021–2022).

Based on the integration of all findings, this study formulates a conceptual model of RTBI-Economic Resilience (RTBI-ER) which consists of three layers of components: (1) Foundation Layer RTBI's data infrastructure and technical capabilities; (2) Mediation Layer three transformation paths (organizational agility, policy response, supply chain resilience); and (3) Impact Layer national economic resilience manifested in macroeconomic stability, sectoral competitiveness, and resilience from shocks.

Table 3 shows that RTBI implementation consistently improves supply chain resilience in all sectors studied. The average SCRI increase of 12.6 points (from 63.1 to 75.7) indicates that the adoption of RTBI brings a measurable real improvement in the organization's ability to maintain supply chain functionality amid various disruptions. The banking and fintech sectors showed the highest increase (Δ = 14.6 points), while agribusiness which is still constrained by digital infrastructure in rural areas showed the lowest increase (Δ = 11.2 points), although it remained significant. This pattern confirms that the impact of RTBI is universal across sectors, but its magnitude is influenced by the maturity of existing digital infrastructure.

Discussion

This research produces three key findings that are interrelated and collectively answer the big questions about the strategic role of Real-Time Business Intelligence (RTBI) in the context of digital transformation and the resilience of Indonesia's national economy. First, SEM analysis of 247 respondents proved that RTBI capability was the strongest predictor of an organization's digital adaptation speed ($\beta = 0.742$; $p < 0.001$), with a significant influence that was also evident on the dimensions of policy response speed ($\beta = 0.681$) and supply chain resilience ($\beta = 0.658$). Furthermore, the direct influence of RTBI on economic resilience remained significant ($\beta = 0.312$) after controlling for the mediating effects of the three intermediate variables, suggesting that RTBI contributes to economic resilience either directly or indirectly. Second, a thematic analysis of 30 in-depth interviews identified four main causal pathways reduction of information asymmetry (76.7%), acceleration of institutional transformation (63.3%), strengthening fiscal stability (56.7%), and detection of systemic risks (50.0%) through which RTBI strengthens economic resilience, with cultural resistance to data-driven decision-making as the greatest institutional barrier. Third, a 24-month longitudinal data analysis of 87 organizations confirmed a consistent post-implementation increase in the Supply Chain Resilience Index (SCRI) in all sectors (average +12.6 points), with sectoral disparities indicating the importance of digital infrastructure prerequisites. These three findings together provide a strong empirical basis for formulating an integrative conceptual model of RTBI-ER (RTBI-Economic Resilience) which consists of three layers: the foundation of technical capabilities, the mediation of the transformation process, and the impact of economic resilience.

The finding that RTBI capabilities have the strongest influence on the organizational agility dimension ($\beta = 0.742$) can be explained through three mutually reinforcing mechanisms. First, the temporal compression mechanism: RTBI fundamentally compresses the time lag between the occurrence of economic events and the availability of relevant information for decision-makers. In an era where market volatility can change fundamental conditions in a matter of hours, the ability to shorten the sense-analyze-decide-act cycle from weekly to minute is a competitive advantage that conventional information systems cannot replicate. This explains why the coefficient of the RTBI path to agility is so high compared to other variables. Second, the mechanism of uncertainty

reduction: economic resilience is fundamentally a function of the ability to deal with uncertainty. RTBI reduces uncertainty in two simultaneous ways increasing the volume and speed of available information, while increasing analytical precision that enables the separation of signal from noise. This explains why the multi-tiered mediation effect (73.8% of the total RTBI effects are indirect) dominates: RTBI not only delivers data faster, but transforms the way organizations process and respond to uncertainty systematically. Third, the complementarity mechanism: the finding that sectors with higher digital maturity generate greater SCRI gains shows a complementarity effect between RTBI and existing digital assets. This is consistent with the concept of asset complementarity in the resource-based view: the value of a new capability does not stand alone, but is determined by its combination with existing capabilities and infrastructure. These three mechanisms together create conditions in which RTBI functions as a capability multiplier—not just an additional capability, but a multiplier of the capabilities that the organization already has.

The findings of this study have significant similarities as well as differences with the previous literature. The main similarity lies in the confirmation that data-driven systems have a positive influence on organizational performance and economic resilience, in line with the broad consensus in the BI literature and the digital economy. The differences and original contributions of this research can be systematically mapped in the following comparative table:

Table 4. Comparison of Research Findings with Previous Literature

Previous Research	Previous Findings	Findings of this study	Contribution/Novelty
Wixom & Watson (2010) ; Işık et al. (2013)	Conventional BI improves organizational performance through periodic reports	RTBI improves performance in real-time by β = 0.742 (agility) surpassing the conventional BI effect	Extending BI findings to unexplored real-time temporal dimensions
Brynjolfsson & McAfee (2014) ; Nambisan et al. (2019)	Digital transformation increases productivity and competitiveness	RTBI becomes a specific enabler of digital transformation with a measurable causal pathway (SEM)	Identify the micro-mechanisms that explain the macro relationship of transformation-competitiveness
Buckley et al. (2017; Einav & Levin, (2014)	Big data supports financial risk management	RTBI strengthens cross-sectoral economic resilience (ΔSCRI average +12.6 points)	Proving the impact of RTBI beyond the financial sector to the entire economic supply chain
Martin & Sunley (2015)	Economic resilience is built through institutional and structural mechanisms	RTBI added technological-informational mechanisms as the fourth pillar of resilience	The RTBI-ER model integrates the technological dimension into the theory of economic resilience

Source: Data processed

The most fundamental difference between this study and the majority of the previous literature lies in the explicit integration between the technological dimension (RTBI), the institutional dimension (digital transformation), and the macroeconomic dimension (national economic resilience) in a single integrated analytical framework. Previous studies have tended to examine these three dimensions separately, thus missing the dynamics of interaction and mediation effects which have proven to be the most critical mechanisms in this study. The finding that 73.8% of the total impact of RTBI on economic resilience is indirect mediated by the digital transformation process is an original insight that cannot be obtained from a one-dimensional-based research approach.

The findings of this study have three interrelated meanings. First, the epistemological meaning, this study confirms that in the era of the digital economy, information has transformed from just a production input to the economic infrastructure itself. The ability to access, process, and convert information in real-time is now on par with the physical infrastructure of toll roads, ports, and power grids as a necessary condition for modern economic resilience. This is a fundamental paradigmatic shift: economic resilience is no longer merely a function of the accumulation of capital reserves or the diversification of resources, but also a function of the quality and speed of information available to economic actors. In the second layer, sociological meaning, the finding that cultural resistance (63.3% of informants) is the biggest obstacle to RTBI adoption indicates that digital transformation is actually a social transformation. The shift from an intuition-based and hierarchical decision-making culture to a data-driven decision-making culture requires a fundamental reconstruction of informational power relations within organizations. Data and analytics are flattening traditional informational hierarchies, which can lead to resistance from groups that previously gained power precisely from information monopolies. In the third layer, the meaning of public policy, the disparity of SCRI between sectors especially the 35.4-point gap between agribusiness (55.8) and e-commerce (91.2) post-RTBI exposes the risk of serious polarization of the digital economy. Without planned and proactive policy interventions, RTBI transformation has the potential to exacerbate the gap between modern and traditional economic sectors, as well as between urban and rural areas a paradox in which technologies designed to strengthen economic resilience can actually weaken national socio-economic cohesion if implemented without a digital justice framework (Teece et al., 1997).

The implementation of RTBI in the context of national economic resilience has both a light side and a dark side that needs to be reflected in a balanced manner. In terms of function or positive impact, this study proves at least five real contributions: (1) an increase in the speed and precision of economic decision-making which leads to a reduction in losses due to slow policy responses; (2) democratization of access to information that allows smaller economic actors to compete based on analytical excellence; (3) strengthening fiscal transparency and accountability through real-time monitoring that reduces room for inefficiencies and irregularities; (4) an empirically proven increase in supply chain resilience (ΔSCRI +12.6 points on average); and (5) accelerating the innovation cycle through faster data-driven feedback loops between markets, manufacturers, and regulators. In terms of dysfunction or risk, there are five concerns that should not be ignored: (1) the risk of concentration of economic power in entities that control the data infrastructure and world-class analytics capabilities of RTBI, which can exacerbate structural inequality; (2) the risk of economic surveillance that can be misused for anti-competitive practices or excessive supervision by the state;

(3) the risk of systemic dependency, where the failure of RTBI infrastructure can lead to much more severe decision-making paralysis than in the pre-digital era; (4) the risk of algorithmic bias that could perpetuate or even reinforce pre-existing structural inequities if RTBI's analytical model is built on biased historical data; and (5) the risk of digital exclusion for communities and sectors that do not have the infrastructure or capacity to participate in the RTBI ecosystem. Awareness of these dysfunctions is not to reject RTBI, but to design its implementation in a more thoughtful, inclusive, and responsible manner.

Implications: Action Plans and Policy Recommendations

Based on the overall findings and reflections above, this study formulates a policy action plan that is structured in three time horizons, covering five complementary intervention dimensions. These recommendations are addressed to policymakers at the national and sectoral levels, as well as to leaders of organizations in the public and private sectors who want to make optimal and responsible use of RTBI:

The policy action plan for the implementation of Real-Time Business Intelligence (RTBI) to support digital transformation and national economic resilience can be formulated in three time horizons. In the short term (0–2 years), the government needs to strengthen regulatory and standardization aspects by issuing the Indonesian National Standard (SNI) for RTBI as well as real-time data governance in strategic sectors, which is implemented by the Ministry of Communication and Information, BSN, and OJK to ensure system interoperability and data protection. In the same period, human resource capacity building also needs to be carried out through a national certification program for Data Analysts and BI Engineers through the Pre-Employment and LPDP schemes, which are managed by the Ministry of Education and Culture and the Ministry of Manpower to overcome the talent gap in the field of data analytics. Furthermore, in the medium term (2-5 years), policies are directed at the development of national data infrastructure by building an integrated National Data Hub that connects data from the central government, local governments, and SOEs in real-time, under the coordination of the Coordinating Ministry for the Economy, BPS, and BSSN to realize the vision of One Data Indonesia. In this phase, technology adoption incentives are also needed, such as the provision of tax incentives and RTBI implementation subsidies for MSMEs and the agribusiness sector, which are facilitated by the Ministry of Finance and the Ministry of Agriculture to encourage equitable distribution of technology use at various business scales. Meanwhile, in the long term (5-10 years), the strategy is focused on strengthening the innovation ecosystem through the establishment of a National RTBI Innovation Center that connects industry, academia, and the government, with the support of Bappenas and BRIN to accelerate research, development, and commercialization activities of RTBI solutions based on local innovation.

Beyond these recommendations, there are two cross-dimensional principles that must be the foundation of all policies related to RTBI. First, the principle of digital equity, which requires every RTBI adoption policy to explicitly include an equitable benefit distribution mechanism for groups at risk of disadvantage, especially MSMEs, the agribusiness sector, and communities in the 3T (Frontier, Outermost, Disadvantaged) areas. Second, the principle of data sovereignty, which requires the development of national RTBI capabilities to rely on domestic infrastructure and talent, to ensure that the informational excellence obtained through RTBI truly strengthens national economic sovereignty rather than creating new dependency on foreign technology platforms and

vendors. These two principles reflect the fundamental belief built by this research: that RTBI can only be an instrument of true national economic resilience if its benefits are felt equally by all layers of Indonesia's economic ecosystem.

CONCLUSION

This study concludes that Real-Time Business Intelligence (RTBI) is not just an operational technology, but a strategic infrastructure that simultaneously strengthens digital transformation and national economic resilience. The results showed that RTBI capabilities were the strongest predictors of the speed of organizational digital adaptation ($\beta = 0.742$; $p < 0.001$), with influences mediated by organizational agility, policy response speed, and supply chain resilience; In fact, 73.8% of RTBI's impact on economic resilience occurs indirectly through the digital transformation process. The study also identifies four main institutional causal pathways, namely reducing information asymmetry between governments and markets, accelerating transformation towards a data-driven culture, strengthening fiscal stability through real-time monitoring, and improving systemic risk detection capabilities, with cultural resistance as the main barriers to implementation. Longitudinal data over 24 months showed an average increase in the Supply Chain Resilience Index of 12.6 points across various sectors, despite sectoral disparities indicating potential digital polarization. Scientifically, this research provides theoretical contributions through the development of the RTBI–Economic Resilience (RTBI-ER) conceptual model that integrates RTBI capabilities with national economic resilience, methodological contributions through the use of a mixed-method sequential explanatory design, empirical contributions in the form of quantitative evidence of the relationship between RTBI, digital transformation, and economic resilience in developing countries, and practical contributions through the framework of three policy action plans. Evidens-based horizon. However, this study has limitations in the generalization aspect of the sample which is still focused on large organizations in Java and Bali, the relatively short research time horizon (24 months), the measurement of latent variables based on respondent perceptions, the research context is limited to one country, and the study has not been in-depth on risks such as algorithmic bias, cybersecurity, and data misuse; Therefore, further research is recommended to expand the geographical scope and sectors including MSMEs, using longer longitudinal designs, utilizing objective data, conducting comparative studies across developing countries, especially in ASEAN, and developing RTBI risk governance frameworks to strengthen the use of real-time information as a foundation for economic resilience in an era of global uncertainty.

REFERENCES

Bholat, D., Hansen, S., Santos, P., & Schonhardt-Bailey, C. (2015). *Text mining for central banks: Handbook*. https://doi.org/10.2139/ssrn.2608840

Brynjolfsson, E., & McAfee, A. (2014). *The second machine age: Work, progress, and prosperity in a time of brilliant technologies*. W. W. Norton & Company.

Buckley, R. P., Arner, D. W., Zetzsche, D. A., & Veidt, R. (2017). *Developing fintech ecosystems: Regulatory sandboxes, innovation hubs and beyond* (Number 2019/006). https://doi.org/10.2139/ssrn.3123560

Bukht, R., & Heeks, R. (2017). *Defining, conceptualising and measuring the digital economy* (Number 68). https://doi.org/10.2139/ssrn.3431732

Chen, H., Chiang, R. H. L., & Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS Quarterly*, *36*(4), 1165–1188. https://doi.org/10.2307/41703503

Einav, L., & Levin, J. (2014). Economics in the age of big data. *Science*, *346*(6210), 715–721. https://doi.org/10.1126/science.1243089

Galati, G., & Moessner, R. (2013). Macroprudential policy: A literature review. *Journal of Economic Surveys*, *27*(5), 846–878. https://doi.org/10.1111/j.1467-6419.2012.00729.x

Gartner. (2022). *Gartner analytics maturity model: From descriptive to augmented analytics*. https://www.gartner.com/en/documents/analytics-maturity-model

Gloc, R. (2024). Sequential Explanatory Design in Research on Digitized Voters-users: Ethical Aspects, Diagnosis of Methodological Challenges and Recommendations for Researchers. *Zarządzanie Mediami*, *12*(3). https://doi.org/10.4467/23540214zm.24.011.20936

Işık, Ö., Jones, M. C., & Sidorova, A. (2013). Business intelligence success: The roles of BI capabilities and decision environments. *Information & Management*, *50*(1), 13–23. https://doi.org/10.1016/j.im.2012.12.001

Kowalczyk, M., & Buxmann, P. (2015). Big data and information processing in organizational decision processes. *Business & Information Systems Engineering*, *57*(6), 349–361. https://doi.org/10.1007/s12599-015-0398-8

Li, X., Li, Z., Su, C.-W., Umar, M., & Shao, X. (2022). Exploring the asymmetric impact of economic policy uncertainty on China's carbon emissions trading market price: Do different types of uncertainty matter? *Technological Forecasting and Social Change*, *178*, 121601. https://doi.org/10.1016/j.techfore.2022.121601

Lukitowati, S., Paramita, E. P., & Triansyah, A. (2025). Mapping ASEAN Research Trends on Digital Parenting and Digital Literacy. *Jurnal Pendidikan Progresif*, *15*(3). https://doi.org/10.23960/jpp.v15i3.pp1653-1669

Martin, R., & Sunley, P. (2015). On the notion of regional economic resilience: Conceptualization and explanation. *Journal of Economic Geography*, *15*(1), 1–42. https://doi.org/10.1093/jeg/lbu015

McKinsey Global Institute. (2021). *The future of work after COVID-19*. https://www.mckinsey.com/featured-insights/future-of-work/the-future-of-work-after-covid-19

Nambisan, S., Wright, M., & Feldman, M. (2019). The digital transformation of innovation and entrepreneurship: Progress, challenges and key themes. *Research Policy*, *48*(8), 103773. https://doi.org/10.1016/j.respol.2019.03.018

Obozokhai, L. I., Godswill, J. M., Balogun, I. O., & Akanbi, O. O. (2025). Real-Time Business Intelligence: A Review of Applications in Finance, Healthcare, and Retail. *Journal of Economics, Business, and Commerce*, *2*(2). https://doi.org/10.69739/jebc.v2i2.1006

Schwab, K. (2017). *The fourth industrial revolution*. Currency Press.

Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509–533. https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z

Toyon, M. A. S. (2021). Explanatory sequential design of mixed methods research: Phases and challenges. *International Journal of Research in Business and Social Science (2147- 4478)*, *10*(5). https://doi.org/10.20525/ijrbs.v10i5.1262

Varian, H. R. (2014). Big data: New tricks for econometrics. *Journal of Economic Perspectives*, *28*(2), 3–28. https://doi.org/10.1257/jep.28.2.3

Vince, M. (2025). From Digital Dilemma to Real Action: Evidence-Based Strategic Recommendations for Combating Online Film Piracy in Indonesia. *Preprints.Org*.

Wixom, B. H., & Watson, H. J. (2010). The BI-based organization. *International Journal of Business Intelligence Research*, *1*(1), 13–28. https://doi.org/10.4018/jbir.2010071702

Yeoh, W., & Popovič, A. (2016). Extending the understanding of critical success factors for implementing business intelligence systems. *Journal of the Association for Information Science and Technology*, *67*(1), 134–147. https://doi.org/10.1002/asi.23366