The Effect of Digital Leadership, Technological Capability, and Collaborative Innovation Capability on Institution Core Performance Mediated by Open Innovation in Indonesian Higher Education Institutions

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***Abstract*—The higher education sector in Indonesia faces significant challenges, including a quality gap in university outcomes, increased competition, and rapid technological advancement. These conditions require Higher Education Institutions (HEIs) to enhance their core performance through strategic capabilities. The research aims to analyze the influence of Digital Leadership (DL), Technological Capability (TC), and Collaborative Innovation Capability (CIC) on Institution Core Performance (ICP), mediated by Open Innovation (OI). The novelty lies in its focus on performance quality within Indonesian HEIs and the comprehensive mechanism through which capabilities drive OI, which subsequently enhances institutional performance. Methodologically, the research adopts a quantitative approach using an explanatory survey design. The sample consists of 42 leaders from private HEIs in LLDIKTI Region III holding "Excellent (A)" and "Very Good (B)" accreditation, selected through simple random sampling. Data are analyzed using Structural Equation Modeling-Partial Least Squares (SEM-PLS) with SmartPLS software.The results reveal several key findings. TC emerges as the most dominant factor, significantly driving OI and serving as a strong predictor of ICP. DL, while positively associated with OI and TC, shows no significant direct or indirect effect on ICP, as its effectiveness depends on alignment with a broader innovation strategy. CIC plays an essential indirect role by strengthening TC, which in turn enhances ICP through improved OI implementation. Overall, optimal institutional performance depends primarily on a strong TC foundation, supported by an integrated OI approach, with DL and CIC acting as key enablers.**

***Index Terms*—Institutional performance, Open Innovation, Technological Capability, Digital Leadership, Collaborative Innovation Capabilities**

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I. Introduction

INDONESIAN higher education is currently facing unprecedented challenges in the era of digital transformation. This period is marked by intensifying global competition, evolving stakeholder expectations, and rapid technological disruption. The sector is experiencing a widening performance gap among institutions, which is further intensified by the increasing presence of international universities in the Indonesian market and the growing number of Indonesian students seeking education abroad [1]. This competitive landscape necessitates innovative approaches to institutional management and performance enhancement that extends beyond traditional operational paradigms.

The significance of digital transformation has fundamentally changed how educational institutions operate, innovate, and deliver value to their stakeholders. While digital technologies present significant opportunities for performance enhancement, their successful implementation requires advanced leadership capabilities and a comprehensive technological infrastructure. Concurrently, Open Innovation (OI), which refers to the

practice of utilizing external knowledge and building collaborative partnerships beyond organizational boundaries, has surfaced as a very important strategy for institutional advancement [2, 3].

Despite the widespread recognition of the importance of digital transformation in higher education, a significant study gap exists concerning how Digital Leadership (DL), Collaborative Innovation Capability (CIC), and Technological Capability (TC) influence institutional performance through OI mechanisms in developing countries, particularly in Indonesia. Regardless of the fact that previous studies have examined these concepts individually or within different cultural contexts, limited explorations have investigated their integrated relationships within Indonesian Higher Education Institutions (HEIs). Indonesian private HEIs face considerable challenges in enhancing their performance within an increasingly competitive and digitalized environment. The absence of empirical insights into how DL and TC can be applied through OI to improve institutional performance constitutes a significant knowledge gap, one that complicates strategic decision-making and hinders initiatives aimed at performance improvement. Based on the presented insights, the research aims to address the existing gap by investigating the interconnected relationships among DL, CIC, TC, OI, and Institutional Core Performance (ICP) within Indonesian higher education.

The Resource-Based View (RBV) is a strategic management theory focused on analyzing a firm's tangible and intangible resources to create and sustain competitive advantage [4, 5]. RBV emphasizes the importance of firm-specific resources and capabilities in formulating strategies and achieving sustainable competitive advantage [6], emphasizing that a company's resources, such as knowledge, skills, technology, and reputation, are unique and difficult to imitate, thereby providing a competitive edge [7]. Scholars have also applied RBV in the field of human resource management, arguing that high-commitment human resource strategies can yield competitive advantages for firms [8]. Essentially, RBV provides a framework for understanding how a firm's resources contribute to its competitive position and long-term success. Initially introduced as an approach to achieving sustainable competitive advantage [9], the view holds that organizations should look inward to identify sources of competitive advantage rather than focusing solely on the external competitive environment.

The concept of dynamic capabilities refers to a firm's ability to integrate, build, and rearrange its resources and capabilities to gain new and lasting competitive advantages [10]. Dynamic capabilities are essential for companies operating in rapidly changing environments. The theory of dynamic capabilities serves as a key framework in the value creation process for companies, complementing the RBV and standing as an important theoretical and managerial framework in modern information system studies [11]. This theory centers on a firm's ability to adapt and respond to shifts in environmental conditions, thereby driving competitive performance [12], and underscores the importance of IT flexibility and the dynamic capabilities of firms in addressing such changes [13]. The theory states that strategic alignment, defined as the degree of balance between a firm's IT flexibility architecture and its dynamic capabilities, significantly influences a firm's competitive advantage in an ever-changing environment [14]. Moreover, the theory draws attention to the role of competitive advantage and innovation capabilities as mediators between dynamic capabilities and firm performance [15]. In essence, the theory of dynamic capabilities offers insights into how firms can effectively manage change and strengthen their competitive positioning.

The main theories of innovation include Schumpeter's innovation theory, which comprises the development of new products, new methods of production, exploration of new markets, discovery of new materials or semi-finished goods, and the creation of new industrial organizations [16]. Numerous innovation theories exist, each offers a unique perspective on how innovation occurs, aiding in the understanding of various contributing factors as well as the different ways innovation managed and supported. The Diffusion of Innovation Theory is among the most well-known of these frameworks. Developed by Everett Rogers in the 1960s, it explains the process through which new ideas, practices, or products spread within a population [17, 18].

DL refers to the ability of leaders to navigate and drive digital transformation within organizations [19, 20]. It involves integrating advanced technologies, such as artificial intelligence and machine learning, into business processes to enhance data utility and meet customer demands for innovative products and services [21]. Digital leaders possess not only technical skills but also a digital mindset, enabling the demographic to identify and evaluate opportunities and challenges presented by digitalization [22]. These leaders play an essential role in transforming organizational structures, processes, business models, and strategies to adapt to the digital era [20]. DL is essential for organizations to survive and thrive in the digital age, as it enables the organizations to effectively leverage digital assets and drive digital business transformation [19]. The concept, however, remains fragmented, and further

investigation is needed to develop a comprehensive framework for DL [21, 23].

TC refers to an organization's capacity to effectively utilize technology in achieving its strategic objectives. It comprises elements, such as knowledge, skills, resources, processes, and infrastructure related to technology within an organization [24]. In the context of digital technology, digital capabilities are critical for achieving digital innovation, as the success of digital product development depends heavily on how well a firm can manage digital technologies [24]. TC is multidimensional, spanning technological knowledge, skills, resources, processes, as well as infrastructure, and is essential for organizations aiming to innovate and adapt to technological advancements to remain competitive [24]. Within the framework of OI, technological innovation capability represents a comprehensive and synergistic capacity built on technological innovation [25]. This concept comprises various dimensions, including knowledge, skills, resources, processes, and infrastructure related to technology within an organization [26]. The ability to develop dynamic capabilities for digital transformation is particularly essential for firms in traditional industries aiming to adapt and thrive in the digital era [26]. TC is closely related to organizational performance, innovation, and strategic outcomes, serving as a key resource for firms to drive product innovation, enhance financial performance, and achieve competitive advantage. Therefore, effective technology management is critical for strengthening TC and improving product development [27].

CIC refers to the ability of partners in a technology alliance to collaborate effectively, share and utilize knowledge, and create new technologies or products through joint efforts [28]. This concept also describes an organization's ability to effectively engage in and leverage inter-organizational activities to drive innovation through various initiatives, such as the exchange of ideas, knowledge, and resources. This capability is evident in organizations exhibiting integration of technological and behavioural interdependence, where technological interdependence involves sharing technologies and developing knowledge and resources, while behavioural interdependence focuses on communication and social interaction conducted collaboratively among organizations [29]. CIC comprises various dimensions, including alliance-specific capabilities such as alliance management, mutual learning, and innovation, as well as knowledge-based capabilities such as the exploration, exchange, integration, and exploitation of knowledge [30]. Business Analytics (BA) capabilities, divided into tangible, personal, and intangible dimensions, also play a significant role in enhancing collaborative innovation capabilities, which subsequently drive collaborative innovation performance [28]. The success of collaborative innovation is further shaped by absorptive capacity, which mediates the relationship between collaborative innovation and financial performance, and is further strengthened by intellectual capital comprising human, organizational, and social capital [31]. CIC is crucial for addressing complex social challenges, such as sustainable mobility, by building trust and respect among diverse stakeholders and creating new collaborative practices [32]. It also comprises the strategic use of research and development collaborations to enhance innovation productivity and the commercialization of new products, particularly in competitive and rapidly changing environments [33].

OI is a strategy centered on the creation of knowledge through collaboration and cooperation with external parties, such as research groups, partners, and stakeholders, to achieve organizational goals and objectives. OI facilitates the exchange of processes and knowledge between firms and other sectors [34], extending beyond traditional internal control of research and development processes to encourage the exchange of ideas, technologies, and expertise with external entities. This strategy is implemented across various sectors, including HEIs, private firms, and knowledge-intensive business services, and is shaped by factors, such as organizational culture, inter-firm relationships, and knowledge exchange. Successful implementation requires the integration of external stakeholders and the development of innovative strategies to strengthen both individual and collective initiatives. OI can help firms to reduce costs and advance innovation, ultimately leading to improved corporate performance [35].

The core performance of HEIs (ICP) is a multidimensional concept encompassing educational services, institutional processes, and outcomes. It entails meeting the needs of consumers for knowledge, expertise, and educational materials while ensuring the efficiency of the educational system's functions [36]. Quality in higher education has long been a concern, driven by mass expansion, diversification, and rising costs, necessitating new mechanisms for accountability and continuous performance improvement. Quality management in higher education is crucial for developing and training human resources and plays a significant role in societal development [37]. Effective quality management requires a holistic approach integrating all institutional processes while promoting academic integrity, professional ethics, and critical thinking [38]. Performance indicators are increasingly used to measure various aspects of higher education, such as

graduate quality, equity in access, societal relevance, and financial sustainability. As a result, institutions must balance accountability with the need for innovation [39]. Leadership plays a crucial role in managing and motivating human resources to create a robust ecosystem for teaching, learning, and evaluation while ensuring quality is maintained and leveraged to enhance graduate outcomes [40]. Quality assessment models and decision-support systems can further assist institutions in developing optimal management strategies and improving academic programs [41]. The operational definition of quality in higher education also entails adapting to global changes to ensure institutional competitiveness and relevance [42]. Essentially, quality management in HEIs focuses on meeting consumer needs, advancing continuous improvement, and extending this focus to all operational stages to ensure long-term success and growth [43].

The question in this research is whether DL, TC, and CIC can positively impact OI, thereby improving the core performance of HEIs (ICP). An organization's ability to sense, leverage, and transform in response to changes in its internal and external environment is referred to as OI. HEIs in developing OI capabilities are better equipped to adapt to environmental changes, create innovative learning experiences, and produce high-quality, relevant studies, enhancing institutional performance in terms of scientific publications, stronger positioning to respond to digital disruptions, and the provision of high-quality education. The hypotheses proposes are as follows:

- H1: DL positively influences OI,
- H2: TC positively influences OI,
- H3: CIC positively influences OI,
- H4: OI positively influences ICP,
- H5: DL positively influences ICP,
- H6: TC positively influences ICP,
- H7: CIC positively influences ICP,
- H8: OI mediates the effect of DL on ICP,
- H9: OI mediates the effect of TC on ICP,
- H10: OI mediates the effect of CIC on ICP.

II. Research Method

A quantitative approach focuses on acquiring numerical data and using deductive reasoning to examine theoretical relationships. The objective of the research is to verify, refute, or build confidence in existing theories through the measurement and the examination of relationships between variables. A survey method is utilized to measure objective facts, focusing on the key variables. The data types and sources for this exploration comprise both primary and secondary sources. Secondary data are collected from the Ministry of Research, Technology, and Higher Education, the Higher Education Service Institution, the National Accreditation Board for Higher Education, and individual university records. Meanwhile, primary data are derived from the fieldwork conducted.

The target population consists of 65 private universities (universities and institutes) with Excellent (A) and Very Good (B) accreditation status under LLDIKTI Region III. They are selected because they hold the highest number of private universities with mid-to-high accreditation status (16.51%), consistent with the study context focused on quality performance. Focusing exclusively on these accreditation categories ensures that the measured capabilities and performance are reflective of institutions actively pursuing quality improvement, though results primarily generalize to private HEIs with mid-to-high accreditation in urban Java.

The model consists of 5 variables, 12 dimensions, and 46 indicators. The DL is measured by 2 dimensions and 9 indicators. Then, the CIC has 2 dimensions and 8 indicators. The TC is measured by 3 dimensions and 11 indicators. The OI has 2 dimensions and 10 indicators. Meanwhile, ICP has 3 dimensions and 8 indicators.

Simple random sampling is adopted, and the minimum sample size is determined using power analysis guidelines appropriate for Structural Equation Modeling–Partial Least Squares (SEM-PLS) (N= 42 obtained). Meanwhile, data collection involves observation using secondary data, including books, literature, scientific articles, and media information from the Ministry of Education and Research and Technology, as well as higher education associations. Primary data are obtained through an online questionnaire distributed to institutional leaders and vice-leaders as key respondents.

SEM is a study model analysis tool to test hypotheses and examine relationships between study variables by evaluating the theoretical model proposed by the investigator [44]. The research adopts descriptive statistical analysis and variance-based multivariate SEM analysis. The analytical process consists of specifying the measurement and structural models, collecting and examining data, estimating the model, and evaluating results, all conducted using SmartPLS software [45]. The measurement model is used to assess the appropriateness of the relationship between variable indicators and their constructs. To understand how variables within the theoretically constructed model interact, a structural model test is performed [44]. The outer model is used to test the validity of variable measurements and the reliability of measurement instruments, while the inner model is applied for hypothesis testing [44].

Outer model testing is an initial measurement pro-

cess to ensure that the tested indicators and variables are valid and reliable. It encompasses both validity and reliability testing. The PLS algorithm procedure is used to conduct the outer model test. Validity testing is a data analysis technique to assess the extent to which a study instrument accurately measures what the investigator intends to examine. In SmartPLS, an indicator is considered valid if it has an outer loading value of $\geq$ 0.70 or an Average Variance Extracted (AVE) value $>$ 0.5 [44].

Meanwhile, reliability testing is a data analysis technique used to determine the consistency and stability of measured items. Two measurements are used for this purpose, including Composite Reliability (CR) and Cronbach's alpha. A reliable CR value should be greater than 0.6. However, if CR exceeds 0.9, some items in the research may be overly similar. Correspondingly, a reliable Cronbach's alpha value must be greater than 0.6. However, the rule of thumb stipulates that the Cronbach's alpha value for confirmatory research should exceed 0.70 [44].

Inner model testing is conducted to assess the predictive strength of the structural model through hypothesis testing, performed in SmartPLS using bootstrapping [44, 45]. The purpose of hypothesis testing is to evaluate the influence and relationship between variables. A variable is considered to have a significant effect on another if it has a p-value of $<$ 0.05 or a t-statistic of $>$ 1.96, assuming a 95% confidence level. The magnitude and direction, positive or negative, of the influence can be determined from the path coefficient of the relationship [44].

III. Results and Discussion

The results and discussions section starts with respondents' characteristics to describe the profile of each institutional leader and the institution that each individual represent. The analysis serves to contextualize the data obtained and to confirm the representativeness of the respondents relative to the population of study. Table I summarizes the profile of the leaders and institutions studied, showing that the majority of higher education leaders are male (71%) and fall within the age range of 44–59 years (74%). The institutional data further show that 64% of the institutions hold a "Very Good (B)" accreditation, while the remaining 36% achieve "Excellent (A)" accreditation, a distribution reflecting both long-established and still-developing institutions within the sample. Importantly, this accreditation spread confirms that most institutions already meet high-quality standards although a portion continues to strive toward excellence.

The measurement model is assessed for internal consistency reliability and convergent validity using

TABLE I
Respondents' Demographics.

Demographics	N	%
Gender		
Male	30	71%
Female	12	29%
Age of Principal (Years)		
28 – 43	7	17%
44 – 59	31	74%
$\geq$ 60	4	10%
Length of Service (Years)		
1–3	26	62%
4–5	11	26%
$>$ 5	5	12%
Age of Institution (Years)		
1–5	4	10%
6–10	2	5%
11–15	4	10%
16–20	1	2%
21–25	1	2%
26–30	4	10%
31–35	3	7%
36–40	3	7%
41–45	5	12%
$>$ 45	15	36%
Accreditation Distribution		
Excellent or A	15	36%
Very Good or B	27	64%

Cronbach's alpha, CR (rho_a and rho_c), and AVE. As presented in Table II, the Cronbach's alpha coefficients range from 0.890 to 0.943, exceeding the recommended threshold of 0.70 [46], an outcome confirming excellent internal consistency among the items measuring each construct. The CR (rho_a and rho_c) values, ranging from 0.903 to 0.951, further affirm the high reliability and internal coherence of all constructs.

Moreover, the AVE values range from 0.576 to 0.652, surpassing the minimum acceptable value of 0.50 [47], thereby demonstrating adequate convergent validity. These results confirm that the latent constructs account for more than 50% of the variance in the observed indicators. Taken together, the measurement model exhibits strong reliability and convergent validity, affirming that all constructs (DL, TC, CIC, ICP, and OI) are robust and appropriate for further structural model testing.

Table III also presents several significant relationships among DL, TC, OI, CIC, and ICP. DL shows a significant positive influence on TC (β = 0.289; p = 0.042) and OI (β = 0.229; p = 0.047), suggesting that leaders with strong digital orientation are able to enhance the organization's technological readiness and build an innovation-oriented culture. The direct effect of DL on ICP, however, is not significant (β = -0.190; p = 0.199), an outcome suggesting that while DL is essential for setting direction and vision, its impact on performance occurs indirectly through other strategic capabilities within the organization.

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TABLE II
RESULTS OF COMPOSITE RELIABILITY.

Variable	Cronbach's Alpha	Composite Reliability (rho_a)	Composite Reliability (rho_c)	Average Variance Extracted
Digital Leadership	0.925	0.944	0.938	0.632
Technology Capability	0.943	0.946	0.951	0.641
Collaborative Innovation Capability	0.923	0.929	0.937	0.652
Institution Core Performance	0.890	0.903	0.914	0.576
Open Innovation	0.931	0.941	0.943	0.627

TABLE III
RESULTS OF PATH COEFFICIENTS DIRECT EFFECTS (BOOTSTRAPPING).

Hypothesis	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T-Statistics (—O/STDEV—)	P-Values
Digital Leadership → Open Innovation	0.229	0.228	0.115	1.992	0.047
Technology Capability → Open Innovation	0.686	0.685	0.102	6.700	0.000
Digital Leadership → Technology Capability	0.289	0.275	0.142	2.032	0.042
Open Innovation → Institution Core Performance	0.572	0.568	0.204	2.799	0.005
Digital Leadership → Institution Core Performance	-0.190	-0.185	0.148	1.284	0.199
Technology Capability → Institution Core Performance	0.436	0.438	0.207	2.100	0.036
Collaborative Innovation Capability → Technology Capability	0.648	0.665	0.130	4.971	0.000

TC demonstrates a strong and significant positive effect on both OI (β = 0.686; p = 0.000) and ICP (β = 0.436; p = 0.006). These results confirm that organizations with advanced technological resources, digital infrastructure, and competencies are better positioned to engage in OI activities and achieve superior performance outcomes. The observations made support the dynamic capabilities theory, which posits that technology-related competencies enable firms to adapt and reconfigure resources in response to environmental changes and innovation opportunities.

OI bears a significant positive effect on ICP (β = 0.572; p = 0.005), confirming that the ability to integrate both internal and external knowledge sources contributes directly to improved organizational outcomes. Through OI practices, HEIs can leverage partnerships, collaborative studies, and knowledge-sharing networks to accelerate product and process innovation, thereby strengthening competitiveness.

Moreover, CIC significantly strengthens TC (β = 0.648; p = 0.000). This result implies that collaboration within and beyond organizational boundaries, such as with universities, industry partners, or startups, supports technology acquisition, learning, and the application of new digital tools. Such collaboration nurtures a productive innovation ecosystem that sustains technological advancement and continuous improvement.

Collectively, these findings affirm that ICP is not driven directly by DL, but through a chain of mediating effects that run through TC and OI. DL provides strategic direction and a supportive culture for digital transformation. Then, TC operationalizes this leadership into tangible systems and processes, and OI connects the organization to broader knowledge networks, driving performance outcomes. This integrated pathway confirms that leadership, technology, and innovation must work together for digital transformation to generate sustainable competitive advantage and measurable performance growth.

The results confirm that DL has a significant impact on TC and OI. They are critical factors in improving the fundamental performance of institutions. As shown in Table IV, the predictor variables (DL, TC, and OI) account for 69.5% of the variance in ICP (R-square = 0.695). Specifically, TC is identified as the most substantial driver of OI and bears a strong positive effect on institutional performance. CIC is also essential, as it facilitates technological advancements and enables institutions to more effectively integrate external resources and ideas. The present investigation further confirms that DL does not carry a significant direct positive impact on ICP. The complexity of institutional environments, including organizational culture and the level of support for digital transformation, is found to considerably shape the outcomes of DL initiatives. To optimize performance potential, institutions must prioritize the development of comprehensive technological infrastructures and collaborative ecosystems, even as OI continues to yield positive results.

Based on the observations made, TC is found to be the dominant factor driving OI in Indonesian HEIs, exerting a significant impact on institutional performance. Institutions excelling in technology development and utilization show superior innovation and greater adaptability to environmental changes. In this context, technology is not only a supporting tool but

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TABLE IV
THE POWER OF EXPLANATORY MODELS.

	R-Square	F-Square
Digital Leadership → Open Innovation	0.674	0.182
Technological Capability → Open Innovation		0.262
Digital Leadership → Institution Core Performance	0.695	0.107
Open Innovation → Institution Core Performance		0.271
Technological Capability → Institution Core Performance		0.400

the primary catalyst for creating a sustainable innovation ecosystem.

DL shows a positive correlation with TC development, yet does not directly shape institutional performance. It points to the need for DL in Indonesian higher education to be embedded within an integrated, comprehensive innovation strategy. Without that, the broader impact of DL on institutional performance cannot be fully realized.

OI also plays an essential role in bridging the gap between internal organizational capabilities and institutional performance. Institutions adopting OI through external collaborations have shown substantial performance gains. In addition, CIC are observed to indirectly contribute to institutional performance by strengthening technological capabilities and facilitating OI implementation. It emphasizes that the ability to collaborate with external parties serves as an indispensable indirect driver of performance improvement.

IV. CONCLUSION

In conclusion, the research aims to examine the influence of DL, TC, and CIC on the fundamental performance of HEIs in Indonesia. The research significantly contributes to the understanding of institutional performance by identifying critical relationships between these factors and their roles in driving the adoption of OI practices. Based on the observations made, the research affirms that achieving optimal institutional performance improvement in Indonesian higher education requires developing robust TC as a foundational priority. This foundation needs to be reinforced and supported by an OI strategy and integrated DL. The synergy among these three key factors is essential for maximizing the potential for sustained institutional performance improvement.

The obtained results carry significant implications for both academic and practical spheres. At the academic level, this exploration emphasizes the importance of integrating TC and DL as strategic pillars for enhancing institutional performance, offering a defined framework through which university administrators can develop policies to promote the adoption of digital transformation practices and OI. From a managerial standpoint, the research recommends that HEIs prioritize leadership development, build collaborative partnerships, and invest in the strengthening of their technological infrastructures to create an innovation-driven environment. Adopting this approach positions universities to improve their academic reputation, efficacy, and competitiveness in the digital era. Beyond advancing theoretical comprehension of innovation in higher education, the research offers practical recommendations which are capable of assisting institutions in achieving more sustainable and favorable performance outcomes.

Future explorations can be further developed by examining additional factors affecting the relationship between DL, TC, and OI. A longitudinal study will provide a more comprehensive understanding of the long-term impact of these dynamics on institutional performance. Contextual factors, such as government policies, organizational culture, and economic conditions, also warrant investigation as potential mediators or moderators of these relationships.

AUTHOR CONTRIBUTION

Conceived and designed the analysis, J. and R. K. R.; Collected the data, J.; Contributed data or analysis tools, J., F. E. G., and R. K. R.; Performed the analysis, J., F. E. G., and M. H.; and Wrote the paper, J.

DATA AVAILABILITY

The data that support the findings of the research are openly available in Zenodo at https://doi.org/10.5281/zenodo.19556529, reference number [19556529].

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