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DIGITAL TRANSFORMATION AND OPERATIONAL PERFORMANCE OF VIETNAMESE JOINT-STOCK BANKS

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Abstract

The study's main purpose is to build a research model for investigating the impact of digital transformation on the organizational performance of Vietnamese joint-stock commercial banks. Panel data from 27 banks spanning 2015 to 2024, multivariate panel regression is gathered to evaluate six hypotheses that connect Digital Transformation to Return on Assets (ROA), Return on Equity (ROE), and the Cost to Income Ratio (CIR), with Covid-19 serving as a moderating variable. It is grounded in the Resource-Based View, Transaction Cost Economics, and Innovation Theory. The study is expected to contribute empirical insights from Vietnam's banking sector to the global discourse on digital transformation and to propose strategic and policy-oriented recommendations for enhancing digital investment and operational management within the banking industry.

Key words: Digital Transformation, Organizational Performance, Vietnamese Joint-Stock Banks.

Introduction

1.1 Background of the Study

The Fourth Industrial Revolution is sweeping across the globe with tremendous force, ushering in digital transformation as an inevitable worldwide trend. This shift is touching every sector, reshaping economic and social relationships, and is seen as a critical factor in the survival of nations, organizations, businesses, and consumers everywhere (Schilirò, 2024).

Vietnam is undergoing a profound transformation, marked by a surge in digital technologies across nearly all areas, from e-commerce and finance to education and healthcare. This evolution isn't just altering old ways of doing things – it's boosting operational efficiency and enhancing the everyday experiences of citizens. Against the backdrop of Industry 4.0, the government and companies have taken proactive steps to roll out various digital strategies, seizing opportunities to strengthen the country's competitive edge. Over the past three years, Vietnam's digital economy has shown remarkable growth, evident in its rising share of GDP and its annual expansion rates (Cuong, 2025). According to the “Southeast Asia Digital Economy 2024” report by Google and Temasek, Vietnam's economy hit \$36 billion in 2024, up 16% from the previous year, and it was recognized as the fastest-growing digital economy in Southeast Asia for two years running.

Banks as the backbone of any economy, acting as the core of the financial system by channeling capital for growth and maintaining macroeconomic stability. In the last decade, Vietnam's banking sector has expanded dramatically in both size and performance. Data from the State Bank of Vietnam (2015; 2025) shows that total assets across Vietnamese banks reached 21,938,271 billion VND by the end of 2024, more than tripling from the 6,514,900 billion VND at the close of 2014.

The push toward digital transformation has sparked a complete overhaul in how banks organize and operate. It's become a cornerstone for meeting transaction demands, essential for staying competitive and improving overall efficiency (Boot et al., 2021). The coronavirus outbreak has been widely acknowledged as a major catalyst for accelerating digital adoption in finance and banking (Erdag, 2022; Karcioğlu et al., 2022; Khunfur et al., 2022; Hayat et al., 2024).

Given these advantages, digital transformation is viewed as a powerful driver for bank performance. As noted in the Banking Review Journal (2023), most credit institutions in Vietnam have fully digitized key operations. Many banks now handle over 90% of transactions through digital channels. Overall, studies affirm that technological innovation plays a key role in banks' growth and long-term viability (Ranganadhareddy, 2023).

1.2 Problem Statement

On a global scale, digital transformation has emerged as one of the most pressing and timely research topics in the banking sector. The rapid advancement of digital technologies is compelling banks to overhaul their organizational structures, management practices, and service delivery methods. In numerous countries, digital transformation has proven its vital role in boosting operational efficiency, enhancing customer satisfaction, and driving higher profits (Wu & Cheng, 2024; Porfirio, Felício & Carrilho, 2024). On one hand, various studies indicate that it enables banks to cut transaction costs, streamline branch networks and staffing, while also strengthening risk management capabilities. Findings from Citterio, King, and Locatelli (2024) in Europe reveal a positive link between digital transformation and bank profitability. Moreover, the Covid-19 pandemic has been shown to act as a positive moderating factor, amplifying the effects of digital transformation during times of crisis (Dadoukis, Fiaschetti & Fusi, 2021; Savvakis, Kenourgios & Trakadas, 2024).

That said, there are still conflicting viewpoints. Beccalli (2007) highlighted how hefty technology investments can erode short-term financial performance, leading to what's known as the "profitability paradox." Similarly, Xiang and Jiang (2023) uncovered a non-linear relationship between digital transformation and banking efficiency in China: the impact is more pronounced in small and medium-sized banks, whereas larger institutions don't see comparable benefits.

In Vietnam, even though joint-stock commercial banks have poured significant resources into digital technologies, existing research largely focuses on assessing the level of digital banking development or gauging customer satisfaction. No studies have yet comprehensively measured the impact of digital transformation on cost efficiency metrics using multi-year quantitative data. This gap is particularly significant given that operational costs for Vietnamese banks remain elevated (with an average CIR of

35–40%, far higher than in many other ASEAN countries). Recognizing these shortcomings, it's clear that investigating how digital transformation influences operational performance is a highly relevant issue with substantial practical implications.

1.3 Research Objectives

Based on the research gaps outlined above, this study establishes the following objectives. The overall goal of the essay is to measure and analyze the extent to which digital transformation affects the operational performance of listed commercial banks in Vietnam from 2015 to 2024, while also examining the moderating influence of the Covid-19 pandemic. From there, it aims to offer recommendations for optimizing the performance of joint-stock commercial banks through digital transformation.

2. Literature Review

2.1. Review of Theories

Resource-Based View

The Resource-Based View (Wernerfelt, 1984; Barney, 1991) posits that a firm's enduring competitive advantage is derived from resources that are Valuable, Rare, Inimitable, and Non-substitutable (VRIN). In banking, digital transformation is the process of turning resources like IT infrastructure, customer data, and digital capabilities into strategic assets that meet the VRIN criteria. When these resources are managed well, they make processes more efficient, lower costs, and raise profits (Karim et al., 2022). Banks that use big data, artificial intelligence, and digital platforms to get ahead have better performance and market share, while those that don't are having a hard time staying competitive.

Transaction Cost Economics Theory

Transaction Cost Economics, first proposed by Coase (1937) and later developed by Williamson (1975, 1985), asserts that firms exist to reduce transaction costs resulting from bounded rationality, opportunism, and uncertainty. Digital Transformation in commercial banking is a way to lower the costs of transactions and coordination by using automation, digital contracts, and online channels. E-banking, data analytics, and blockchain are some of the tools that make it easier to share information, lower the cost of monitoring, and lower the risk. Using TCE in this study helps us understand how digital adoption makes Vietnam's joint-stock commercial banks more cost-effective and better at running their businesses.

Innovation Theory

Schumpeter's Innovation Theory (1934; 1943) posits that innovation serves as the catalyst for economic growth, including new products, processes, markets, inputs, and organizational structures. Digital transformation is an example of this process of creative destruction in banking. It replaces old models with digital systems that make service delivery and competition better (Carayannis & Campbell, 2010). In Vietnam, digital innovation changes not only how the financial system works on the inside, but also how it is set up and how competitive it is.

2.2. Review of Previous Studies

Citterio, King, and Locatelli (2024) analyzed 279 banks across 27 EU countries (2017–2022) utilizing a composite Digital Transformation Index that encompasses both financial and non-financial indicators (intangible assets, branch networks, app usage). Using panel regression, they discovered that Digital transformation greatly increased profitability, mostly through investments in IT and better network management. They also found that Covid-19 made this relationship stronger. The study also found a non-linear effect, where too much digital spending led to lower returns. This means that people need to plan their investments carefully.

Porfirio, Felício, and Carrilho (2024) similarly surveyed more than 100 banks in Portugal and utilized structural equation modeling to evaluate the organizational impact of Digital transformation. Their results showed that DT improves both performance and business size, which shows how important it is for banks in Europe to stay competitive.

Dadoukis, Fiaschetti, and Fusi (2021) examined panel data of U.S. banks during the Covid-19 pandemic, demonstrating that banks with greater Information Technology adoption exhibited enhanced operational efficiency during the crisis, thereby reinforcing the idea that digital capabilities bolster resilience in challenging circumstances.

Xiang and Jiang (2023) examined commercial banks in China from 2010 to 2020 using panel regression and discovered that Digital transformation lowers costs for small and medium-sized banks but has negligible effects on large banks, attributed to substantial transformation costs and structural inflexibility. Wu and Cheng (2024) corroborated this perspective through two-way fixed effects regression (2012–2020), demonstrating that digital transformation enhances revenues and stability, especially in contexts with pro-digital local policies.

Gupta and Xia (2018) utilized Data Envelopment Analysis on commercial banks in India (2008–2016), demonstrating that Digital transformation enhanced cost efficiency in private banks, whereas it did not yield similar results in state-owned banks. Thakur et al. (2023) later used panel regression (2010–2019) and found that investments in information and communication tech lower short-term profitability at first because of setup costs, but they raise long-term efficiency, with non-performing assets levels having an effect.

InViet Nam, Son and Linh (2022) demonstrated that Digital transformation is crucial for developing intelligent banking ecosystems and enhancing user experience, although numerous institutions continue to encounter infrastructural and talent-related challenges. Trang et al. (2022) examined 13 Vietnamese joint-stock banks from 2011 to 2019 utilizing System GMM and Bayesian robustness checks. Their findings indicate that Digital transformation substantially improves bank performance, particularly for larger banks that gain from economies of scale. Lan et al. (2023) discovered a short-term detrimental effect of digital transformation on profitability (ROA, ROE), while Covid-19 exhibited a positive moderating influence, suggesting that digital investments necessitate time to generate benefits. Nhan et al. (2023) conducted a survey of 350 banking managers, revealing that explicit digital strategies and leadership commitment are essential factors for successful transformation and enhanced performance management.

While various international studies have demonstrated that digital transformation brings tangible advantages to banking operations—such as higher profits, better cost management, and improved customer interactions—key research gaps still remain that deserve attention.

First off, the bulk of these studies center on developed nations or major economies; work in emerging markets like Vietnam is scarce, particularly those drawing on extended timelines and directly quantifying cost efficiency or financial outcomes, rather than merely assessing user habits or service standards. Second, only a handful of analyses compare how digital transformation plays out across different bank categories based on size, ownership types, or structural adaptability, even though findings from China suggest that bigger institutions face greater hurdles in realizing cost savings from such shifts. Third, there's limited exploration into how the Covid-19 pandemic influences the link between digital transformation and bank performance, especially within an emerging context like Vietnam.

Therefore, the topic “Does Digital Transformation Improve Performance? Evidence from Vietnamese Joint-stock Banks” stands to make a meaningful addition by leveraging data from Vietnam's joint-stock commercial banks from 2015 to 2024, delving into both cost efficiency and profitability, and probing the role Covid-19 played in shaping this dynamic.

2.3. Hypothesis Development

Research on the relationship between digital transformation and bank performance is still mixed. Lan et al., 2023 contend that digital transformation may initially diminish profitability, as significant upfront technology investments can eclipse short-term gains. On the other hand, research by Wu and Cheng (2024), Zhu and Jin (2023), Xiang and Jiang (2023), and Citterio, King, and Locatelli (2024) showed that digital transformation is linked to better financial performance, meaning that digital projects improve ROA and ROE.

Hypothesis 1 (H1): Digital Transformation has a positive impact on Return on Assets.

Hypothesis 2 (H2): Digital Transformation has a positive impact on Return on Equity.

Linh et al. (2025) indicates that using technology in banking makes customers more involved, gives managers more control over operations, and makes employees more productive. This leads to lower costs and better use of resources. This means that digital transformation lowers the CIR by making internal processes more efficient and cutting down on unnecessary costs.

Hypothesis 3 (H3): Digital Transformation hurts the Cost to Income ratio.

The Covid-19 pandemic sped up the use of technology and showed how beneficial it is for banks to be technologically advanced. Citterio et al. (2024) assert that Covid-19 reinforced the correlation between digital transformation and banking efficiency. Consequently, this study incorporates Covid-19 as a moderating variable, anticipated to enhance impact of digital transformation on performance.

Hypothesis 4 (H4): COVID-19 moderates the impact of Digital transformation on Return on Assets; Return on Equity and Cost to Income ratio.

In the proposed research model, Digital Transformation stands out as a key independent variable, capturing

the extent of digitization among Vietnam's joint-stock commercial banks. For this study, the Digital Transformation Index – crafted by Peking University's Center for Digital Finance Research back in 2022—has been chosen to represent the digital shift process, thanks to its thorough and sensible design (Xie & Wang, 2023).

The effects of Digital Transformation will be tested against three dependent variables that stand for operational performance: ROA, ROE, and CIR. Here, ROA and ROE serve as fundamental financial metrics highlighting profitability potential, while CIR acts as a core gauge for assessing how efficiently a bank handles its operating expenses. Beyond the straightforward link between DTI and banking efficiency, this research also delves into the moderating influence of the Covid-19 pandemic.

On top of the primary variables, the model incorporates control variables to make the analysis more precise and well-rounded, filtering out any confounding elements. The selected controls include credit risk, capital adequacy ratio, bank size, and GDP growth rate. These are all factors that prior studies have confirmed impact bank performance (Wu & Cheng, 2024; Xiang & Jiang, 2023). Adding these controls helps eliminate noise and allows for a sharper evaluation of the ties between DT and overall bank effectiveness.

3. Research Methodology

3.1. Regression Models

Based on the established research framework, multivariate regression techniques is applied to panel data. The suggested regression models are outlined below:

$$ROA_{i,t} = \alpha_0 + \alpha_1 DTI_{i,t} + \alpha_2 DTI_{i,t} * COVID_t + \alpha_3 NPL_{i,t} + \alpha_4 CAP_{i,t} + \alpha_5 GDP_t + \varepsilon_{i,t}$$

$$ROE_{i,t} = \beta_0 + \beta_1 DTI_{i,t} + \beta_2 DTI_{i,t} * COVID_t + \beta_3 NPL_{i,t} + \beta_4 CAP_{i,t} + \beta_5 GDP_t + \mu_{i,t}$$

$$CIR_{i,t} = \gamma_0 + \gamma_1 DTI_{i,t} + \gamma_2 DTI_{i,t} * COVID_t + \gamma_3 NPL_{i,t} + \gamma_4 CAP_{i,t} + \gamma_5 GDP_t + \nu_{i,t}$$

In which:

$ROA_{i,t}$: The return on assets for bank i in year t.

$ROE_{i,t}$: The return on equity for bank i in year t.

$CIR_{i,t}$: The Cost to Income ratio for bank i in year t.

$DTI_{i,t}$: The extent of technology investment for bank i in year t.

$COVID_t$: A dummy variable indicating the Covid-19 pandemic in year t.

$NPL_{i,t}$: The non-performing loans ratio to total outstanding loans for bank i in year t.

$CAP_{i,t}$: The equity-to-total-assets ratio for bank i in year t

$\alpha_0, \dots, \alpha_5, \beta_0, \dots, \beta_5, \gamma_0, \dots, \gamma_5$: The estimated regression coefficients within the model.

$\varepsilon_{i,t}, \mu_{i,t}, \nu_{i,t}$: The random error terms for the corresponding regression equations.

3.2. Variable Measurement

3.2.1. Dependent Variable

Return on Assets – ROA

ROA is a critical financial indicator used in evaluating the overall performance of an organization, particularly financial institutions such as banks, in terms of their ability to utilize assets to generate profit. Since bank assets primarily consist of loans, securities investments, deposits at the State Bank of Vietnam, and other interest-bearing assets, ROA serves as a measure of a bank's capacity to employ these resources effectively to generate returns (Rose & Hudgins, 2013). This ratio reflects the efficiency with which total assets are transformed into net income over a given period and is calculated as follows:

$$ROA = \frac{Net\ Income}{Average\ Total\ Asset}$$

In the banking sector, ROA not only indicates the efficiency of asset utilization but also reflects a bank's ability to manage costs, the quality of its credit portfolio, and its capacity to control risks (Athanasoglou, Brissimis & Delis, 2008). Consequently, ROA is frequently employed as a dependent variable in studies assessing the impact of digital transformation on banking performance (Wu & Cheng, 2024; Porfirio, Felício & Carrilho, 2024).

Return on Equity – ROE

ROE is an essential indicator reflecting a bank's profitability relative to the capital invested by its shareholders, thereby providing investors with a clearer understanding of financial performance (Miskin & Eakins, 2018). It measures how much net income is generated from each unit of shareholders' equity, thereby illustrating the efficiency with which a bank utilizes its equity capital. ROE is calculated as follows:

$$ROE = \frac{Net\ Income}{Average\ Total\ Equity}$$

In empirical studies on performance, ROE is often regarded as a dependent variable or a performance indicator, as it directly reflects the returns that shareholders receive from a bank's business activities (Petersen & Schoeman, 2008).

Cost to Income ratio – CIR

A lot of people know about the Cost to Income Ratio, which is a way to measure how well a bank runs its business, especially how well it manages its costs compared to the money it makes. The formula for CIR is the ratio of operating costs to operating income:

$$CIR = \frac{Operating\ Expenses}{Operating\ Income}$$

A lower CIR means that a bank is more efficient because it can make more money for every dollar it spends. On the other hand, a higher CIR means that costs are not being managed well, and operating costs take up a bigger part of revenues (Mahendru & Bhatia, 2017). Research by Xiang and Jiang (2023), Wu and Cheng

(2024), and Citterio et al. (2024) shows that digital transformation lowers CIR by automating workflows, making branch operations more efficient, and lowering transaction costs. Gupta and Xia (2018) also find that private banks that use more online and mobile channels are more cost-effective.

3.2.2. Independent Variable

Digital Transformation Index (DTI)

To date, scholars worldwide have employed various approaches to measure digital transformation variables. In this study, the DTI developed in 2022 by the Center for Digital Finance Research at Peking University, is selected as the proxy for banks' digital transformation due to its comprehensiveness and rationality. The index is divided into three dimensions: strategy, business, and management (Xie & Wang, 2023). Specifically, the strategic dimension focuses on the bank's commitment to digital technology, the business dimension captures the degree of integration of digital technologies into financial services, and the management dimension assesses the extent to which digital tools are embedded in governance structures and organizational management.

Control Variable

Credit Risk (NPL)

Non-Performing Loans (NPLs) are an indicator reflecting both the efficiency and the safety of a bank's credit operations, measured as the ratio of total non-recoverable loans to total outstanding loans. According to Lan Nguyen Thi Huong et al. (2023), the NPL ratio is a critical factor influencing the performance and stability of the banking system, showing an inverse relationship with bank efficiency. When the NPL ratio rises, provisions for credit risk increase accordingly, thereby reducing profitability and weakening the bank's competitiveness.

$$NPL = \frac{\text{Bad Debt}}{\text{Total Outstanding Loans}}$$

Solvency Ratio (CAP)

CAP is employed to assess the financial condition of a bank; the higher the ratio, the greater the stability of its capital during operations. A larger equity base strengthens a bank's credibility, enhances its ability to attract investment, and reduces funding costs. Moreover, banks with higher equity capital possess greater potential to expand their business scale and to maintain financial stability under volatile market conditions.

$$CAP = \frac{\text{Total Equity}}{\text{Total Asset}}$$

GDPGrowth (GDP)

Economic Growth Rate represents the percentage change in the size of a country's Gross Domestic Product (GDP) over a given period. When the economy is experiencing robust growth, businesses typically expand their production scale, while consumers tend to spend more. This dynamic encourages financial intermediaries to operate more actively, thereby becoming an effective channel for capital provision (Lan

Nguyen Thi Huong et al., 2023).

$$GDP = \frac{GDP_t - GDP_{t-1}}{GDP_{t-1}}$$

3.3. Data Collection and Analysis

Data Collection

The study utilizes secondary data collected from audited financial statements and annual reports of 27 joint-stock commercial banks during the period 2015–2024. After screening and excluding observations that lacked sufficient information or reliability, banks with incomplete listing periods, and outliers that could distort results, the dataset is consolidated.

A common feature of these institutions is that they are all joint-stock commercial banks in Vietnam. By 2022, the total assets of the 27 banks included in this study amounted to VND 17.2 quadrillion, accounting for approximately 78.18% of the banking sector's total assets. This indicates that the selected sample is sufficiently comprehensive and broadly representative of the Vietnamese banking industry.

After data collection, computation, cleaning, and removal of missing values in Microsoft Excel, the dataset is imported into EViews for further analysis.

Data Analysis

Descriptive Statistics Analysis

Descriptive statistical analysis was performed using EViews to summarize and present an overview of the dataset. The descriptive statistics table reports basic measures of the variables used in the research model, including the number of observations, mean, standard deviation, minimum, and maximum values. These indicators provide an overall picture of the dataset and form the basis for more in-depth analyses in subsequent stages.

Correlation Analysis

Correlation analysis is a statistical method used to measure both the strength and the direction of the relationship between independent and dependent variables. The correlation coefficient ranges between -1 and $+1$, with absolute values closer to 1 indicating stronger relationships. Notably, if the correlation coefficient between two independent variables exceeds 0.7, it suggests a strong linear relationship, which may indicate the presence of multicollinearity in the model. In such cases, adjustments may be considered, such as removing one of the highly correlated variables, collecting additional data, or reconstructing the sample.

Regression Analysis

In this study, the secondary dataset is structured as panel data; therefore, regression analysis is conducted using the Panel Data Regression approach, applying three models: the Pooled Ordinary Least Squares (Pooled OLS), the Fixed Effects Model (FEM), and the Random Effects Model (REM). Model selection is performed through diagnostic tests, including the F-test, Breusch–Pagan LM test, and Hausman test. Finally,

the model is refined by applying the Feasible Generalized Least Squares (FGLS) method to address the limitations of the initial models.

Model Selection

In panel data analysis, selecting the appropriate model requires statistical testing to ensure accurate and efficient estimation. The most commonly used tests are as follows:

F-test

The F-test serves as a tool for comparing the Pooled OLS model against the FEM. Essentially, it evaluates the null hypothesis that individual-specific effects are negligible, implying no fundamental distinctions among the observed entities. The hypotheses are outlined below:

H_0 : No individual effects present

H_1 : Individual effects are present

If the P-value ≥ 0.05 , we fail to reject H_0 , suggesting insufficient grounds to shift from Pooled OLS to FEM—which points to Pooled OLS being the better fit. On the flip side, a P-value < 0.05 leads us to reject H_0 in favor of H_1 , positioning FEM as the preferable option over Pooled OLS (Greene, 2012), and thus indicating that the FEM approach aligns more appropriately.

Breusch-Pagan Lagrangian Multiplier (LMtest)

The LM test is used to assessing which model fits better between Pooled OLS and REM. At its core, it checks whether the variance of individual-specific effects deviates from zero.

H_0 : Variance of individual effects equals zero

H_1 : Variance exceeds zero

If the P-value ≥ 0.05 , we don't reject H_0 , indicating that Pooled OLS is the right choice. However, a P-value < 0.05 means we reject H_0 and go with H_1 , revealing the presence of individual effects and making REM the more suitable option (Baltagi, 2008)

Hausman test

The Hausman test stands out as a statistical approach for weighing up and deciding between FEM and REM. Basically, it probes the null hypothesis that there's no correlation linking individual effects to the explanatory variables.

H_0 : Individual effects show no correlation with the explanatory variables

H_1 : Individual effects do correlate with the explanatory variables

When the P-value is ≥ 0.05 , there's not enough evidence to toss out H_0 , which suggests REM is the way to go due to its stronger statistical efficiency. But if the P-value is < 0.05 , that gives us reason to reject H_0 and embrace H_1 , favoring FEM instead—since REM would then produce biased and inefficient estimates in that scenario (Hausman, 1978).

4. Conclusion

This study aims to develop a research framework for examining the effects of digital transformation (DT) on the performance of Vietnamese joint-stock commercial banks from 2015 to 2024. Based on the Resource-Based View, Transaction Cost Economics, and Innovation Theory, the study combines profitability (ROA, ROE) and cost efficiency (CIR) as important measures to evaluate DT results. The study employs multivariate panel regression, incorporating Covid-19 as a moderating variable, to furnish substantial empirical evidence within an emerging market context. The study results are anticipated to indicate that digital transformation (DT) improves both profitability and efficiency, while also bolstering banks' adaptability in times of crisis. The present study attempts to enhance global comprehension of digital transformation in banking and provides strategic guidance for Vietnamese banks and policymakers to maximize digital investment, enhance cost management, and secure sustainable performance in the digital age.

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BUILDING ORACLE AI AGENTS WITH ORACLE XE: A TUTORIAL

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Abstract

Generative artificial intelligence (AI) is a broad category of AI systems that can create new content, such as text, images, music, video, and more. AI operations frequently rely on AI Agents to carry out tasks and generate different forms of content. However, the creation and utilization of AI Agents to undertake business tasks is challenging. This paper illustrates how to create an AI Agent that accesses the free Oracle XE database through a tutorial utilizing node.js as a reasoning engine. The tutorial shows how an Oracle AI Agent can be created on a Windows PC to interact with the free scaled-down Oracle XE database.

Keywords: *Artificial Intelligence, AI Agents, Agents, Oracle, Node.js, OpenAI API, PL/SQL.*

1.0 Introduction

Generative artificial intelligence (AI) is a broad category of AI systems that can create new content, such as text, images, music, video, and more. ChatGPT is a specific generative AI tool or reasoning engine that uses a large language model (LLM) to create human-like text responses (Awasthi, 2023; Chiu, 2024; Haleem et al, 2022; Koh & Doroudi, 2023). Even though AI use in content creations have been very successful, its adaptation to business operations is limited and still evolving.

AI operations frequently rely on AI Agents to carry out tasks and generate different forms of content (Baidu et al, 2025; Chaplia et al, 2025; Chawla, et al, 2024; Dwivedi et al, 2025; Hettiarachchi, 2025; Huang, 2025; Kaal, 2025). For instance, when a user asks for the weather in a specific city, the generative AI tool employs an agent to retrieve the relevant weather information and then crafts a natural language response. An AI Agent is a software entity that leverages artificial intelligence to autonomously perform tasks on behalf of a user. It can perceive its environment, reason, make decisions, and take actions to accomplish objectives with minimal human input, often utilizing large language models (LLMs) to interpret and respond to user queries. However, the creation and utilization of AI Agents to undertake business tasks is challenging as (a) a business operates in a competitive environment which requires it to often change strategies and associated operations, (b) involves access to enterprise databases to facilitate associated tasks, and (c) requires incorporation of semantic language components to facilitate understanding and interpretation of user request and agent outcome to accomplish business objective.

This paper illustrates how to create an AI Agent that accesses the free Oracle XE database through a tutorial. It utilizes Oracle 21c XE or later versions of Oracle free database since AI Agents commonly use JSON data format. Earlier versions of Oracle database did not support native JSON data type. The tutorial shows how an Oracle AI Agent can be created on a Windows PC to interact with the free scaled-down Oracle XE

database.

2.0 AI Agent Structure

Creating an AI agent requires a reasoning engine which is the core component that processes information and makes decisions. This engine is often powered by a large language model (LLM) like ChatGPT and others. However, allowing LLMs like ChatGPT to be the engine for an AI agent that accesses a local database presents significant drawbacks primarily associated with security and data privacy. Besides, OpenAI's hosted tools can't access local machine (localhost) where XE is installed. For this reason, node.js was chosen as the reasoning engine that interacts with OpenAI ChatGPT to develop the AI Agent (Chaplia & Klym, 2023; Shah, 2017).

Node.js is an open-source, cross-platform JavaScript runtime environment that allows developers to execute JavaScript code outside of a web browser. Node.js as a reasoning engine with respect to an AI Agent (a) handles backend server processing on behalf of LLMs by handling requests from users, sending prompts to LLMs, receiving responses from LLMs, and then processing and delivering those responses back to the user, (b) it facilitates integration with LLM APIs like OpenAI API thereby making it easy to send and receive data from these models, (c) works asynchronously and ensures that data on the local database like Oracle XE stays secure as essentially the "localhost" of the windows machine is not accessible remotely or from the cloud. In other words, node.js is the bridge between OpenAI and Oracle XE. Figure 1 shows the interaction between User → Node.js Agent → OpenAI API → Oracle XE and back:

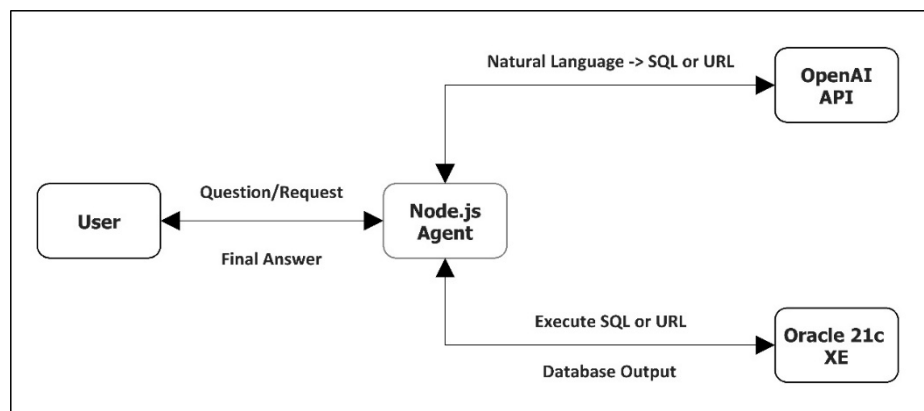


Figure 1: Interactions between Node.js, OpenAI API and Oracle XE

3.0 Oracle AI Agent Tutorial

The tutorial utilizes a hypothetical database table Tenant and Oracle web procedures to show the interaction of node.js driven Oracle AI Agent with Oracle XE and OpenAI. For the tutorial an OpenAI API Key was acquired from OpenAI.

Table 1. Tenant

TENANT_SS	TENANT_NAME	TENANT_DOB	EMPLOYER_NAME	CREDIT_SCORE
123456789	Jack Robin	6/21/1960	Kraft Inc.	650
723556089	Mary Stackles	8/2/1980	Kraft Inc.	675
450452267	Ramu Reddy	4/11/1962	MSU	755
223056180	Marion Black	5/25/1981	MSU	720
173662690	Venessa Williams	3/12/1970	Kraft Inc.	740

The node.js engine API to access the Oracle database is a URL for some database web procedures. Web procedures are similar to a standard Oracle database procedures with the ability to be called from a Web browser. Web procedures are created through the PL/SQL Web Toolkit. The web procedures generate output as JSON since JSON is the preferred format for AI interaction.

JSON (JavaScript Object Notation) is a lightweight, text-based format for data interchange. Its structure is a collection of name(key)/value pairs. For example, the following is JSON output:

```
[
{"id":123456789,"TenantName":"Jack Robin","EmployerName":"Kraft Inc."},
{"id":723556089,"TenantName":"Mary Stackles","EmployerName":"Kraft Inc."},
]
```

where “id”, “TenantName” and “EmployerName” are keys and the entries after thekey are the values associated with it.

3.1 Web Database Procedures

Make sure Oracle 21c XE and PL/SQL Gateway for Web interaction are running locally. This involves the following steps:

1. Login with username sys with sysdba (Role) in the CDB (root) and then run the following SQL statement.

alter user anonymous account unlock;
2. Login username system in pluggable database xepdb1.
 - a. Create a DAD (database access descriptor),
 - b. Run the following SQL statements. In the statements ITC528INST is the already created username account that will have the web procedures.

```
exec dbms_epg.set_dad_attribute('xepsp','database-username','ITC528INST');
exec dbms_epg.authorize_dad('xepsp','ITC528INST');
```

Now, the two web database procedures in PL/SQL on the database table tenant are shown below. The first database procedure api_get_alltenant_json displays selected attributes from the tenant table. The second

database procedure `api_get_tenant_json` which has an input parameter displays details of a tenant specific to the `p_tenant_ss` input parameter. Both tables display output in json.

```
create or replace procedure api_get_alltenant_json as
l_tenant_obj JSON_OBJECT_T;
l_tenant_array JSON_ARRAY_T := JSON_ARRAY_T();
BEGIN
  FOR tenant_rec IN (SELECT tenant_ss, tenant_name, employer_name FROM tenant) LOOP
    l_tenant_obj := JSON_OBJECT_T();
    l_tenant_obj.put('id', tenant_rec.tenant_ss);
    l_tenant_obj.put('TenantName', tenant_rec.tenant_name);
    l_tenant_obj.put('EmployerName', tenant_rec.employer_name);
    l_tenant_array.append(l_tenant_obj);
  END LOOP;

  OWA_UTIL.MIME_HEADER('application/json', TRUE);
  HTP.PRN(l_tenant_array.to_string());
END;
```

This web procedure can be accessed through an API with URL:
http://127.0.0.1:8080/xepsp/itc528inst.api_get_alltenant_json
 where in the URL `itc528inst` is the user account in which the web procedure is stored.

```
create or replace procedure api_get_tenant_json (p_tenant_ss in number) as
l_tenant_json  JSON_OBJECT_T;
l_tenant_ssNUMBER;
l_tenant_name VARCHAR2(100);
l_employer_name VARCHAR2(100);
begin
l_tenant_json := JSON_OBJECT_T(); -- Initialize an empty JSON object
-- Execute a SELECT statement (this uses an implicit cursor)
  SELECT tenant_ss, tenant_name, employer_name
  INTO l_tenant_ss, l_tenant_name, l_employer_name
  FROM tenant
  WHERE tenant_ss = p_tenant_ss;

  IF SQL%FOUND THEN
    -- Add the retrieved values to the JSON_OBJECT_T
    l_tenant_json.put('tenant_ss', l_tenant_ss);
```

```
l_tenant_json.put('tenant_name', l_tenant_name);  
l_tenant_json.put('employer_name', l_employer_name);  
END IF;
```

```
-- Convert the JSON object to a string  
OWA_UTIL.MIME_HEADER('application/json', TRUE);  
http.p(l_tenant_json.to_string);  
END;
```

This web procedure can be accessed through an API with URL:

http://127.0.0.1:8080/xepsp/itc528inst.api_get_tenant_json?p_tenant_ss=123456789

where in the URL itc528inst is the user account in which the web procedure is stored.

3.2 Node.js Setup

The Oracle AI Agent is built through the Node.js (runtime engine) that runs the agent code locally, and it does two things:

1. Communicate with OpenAI's API over the internet (using the API key).
2. Communicates with local Oracle endpoints (PL/SQL web procedures URL or ORDS REST) on the same machine as Oracle XE.
3. When the node.js engine needs to "think," it sends a request to OpenAI's API and gets a reasoning response back.

So, the OpenAI API itself never directly communicates with Oracle XE. It only communicates with the Node.js runtime local process.

3.2.1 Install Node.js (v18+)

- Download the Windows installer (64-bit) from the website nodejs.org. Choose the LTS version.
- Once the download is complete, locate the downloaded .msi file and double-click it to launch the Node.js Setup Wizard. You do NOT need Python or Visual Studio Build Tools options during installation. On the "Custom Setup" screen, ensure that "Node.js runtime" and "npm package manager" are selected, and that "Add to PATH" is enabled. This ensures that you can run Node.js and npm commands from your windows command line.
- Verify the Installation:
 - Open your Command Prompt or search for "cmd" in the Windows search bar.
 - Type the following commands and press Enter key:
 - node -v
 - npm -v

- If the installation was successful, these commands will display the installed versions of Node.js and npm, respectively.

3.2.2 Create Project Folder

The AI Agent will run through the Windows command prompt. So, create a new subfolder that will serve as the container of all the AI Agent project/tutorial files on the machine storage drive. Then open the Windows Command Prompt and type the following statements to initialize the project folder (for example c:\oracle-agent) and then install the necessary files:

- `cd c:\`
- `mkdir c:\oracle-agent`
- `cd c:\oracle-agent`
- `npm init -y`
- `npm install openai@4 axios dotenv`
- `npm install express cors node-fetch@2`

Once all the packages are installed, you will have the environment to create and run the AI agent.

3.2.3 Test Web Procedures

Test the two web procedures json output in windows command prompt. So, first create separate text files in Notepad named `test_gettenant_url.js` and `test_alltenant_url.js` for each of the above Oracle web procedures. Remember the file names can be changed.

`test_gettenant_url.js` content is as follows:

```
/**
 * test_gettenant_url.js
 * -----
 * Simple script to test if a PL/SQL Web procedure URL is working.
 * Example: A PL/SQL procedure deployed on Oracle XE that returns HTML/JSON.
 * -----
 */

const fetch = require("node-fetch"); // CommonJSrequire()

// 1. Replace this with your actual PL/SQL web procedure URL
const get_tenant = "http://127.0.0.1:8080/xepsp/itc528inst.api_get_tenant_json?p_tenant_ss=123456789";
async function testURL() {
  try {
    // 2. Make a GET request to the PL/SQL Web URL
    const response = await fetch(get_tenant);
```

```

// 3. Check if URL responded correctly
console.log("✅ Status Code:", response.status);
// 4. Print raw response text (could be HTML or JSON depending on your PL/SQL)
const data = await response.text();
console.log("📄 Response Body:\n", data);
} catch (err) {
console.error("❌ Error fetching URL:", err.message);
}
}
testURL();

```

test_alltenant_url.js content is similar to the above test_gettenant_url.js with the following two changes:

(a) replace the statement

```
const get_tenant = "http://127.0.0.1:8080/xepsp/itc528inst.api_get_tenant_json?p_tenant_ss=123456789";
```

with the following statement

```
const list_all_tenant = "http://127.0.0.1:8080/xepsp/itc528inst.api_get_alltenant_json";
```

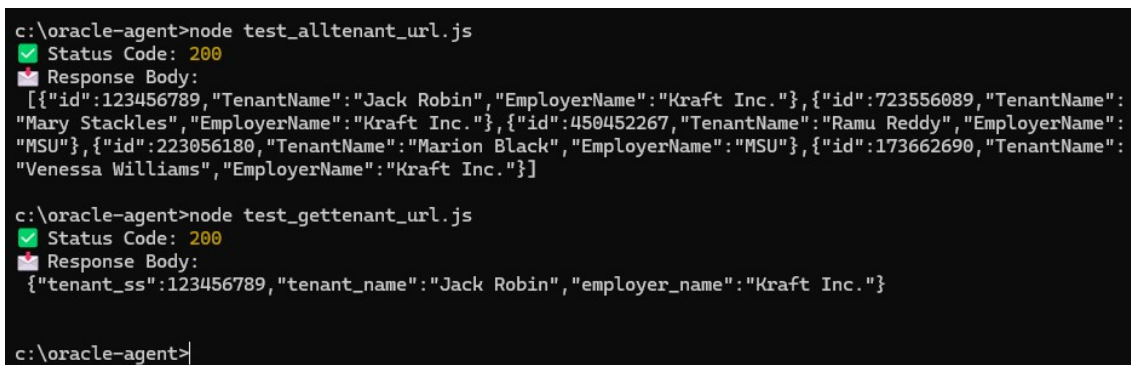
(b) replace the statement

```
const response = await fetch(get_tenant);
```

with the following statement

```
const response = await fetch(list_all_tenant);
```

The runtime output for the above two files are shown below (Figure 2):



```

c:\oracle-agent>node test_alltenant_url.js
✅ Status Code: 200
📄 Response Body:
[{"id":123456789,"TenantName":"Jack Robin","EmployerName":"Kraft Inc."},{ "id":723556089,"TenantName":
"Mary Stackles","EmployerName":"Kraft Inc."},{ "id":450452267,"TenantName":"Ramu Reddy","EmployerName":
"MSU"}, {"id":223056180,"TenantName":"Marion Black","EmployerName":"MSU"}, {"id":173662690,"TenantName":
"Venessa Williams","EmployerName":"Kraft Inc."}]

c:\oracle-agent>node test_gettenant_url.js
✅ Status Code: 200
📄 Response Body:
{"tenant_ss":123456789,"tenant_name":"Jack Robin","employer_name":"Kraft Inc."}

c:\oracle-agent>

```

Figure 2: Web procedures JSON output from Node.js

3.2.4 Extend Tutorial with Local Agent and OpenAI API

Now in the next iteration of the tutorial (a) we will use a web browser to open the previous procedures and (b) specify the web procedure simply by its name in the JavaScript files thereby excluding the full URL. This makes the running of agents more flexible.

3.2.4.1 Create .env file

Create a text file .env or open Notepad and save it as .env in the project folder (C:\oracle-agent). The .env file is a simple text file in the project folder. This file will contain configuration values like the OpenAI API key or the base URL for the Oracle endpoints (or Oracle web procedures). This way the API key or URLs don't have to appear in the agent source files. So now, for this tutorial paste the following content in the .env file:

```
OPENAI_API_KEY=sk-your-key-here
# Enter all your URLs for accessing PL/SQL web procedures like
BASE_URL= http://127.0.0.1:8080/xepsp/itc528inst.
PORT=3000
```

The .env file now has a standard base URL which can now be extended at runtime with different web procedures depending on the nature of natural language semantics.

3.2.4.2 Procedure Dictionary & Web

To handle varying natural language semantics a new file is created titled as procedure_dictionary.json. This file will have the list of each web procedure URL along with some keywords and synonyms to facilitate natural language interactions. Here is the sample procedure_dictionary.json file content as follows:

```
{
  "Get tenant": {
    "procedure": "api_get_tenant_json",
    "description": "Details on specific tenant id.",
    "required_params": ["p_tenant_ss"],
    "output_type": "json",
    "synonyms": [
      "fetch tenant info for specific tenant",
      "find tenant for tenant key",
      "get specific tenant"
    ],
    "keywords": ["tenant", "ss", "id"]
  },
  "Tenant list": {
    "procedure": "api_get_alltenant_json",
    "description": "Generates a list of tenants",
```

```

    "required_params": [],
    "output_type": "json",
    "synonyms": ["show tenants", "list tenants", "who are the tenants"],
    "keywords": ["tenant", "apartment", "rent", "list", "show"]
  }
}

```

In the procedure dictionary file above each web procedure URL is given a name (for example “Get tenant”) and then for each web procedure URL name there is a collection of attributes like name of the procedure, short description, required parameters if any, output type, and lastly synonyms and keywords through which it may be referenced in natural language.

Now two additional text files need to be created in Notepad to run the AI agent and view its working in the web browser. The first file for the updated tutorial is called `agent_hybrid.js` and the second file is `index.html`. Enter the following statements in `agent_hybrid.js`.

```

// agent_hybrid.js — CommonJS version
const express = require("express");
const axios = require("axios");
const dotenv = require("dotenv");
const OpenAI = require("openai");
const fs = require("fs");

dotenv.config();
const app = express();
app.use(express.json());
app.use(express.static("public"));

const client = new OpenAI({ apiKey: process.env.OPENAI_API_KEY });
const dictionary = JSON.parse(fs.readFileSync("procedure_dictionary.json", "utf-8"));

function extractTenantSS(text) {
  const match = text.match(/\b\d{9}\b/);
  return match ? match[0] : null;
}

function findProcedure(question) {
  const q = question.toLowerCase();
  let best = null;
  let bestLength = 0;

```

```

    for (const [intent, info] of Object.entries(dictionary)) {
      const allTerms = [...(info.synonyms || []), ...(info.keywords || [])];
      for (const term of allTerms) {
        if (q.includes(term.toLowerCase()) && term.length > bestLength) {
          best = info;
        }
      }
    }
    return best;
  }

app.post("/ask-local", async (req, res) => {
  const question = req.body.question || "";
  const procedureInfo = findProcedure(question);
  if (!procedureInfo) return res.json({ mode: "local-agent", message: "No matching procedure found." });
  let queryString = "";
  if (procedureInfo.required_params?.length) {
    const ss = extractTenantSS(question);
    if (!ss)
      return res.json({
        mode: "local-agent",
        message: `This action requires parameter(s): ${procedureInfo.required_params.join(", ")}. Please
        include them in your question.`
      });
    queryString = `?${procedureInfo.required_params[0]}=${ss}`;
  }

  try {
    const url = `${process.env.BASE_URL}${procedureInfo.procedure}${queryString}`;
    const response = await axios.get(url);
    res.json({ mode: "local-agent", endpoint: url, result: response.data });
  } catch (err) {
    res.status(500).json({ error: err.message });
  }
});

app.post("/ask-openai", async (req, res) => {

```

```

const question = req.body.question || "";
const procedureInfo = findProcedure(question);
if (!procedureInfo) return res.json({ mode: "openai-agent", message: "No matching procedure found." });
let queryString = "";
if (procedureInfo.required_params?.length) {
  const ss = extractTenantSS(question);
  if (!ss)
    return res.json({
      mode: "openai-agent",
      message: `This action requires parameter(s): ${procedureInfo.required_params.join(", ")}. Please
include them in your question.`
    });
  queryString = `?${procedureInfo.required_params[0]}=${ss}`;
}

try {
  const url = `${process.env.BASE_URL}${procedureInfo.procedure}${queryString}`;
  const apiResponse = await axios.get(url);

  const completion = await client.chat.completions.create({
    model: "gpt-4o-mini",
    messages: [
      { role: "system", content: "You are an AI assistant for ITC 528. Summarize Oracle PL/SQL JSON outputs
clearly." },
      { role: "user", content: `Procedure: ${procedureInfo.procedure}\nURL: ${url}\nJSON data:
${JSON.stringify(apiResponse.data)}\n\nUser question: ${question}` }
    ]
  });

  res.json({
    mode: "openai-agent",
    endpoint: url,
    summary: completion.choices[0].message.content
  });
} catch (err) {
  res.status(500).json({ error: err.message });
}
}

```

```
app.listen(process.env.PORT, () => {
  console.log('✅ Hybrid AI agent running on http://localhost:${process.env.PORT}');
});
```

In the oracle-agent folder in which all the processing files exist create a subfolder “public” and then open Notepad and copy/paste the following html statements and save the file as index.html in the “public” subfolder.

```
<!DOCTYPE html>
<html lang="en">
<head>
<meta charset="UTF-8" />
<title>Hybrid AI Agent Demo</title>
<style>
  body { font-family: Arial; margin: 40px; background: #fafafa; }
  #container { max-width: 700px; margin: auto; background: white; padding: 20px; border-radius: 10px;
box-shadow: 0 2px 8px rgba(0,0,0,0.1); }
textarea{ width: 100%; margin-bottom: 10px; padding: 8px; font-size: 14px; }
  button { margin: 5px; padding: 10px 20px; border: none; border-radius: 5px; cursor: pointer; }
  #localBtn { background-color: #007acc; color: white; }
  #openaiBtn { background-color: #28a745; color: white; }
  pre { white-space: pre-wrap; word-wrap: break-word; overflow-x: visible; background: #f4f4f4;
padding: 10px; border-radius: 6px; }
</style>
</head>
<body>
<div id="container">
<h1>Hybrid AI Agent Demo</h1>
<p>Example questions:</p>
<ul>
<li><b>"List tenants"</b> — calls api_get_alltenant_json</li>
<li><b>"Show tenant 123456789"</b> — calls api_get_tenant_json?p_tenant_ss=123456789</li>
</ul>
<textarea id="question" placeholder="Ask your question..."></textarea><br/>
<button id="localBtn">Ask Local Agent</button>
<button id="openaiBtn">Ask OpenAI Agent</button>
<h3>Response:</h3>
<pre id="responseBox">Awaiting input...</pre>
</div>
```

```

<script>
  async function ask(endpoint) {
    const question = document.getElementById("question").value.trim();
    const res = await fetch(endpoint, {
      method: "POST",
      headers: { "Content-Type": "application/json" },
      body: JSON.stringify({ question })
    });
    const data = await res.json();
    document.getElementById("responseBox").textContent = JSON.stringify(data, null, 2);
  }

  document.getElementById("localBtn").onclick = () => ask("/ask-local");
  document.getElementById("openaiBtn").onclick = () => ask("/ask-openai");
</script>
</body>
</html>

```

To test the running of the Oracle AI Agent open the command prompt window and enter the “node agent_hybrid.js” statement as shown in Figure 3. Press the CTRL key and click the link <http://localhost:3000> to open the home page in web browser.

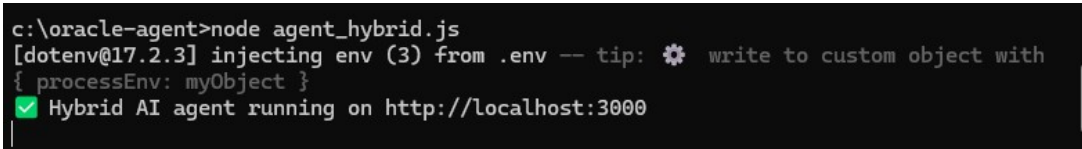


Figure 3: Hybrid AI agent local server

In the Web browser the home page displays two buttons. Ask Local Agent button is the local mode which uses the node.js uses rule-based Natural Language Processing (NLP) systems. Web page with local node.js output is displayed below (Figure 4). This approach involves defining explicit rules or patterns to analyze and interpret natural language input, in contrast to machine learning-based methods like ChatGPT that learn patterns from data.

Hybrid AI Agent Demo

Example questions:

- **"List tenants"** — calls `api_get_alltenant_json`
- **"Show tenant 123456789"** — calls `api_get_tenant_json?p_tenant_ss=123456789`



Ask Local Agent
Ask OpenAI Agent

Response:

```
{
  "mode": "local-agent",
  "endpoint": "http://127.0.0.1:8080/xepsp/itc528inst.api_get_alltenant_json",
  "result": [
    {
      "id": 123456789,
      "TenantName": "Jack Robin",
      "EmployerName": "Kraft Inc."
    },
    {
      "id": 723556089,
      "TenantName": "Mary Stackles",
      "EmployerName": "Kraft Inc."
    },
    {
      "id": 450452267,
      "TenantName": "Ramu Reddy",
      "EmployerName": "MSU"
    },
    {
      "id": 223056180,
      "TenantName": "Marion Black",
      "EmployerName": "MSU"
    },
    {
      "id": 173662690,
      "TenantName": "Venessa Williams",
      "EmployerName": "Kraft Inc."
    }
  ]
}
```

Figure 4: AI Agent JSON output using Node.js involving Node.js NLP

The Ask OpenAI Agent button interacts with the OpenAI through the OpenAI API key to translate the natural language request through a specific URL access on XE. In the Web browser the web page with OpenAI API output is as shown in Figure 5.

Hybrid AI Agent Demo

Example questions:

- **"List tenants"** — calls `api_get_alltenant_json`
- **"Show tenant 123456789"** — calls `api_get_tenant_json?p_tenant_ss=123456789`

show tenant 123456789



Ask Local Agent

Ask OpenAI Agent

Response:

```
{
  "mode": "openai-agent",
  "endpoint": "http://127.0.0.1:8080/xepsp/itc528inst.api_get_tenant_json?
p_tenant_ss=123456789",
  "summary": "The JSON output for tenant 123456789 provides the following details:\n\n
**Tenant SS**: 123456789\n- **Tenant Name**: Jack Robin\n- **Employer Name**: Kraft Inc."
}
```

Figure 5: AI Agent JSON output using OpenAI API

4.0 Conclusion

Generative AI is a paradigm shift in how information technology will shape our work and personal environment. AI Agents along with generative AI are the co-pillars of a successful AI environment in business. Such agents allow for the automation of not just single tasks, but the entire business processes and workflows. In essence AI Agents are the key through which generative AI facilitates business operations.

This tutorial presents a method for building AI Agents capable of performing business tasks that interact with a relational database. It demonstrates how to develop an AI Agent that connects to free Oracle XE database. The concepts introduced here can easily be extended to handle more complex, semantically driven tasks from a Generative AI perspective and to support more advanced database operations.

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TAX AVOIDANCE AND FIRM VALUE: THE MODERATING ROLES OF ESG PERFORMANCE AND AUDIT QUALITY

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Abstract

The present study attempts to develop a research framework for examining the relationship between tax avoidance and firm value, focusing on the moderating role of Environmental, Social, and Governance (ESG) performance and audit quality. The dataset is obtained from 181 listed companies in Japan from 2016 to 2024. Quantitative research method and regression model are utilized to assess if high ESG performance and audit quality modify the impact of tax avoidance on corporate value. Generalized Least Squares (GLS) method is also used to address the issues related to autocorrelation or heteroscedasticity. The study findings are expected to contribute to the current academic literature on corporate governance and tax management. Concurrently, the study proposes additional useful insights to support stakeholders and managers in formulating tax and governance strategies to promote transparency and sustainable development for firm value.

Keywords: Audit Quality; ESG; Firm Value; Sustainable Development; Tax Avoidance.

1. Introduction

Nowadays, sustainable development has become an important strategy for businesses around the world. In this context, integrated Environmental, Social, and Governance (ESG) reporting plays an essential role in corporate governance by enhancing transparency and clarity in information and management systems, thereby satisfying the expectations of stakeholders. This development trend reflects the increasing attention of stakeholders to sustainability information in addition to traditional financial factors (Sandberg et al., 2022). Despite efforts towards green transformation and ESG integration, businesses still face pressure to maximize profits. This leads to the adoption of legal measures to reduce costs, including tax avoidance, which is different from legal tax evasion (Kagan, 2025). However, excessive tax avoidance results in a risk to financial stability and transparency, leading to undermining investor trust (Gallemore et al., 2013).

As mentioned, ESG practices assist stakeholders in evaluating non-financial risks based on three dimensions: environmental, social, and governance dimensions, hence improving operation system efficiency, reducing costs, and enhancing investor and stakeholder confidence (Chen et al., 2024). Furthermore, ESG practices can limit excessive tax avoidance by upgrading the governance system, especially as tax fairness becomes more attention from regulators (Yuan et al., 2025).

Japan's energy and environmental issues pose significant struggles, while also being highly vulnerable to natural disasters. To illustrate, the earthquake-tsunami in 2011 caused the Fukushima nuclear disaster, leading Japan to shut down most of its nuclear power plants and increasing its dependence on imported fossil fuels. Furthermore, the Coronavirus crisis pandemic has further underlined the necessity to restructure the energy mix and expedite the process to renewable energy to achieve Japan's 2050 net-zero emissions goals. Through the context of Japan's economic difficulties, accompanied by its strict regulations, the country is placed in a suitable context for academic research.

Although evidence on the link between ESG activities and tax avoidance remains inconclusive (Gallemore et al., 2013), existing studies largely concentrate on European countries or emerging economies. The Japanese context remains underexplored. In addition, existing studies often analyze ESG and audit quality separately (Lee, 2024), while no study has jointly investigated their moderating roles in the link between tax avoidance and firm value. This gap is particularly crucial because ESG performance can contribute to sustainable outcomes, but it also carries a risk of greenwashing, while audit quality improves the reliability of financial reporting.

As a result, the study examines how ESG performance and audit quality moderate the relationship between tax avoidance and firm value in Japanese listed companies. These findings are expected to contribute new empirical evidence for Japan, while also encouraging more effective ESG adoption across Asia and international nations.

The purpose of this research is to examine the direct effect of tax avoidance on firm value, while exploring the moderating influence of ESG performance and audit quality. Those are strengthening ethics and trustworthiness, potentially providing a more comprehensive view of how tax avoidance affects firm value.

This study contributes to the existing literature by providing empirical evidence in the Japanese context, while also highlighting the combined moderating role of ESG performance and audit quality, an aspect that has not been fully analyzed in previous studies. These findings open new aspects for exploring the interaction between sustainable governance factors and long-term financial performance.

2. Literature Review

The study applies three main theories including stakeholder, agency, and signaling theories to assess the correlation between ESG performance, audit quality, tax avoidance, and firm value, thereby forming hypotheses.

The first theory is stakeholder theory, which emphasizes that organizations must be responsible to all stakeholders, not just shareholders (Sani et al., 2024). This approach allows companies to forge stronger relationships with shareholders and stakeholders, focusing on long-term sustainable development.

The second theory is agency theory, which refers to the relationship between two parties: one being the principals and the other being the agents (Linder et al., 2015). A dilemma in this relationship is that it is difficult for the owner to monitor the manager's performance because the two parties may not have common goals, leading to the risk of conflicts of interest.

Lastly, signaling theory concentrates on how related parties communicate information under conditions of information asymmetry, where one party is the transmitter of a signal, and the other party is the receiver of

the information and decides how to decode the meaning of that signal (Spence, 1973).

Several existing empirical studies have provided mixed findings on the correlation between ESG practices and tax avoidance. Rudyanto and Pirzada (2020) found that tax avoidance has a positive impact on environmentally sensitive industries and a negative impact on non-sensitive industries in the Indonesian context. Voon et al. (2024) collected data from 30 leading Malaysian listed companies and found that the environmental pillar had a negative impact on tax avoidance, the social pillar had an opposite trend, and the governance pillar was insignificant. Similarly, Lee (2024) found that in Chinese listed companies, the impact of ESG on tax avoidance depends on governance quality. The results indicated that only well-governed companies showed a positive association with social and governance aspects.

Through the studies mentioned, most of the differences in research results are largely due to the national context and the characteristics of each company. Therefore, the current study will provide additional empirical research in the Japanese context.

2.3 Hypotheses Development

Tax Avoidance and Firm Value

Remitting taxes is a compulsory obligation of each individual and corporation, contributing to the government budget that supports welfare, education, healthcare, infrastructure, and environmental protection (Sugars, 2024). Compliance with the law to fulfill tax obligations to the government demonstrates corporate responsibility towards stakeholders and the community, thereby promoting integrity in businesses and making an effort to develop the nation. Nevertheless, many companies take some measures to avoid taxes, including tax avoidance, as taxes cause financial burdens for many companies. Tax avoidance strategies can assist in reducing costs, increasing free cash flow, and allowing businesses to have more capital to reinvest in strategies such as CSR or ESG, thereby improving performance (Martin et al., 2020).

Although tax avoidance may bring some advantages to firms, such as higher after-tax profits, a large amount of empirical evidence suggests that the negative impacts from the associated risks often outweigh these benefits. Therefore, the research hypothesis is proposed:

Hypothesis 1: Tax avoidance has a negative impact on firm value.

ESG, Tax Avoidance and Firm Value

According to Freedman (2003), excessive tax evasion reduces government budgets, limits social welfare resources. Consequently, shareholders and investors often oppose this behavior as a negative signal that can harm corporate development. However, Chen et al. (2014) emphasize that transparency in voluntary disclosure, especially non-financial information, plays an important role in reducing market skepticism.

From the perspective of signaling theory, effective ESG practice enables the reduction of information asymmetry between internal and external parties. By voluntarily disclosing ESG indicators, businesses can demonstrate their commitment to using tax savings responsibly, showing that those resources are

strategically and ethically reinvested in sustainable development purposes (Rudyanto & Pirzada, 2020). ESG not only acts as an additional governance mechanism but also plays an moderating role that can weaken or strengthen the relationship between tax avoidance and firm value. As a result, the following hypothesis is suggested:

Hypothesis 2: The negative association between tax avoidance and firm value will be moderated by ESG performance.

Audit Quality, Tax Avoidance And Firm Value

One of the potential risks of tax avoidance behavior is the rise in agency costs (Chen et al., 2014). This not only negatively affects a firm's reputation and public image in the market but also undermines investor and stakeholder confidence, thereby eroding the core values that the firm seeks to achieve. In this circumstance, Carey and Simnett (2006) emphasize the role of auditors in ensuring the transparency and accountability of financial reporting. Thus, the audit of high quality supports firms in improving their moral behavior and compliance standards.

Audit quality acts as an effective monitoring mechanism, limiting the unethical use of tax strategies. Empirical evidence by Riguen et al. (2020) indicated that auditor expertise and audit fees, which are representative measures of audit quality, have an adverse effect on tax avoidance behavior. This suggests that auditor supervision can reduce the incentive to implement risky tax strategies, thereby protecting the long-term value of the firm. Consequently, the following hypothesis is proposed:

Hypothesis 3: The negative association between tax avoidance and firm value will be moderated by audit quality.

3. Research Methodology

3.1 Research design

In this study, quantitative methods are applied to analyze the correlation between ESG performance, audit quality, tax avoidance, and corporate value in listed companies in Japan. The research process involves a literature review to establish the theoretical framework, develop hypotheses, and construct a research model. Data are collected, cleaned, and analyzed by STATA 17, followed by discussions of the results, conclusions, and suggestions for future research.

3.2 Variable Measurement

Dependent Variables

In this study, the dependent variable is enterprise value, measured by the Tobin's Q ratio. This ratio reflects the relationship between a firm's book value and its market value. Thereby, it can be assessed whether the true value of the firm is overvalued or undervalued.

Independent Variables

In the study, tax avoidance is assessed using two measures: the Generally Accepted Accounting Principles

effective tax rate (GAAP ETR) and the Cash effective tax rate (CASH ETR). According to Huseynov and Klamm (2012), GAAP ETR reflects the tax recorded in the accounting books and is computed by dividing tax expense by pre-tax income. Whereas, Cash ETR represents the actual tax paid by the company. This figure is measured by taking the cash tax paid and dividing it by pre-tax income. A higher level of ETR indicates that the company is fully implementing its tax responsibilities, with limited use of tax incentives, deductions, or excessive tax avoidance. Conversely, a low ETR demonstrates that the company is paying less tax than the practical level. An abnormal ETR metric may signal that a company is using tax avoidance strategies to reduce its tax burden.

Moderating Variables

Two moderating variables are considered in this study, specifically ESG performance and audit quality, which may impact the relationship between tax avoidance and firm value.

Initially, ESG performance is measured by the ESG score, reflecting the level of corporate sustainability performance (Rajesh & Rajendran, 2019). The ESG score is presented on a scale of 0 to 100.

The consequent moderating variable is audit quality, which also influences the relationship between tax avoidance and firm value. This study uses a binary variable to represent audit quality. Specifically, companies audited by one of the Big 4 firms, including KPMG, EY, PwC, and Deloitte, will be assigned a value of "1" and "0" otherwise.

Control Variables

Although the study concentrates on analyzing the moderating effects of audit quality and ESG performance on the relationship between tax avoidance and firm value, other financial indicators that may affect firm value are also considered. Hence, a set of control variables including: Firm size (SIZE); Return on Assets (ROA); Leverage (LEV); Sales growth (GROWTH); Tangible assets (TANG); Cash (CASH); Liquidity (LIQDT); and Board of Audit committee (AUD_COM).

3.3 Econometric Model

Models with GAAP ETR as Tax Avoidance proxy

- Model H1 - A: Effect of tax avoidance (GAAP ETR) on firm value (Q)

$$Q_{i,t} = \beta_0 + \beta_1 \text{GAAP_ETR}_{i,t} + \beta_2 \text{SIZE}_{i,t} + \beta_3 \text{ROA}_{i,t} + \beta_4 \text{LEV}_{i,t} + \beta_5 \text{PPE}_{i,t} + \beta_6 \text{LIQDT}_{i,t} + \beta_7 \text{GROWTH}_{i,t} + \beta_8 \text{CASH}_{i,t} + \beta_9 \text{AUD_COM}_{i,t} + \varepsilon_{i,t}$$

- Model H2 - A: Moderating effect of ESG on relationship between tax avoidance (GAAP ETR) and firm value (Q)

$$Q_{i,t} = \beta_0 + \beta_1 \text{GAAP_ETR}_{i,t} + \beta_2 \text{ESG}_{i,t} + \beta_3 (\text{GAAP_ETR}_{i,t} \times \text{ESG}_{i,t}) + \beta_4 \text{SIZE}_{i,t} + \beta_5 \text{ROA}_{i,t} + \beta_6 \text{LEV}_{i,t} + \beta_7 \text{PPE}_{i,t} + \beta_8 \text{LIQDT}_{i,t} + \beta_9 \text{GROWTH}_{i,t} + \beta_{10} \text{CASH}_{i,t} + \beta_{11} \text{AUD_COM}_{i,t} + \varepsilon_{i,t}$$

- Model H3 - A: Moderating effect of audit quality (AQ) on relationship between tax avoidance (GAAP ETR) and firm value (Q)

$$Q_{i,t} = \beta_0 + \beta_1 \text{GAAP_ETR}_{i,t} + \beta_2 \text{AQ}_{i,t} + \beta_3 (\text{GAAP_ETR}_{i,t} \times \text{AQ}_{i,t}) + \beta_4 \text{SIZE}_{i,t} + \beta_5 \text{ROA}_{i,t} + \beta_6 \text{LEV}_{i,t} + \beta_7 \text{PPE}_{i,t} + \beta_8 \text{LIQDT}_{i,t} + \beta_9 \text{GROWTH}_{i,t} + \beta_{10} \text{CASH}_{i,t} + \beta_{11} \text{AUD_COM}_{i,t} + \varepsilon_{i,t}$$

Models with CASH ETR as Tax Avoidance proxy

- Model H1 - B: Effect of tax avoidance (CASH ETR) on firm value (Q)

$$Q_{i,t} = \beta_0 + \beta_1 \text{CASH_ETR}_{i,t} + \beta_2 \text{SIZE}_{i,t} + \beta_3 \text{ROA}_{i,t} + \beta_4 \text{LEV}_{i,t} + \beta_5 \text{PPE}_{i,t} + \beta_6 \text{LIQDT}_{i,t} + \beta_7 \text{GROWTH}_{i,t} + \beta_8 \text{CASH}_{i,t} + \beta_9 \text{AUD_COM}_{i,t} + \varepsilon_{i,t}$$

- Model H2 - B: Moderating effect of ESG on relationship between tax avoidance (CASH ETR) and firm value (Q)

$$Q_{i,t} = \beta_0 + \beta_1 \text{CASH_ETR}_{i,t} + \beta_2 \text{ESG}_{i,t} + \beta_3 (\text{CASH_ETR}_{i,t} \times \text{ESG}_{i,t}) + \beta_4 \text{SIZE}_{i,t} + \beta_5 \text{ROA}_{i,t} + \beta_6 \text{LEV}_{i,t} + \beta_7 \text{PPE}_{i,t} + \beta_8 \text{LIQDT}_{i,t} + \beta_9 \text{GROWTH}_{i,t} + \beta_{10} \text{CASH}_{i,t} + \beta_{11} \text{AUD_COM}_{i,t} + \varepsilon_{i,t}$$

- Model H3 - B: Moderating effect of audit quality (AQ) on relationship between tax avoidance (CASH ETR) and firm value (Q)

$$Q_{i,t} = \beta_0 + \beta_1 \text{CASH_ETR}_{i,t} + \beta_2 \text{AQ}_{i,t} + \beta_3 (\text{CASH_ETR}_{i,t} \times \text{AQ}_{i,t}) + \beta_4 \text{SIZE}_{i,t} + \beta_5 \text{ROA}_{i,t} + \beta_6 \text{LEV}_{i,t} + \beta_7 \text{PPE}_{i,t} + \beta_8 \text{LIQDT}_{i,t} + \beta_9 \text{GROWTH}_{i,t} + \beta_{10} \text{CASH}_{i,t} + \beta_{11} \text{AUD_COM}_{i,t} + \varepsilon_{i,t}$$

Where:

i : Firm i in year t

$Q_{i,t}$: Dependent variable representing firm value

$\text{GAAP_ETR}_{i,t}$: Independent variable representing tax avoidance

$\text{CASH_ETR}_{i,t}$: Independent variable representing tax avoidance

$\text{ESG}_{i,t}$: ESG score

$\text{AQ}_{i,t}$: Audit quality measured by Big 4 company

$\text{SIZE}_{i,t}$: Firm size

$\text{ROA}_{i,t}$: Return on assets

$\text{LEV}_{i,t}$: Financial leverage

$\text{PPE}_{i,t}$: Tangible assets

$\text{GROWTH}_{i,t}$: Change in total revenue compared to the previous period

$\text{CASH}_{i,t}$: Cash holdings

$\text{LIQDT}_{i,t}$: Liquidity

$\text{AUD_COM}_{i,t}$: Audit board committee

$\varepsilon_{i,t}$: Error term

3.4 Data Collection and Analysis

The study uses the data on listed companies in Japan over a nine-year period, from 2016 to 2024. Particularly, companies' financial statements and ESG information is gathered from Thomson Reuters Datastream, a reliable and reputable source for academic research.

The initial sample covered companies across various industries, except for financial firms, due to the distinct characteristics of their operations and regulatory frameworks. The final sample comprised 181 companies, corresponding to 1629 observations.

STATA 17 is employed to process the collected data. The analysis begins with data description and correlation testing among all variables. Next, Ordinary Least Squares (OLS) regression is used to estimate

the baseline and test the direct relationship between tax avoidance and firm value. Fixed Effects Model (FEM) and Random Effects Models (REM) are then applied. The Hausman test is used to select the appropriate model, and Generalized Least Squares (GLS) is utilized to correct for heteroskedasticity and autocorrelation, ensuring efficient estimates and reliable inference.

4. Conclusion

The current study's main purpose is to build a research model for discovering the joint moderating role of both ESG performance and audit quality in the relationship between tax avoidance and firm value. Nine-year data from Japanese listed companies during the period 2016–2024, along with quantitative methods, regression analysis, and complementary tests are employed to examine if higher levels of ESG performance and audit quality can mitigate the impact of tax avoidance.

The study is expected to not only contribute to the existing literature on the relationship among ESG, auditing, taxation, and the long-term value of enterprises, but also provides practical implications for firms by supporting boards of directors and management in implementing sound and reasonable tax strategies alongside sustainability and green development initiatives, thereby fostering resilient and sustainable corporate health.

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DEVELOPMENT OF PROFESSIONALISM: ESSENTIAL IN LEADING TO PROGRESSION OF INDIVIDUALS

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Abstract

The individuals, belonging to all occupations, communities and socio-economic backgrounds need to lead to up-gradation of professionalism. This is important and throughout the lives of individuals, they need to acknowledge the meaning and significance of professionalism. In carrying out this task, individuals need to augment various types of skills and abilities. Furthermore, they need to reinforce the traits of efficiency, honesty and truthfulness. These are the traits, which are facilitating in putting into operation various types of job duties and responsibilities in an adequate manner. It is understood on a comprehensive basis that individuals, belonging to all professions and fields experience problems in terms of various types of subjects and factors. These have major or minor effects on the career prospects and overall living conditions of individuals. Hence, they need to cope with these in a satisfactory manner. Furthermore, these are prevented from giving rise to impediments within the course of putting into operation various types of job duties and responsibilities within personal and professional lives. As a consequence, individuals will be successful in their job duties and responsibilities within homes, educational institutions and in all types of employment settings. In this manner, they will meet the expectations of family members, teachers and employers. Furthermore, individuals will render an important contribution in leading to up-gradation of overall personality traits and standards of living. Therefore, development of professionalism is essential in leading to progression of individuals. The main concepts that are taken into account in this research paper are understanding the meaning and significance of development of professionalism, measures to be put in operation in development of professionalism and advantages of development of professionalism.

Keywords: *Development, Educational Institutions, Employment Settings, Individuals, Job Duties, Methodologies, Professionalism, Progression*

Introduction

The development of professionalism is referred to up-gradation of knowledge, competencies and abilities among individuals. The pursuance of educational programs in educational institutions of all levels, getting engaged in employment opportunities and implementing effective communication processes with family and community members is regarded as the key in leading to gradation of knowledge, competencies and abilities among individuals. As a consequence, development of professionalism takes place among individuals (Professionalism, 2020).

The implementation of effective communication processes is facilitating in augmenting information in terms of various subjects and concepts; exchanging different types of ideas and viewpoints; obtaining answers to different types of questions and clarifying doubts in terms of various subjects and concepts. Furthermore, the possession of information in terms of communication ethics is facilitating in augmenting information in terms of various factors, subjects and concepts. As a consequence, mutual understanding will be developed with other members. The communication processes need to take place with calm and composed mind-sets. Communication processes takes place in a verbal and written form. Hence, implementing effective communication processes within and outside the homes is the key in developing professionalism. Therefore, it is well-understood; individuals need to communicate with others in an effective manner in development of professionalism.

The occurrences of psychological problems of anger, stress, anxiety, frustration and depression are regarded as an integral part of the lives of individuals. In personal lives, within the course of pursuance of educational programs in educational institutions of all levels and in all types of employment settings, individuals experience situations, which enable them to get overwhelmed by psychological problems. These are experienced in a major or minor form. The individuals need to augment information in terms of strategies, which are facilitating in providing solutions to these in an appropriate manner. Furthermore, these need to be prevented from giving rise to impediments within the course of development of professionalism (Chris, 2016).

When individuals experience various types of psychological problems, they need to augment information in terms of techniques of controlling these. As a consequence, these will be prevented from assuming a major form. In this manner, individuals will incur the feelings of pleasure and satisfaction. Furthermore, they will render an important contribution in bringing about improvements in their overall personality traits. One of the major benefits is, social circle of individuals will be strengthened in their personal and professional lives. Therefore, solving psychological problems of anger, stress, anxiety, frustration and depression is essential in development of professionalism.

Understanding the Meaning and Significance of Development of Professionalism

The individuals, belonging to all occupations, communities and socio-economic backgrounds need to be well-informed in terms of job duties and responsibilities. These are put into operation within personal lives, pursuance of educational programs in educational institutions of all levels and in all types of employment settings. These are complicated and manageable, these are implemented in less amount of time or can be more time-consuming and these are carried out on one's own or through working in co-ordination with other members. Furthermore, information needs to be augmented in terms of techniques of carrying these out in an effective manner. In addition, individuals will have to lead to up-gradation of different types of skills and abilities. Furthermore, inculcation of traits of proficiency and adeptness is the key in providing solutions to different types of dilemmas and challenging situations. In this manner, individuals will be well-prepared and generate desired outcomes. As a consequence, they will be able to put into practice all types of job duties and responsibilities in a satisfactory manner.

It is understood on a comprehensive basis that individuals aspire to be successful in their job duties and

responsibilities. As a consequence of doing well in these, individuals will contribute in achieving their desired goals and objectives. Furthermore, they will meet the expectations of family and community members. In this manner, development of professionalism will take place. The individuals are able to augment information in terms of all types of job duties and responsibilities through communicating with family members, teachers, classmates, employers, supervisors and colleagues; conducting research through utilizing various sources; personal and professional experience and daily life routine of the individuals. Therefore, individuals are able to acquire an efficient understanding of the meaning and significance of development of professionalism, when information is generated in terms of all types of job duties and responsibilities.

In putting into operation different types of job duties and responsibilities in an adequate manner, individuals need to augment information in terms of different types of methodologies and procedures. These are the techniques of doing well in one's job duties and responsibilities. The individuals need to acquire an efficient understanding of the concepts. Furthermore, they need to get engaged in regular practice. The regular practice is regarded as the key in augmenting information and understanding in terms of various types of methodologies and procedures. As a consequence, individuals will lead to up-gradation of confidence levels and overcome the feelings of apprehensiveness and vulnerability. Furthermore, individuals will have to hone their skills and abilities. Furthermore, inculcation of traits of morality, ethics, diligence and conscientiousness is the key in overcoming different types of setbacks. In this manner, individuals will not only be well-versed in terms of different types of methodologies and procedures, but they will put these into operation in a well-ordered and regimented manner.

As a consequence of putting into practice different types of methodologies and procedures in an appropriate manner, individuals will contribute in achieving their desired goals and objectives. Furthermore, they will meet the expectations of family members, teachers and employers. In this manner, development of professionalism will take place. The individuals are able to augment information in terms of different types of methodologies and procedures through communicating with family members, teachers, classmates, employers, supervisors and colleagues; getting enrolled in training and development programs; conducting research through utilizing various sources and possession of information in terms of all types of job duties and responsibilities in personal and professional lives. Therefore, one is able to acquire an understanding of the meaning and significance of development of professionalism, when information is generated in terms of different types of methodologies and procedures.

The individuals, belonging to all occupations, communities and socio-economic backgrounds need to inculcate the traits of efficiency, honesty and truthfulness. These are the traits, which are facilitating in acknowledging and implementing different factors, i.e. differentiating between various types of appropriate and inappropriate factors; reinforcing a constructive approach; forming positive viewpoints in terms of various factors and individuals; promoting calm and composed mind-sets; being well-informed in terms of job duties and responsibilities; being well-aware in terms of methodologies and procedures; utilizing different types of modern, scientific and innovative methods and materials; augmenting different types of skills and abilities; leading to up-gradation of motivation and concentration levels towards works; putting in efforts to one's best abilities; possessing the abilities to work under stress; providing solutions to various

types of problems and carrying out all types of job duties and responsibilities in a well-ordered and disciplined manner. These factors are to be implemented by individuals in personal lives, educational institutions of all levels and in all types of employment settings.

As a consequence of acknowledging and implementing these traits, individuals will do well in their job duties and responsibilities and achieve their desired goals and objectives. Furthermore, they will meet the expectations of family members, teachers and employers. In this manner, development of professionalism will take place in an efficacious manner. These traits are facilitating to individuals in reinforcing professionalism in the overall personality of individuals. As a consequence, they will incur the feelings of pleasure and contentment. Hence, when they will communicate and work with others, they will prove that they are professional in their conduct. Throughout the lives of individuals, they need to acknowledge and put into operation the traits of efficiency, honesty and truthfulness. Therefore, an understanding of the meaning and significance of development of professionalism is acquired, when individuals are inculcating the traits of efficiency, honesty and truthfulness.

Measures to be put in operation in Development of Professionalism

An aimless life is a meaningless life. Hence, individuals, belonging to all occupations, communities and socio-economic backgrounds have goals and objectives to achieve. The different factors in terms of which these are formulated are education, careers, employment opportunities, family, relationships, settlement, assets, property, resources, infrastructure, amenities, facilities, travelling, health, well-being, personality traits and overall standards of living. In order to achieve all types of goals and objectives, individuals need to be well-prepared. They need to lead to up-gradation of their competencies and abilities. Furthermore, development of professionalism is the key in achieving desired goals and objectives in an appropriate manner (Professional Development, 2017).

From the stage of early childhood, throughout the lives of individuals, they need to augment information in terms of measures, which are facilitating in development of professionalism. All types of measures are required to be put into operation in a well-ordered and regimented manner. Furthermore, positivity needs to be reinforced in all types of measures. One of the important aspects that needs to be taken into account is, all measures need to be approving in promoting well-being and goodwill of individuals. The information in terms of measures is acquired through communicating with family and community members, conducting research and personal and professional experience of the individuals. Therefore, measures to be put in operation in development of professionalism are stated as follows:

Implementing Effective Communication Processes

The implementation of effective communication processes is essential with family and community members. This is facilitating in augmenting information in terms of various subjects and concepts; exchanging different types of ideas and viewpoints; obtaining answers to different types of questions and clarifying doubts in terms of various subjects and concepts. Furthermore, the possession of information in terms of communication ethics is facilitating in augmenting information in terms of various factors, subjects and concepts. These are making use of polite language and decent words; treating others with respect and

courtesy; making provision of factual information; building trust and understanding; reinforcing the traits of proficiency and adeptness; depicting the traits of helpfulness and co-operation and possessing an approachable nature and an amiable attitude. The acknowledgement and implementation of communication ethics is the key in development of professionalism.

As a consequence, mutual understanding will be developed with other members. The communication processes need to take place in a peaceful manner. Communication processes takes place in a verbal and written form. Hence, implementing effective communication processes within and outside the homes is the key in developing professionalism. Hence, it is understood on a comprehensive basis; individuals need to communicate with family members, relatives, friends, neighbors, teachers, classmates, employers, colleagues and other community members in an effective manner. As a consequence, they will prove that they are professional in their conduct. Therefore, implementing effective communication processes is regarded as one of the indispensable measures to be put in operation in development of professionalism.

Promoting Normal Mind-sets

In development of professionalism, individuals, belonging to all age groups, genders, occupations, communities and socio-economic backgrounds need to promote normal mind-sets. In personal lives, within the course of pursuance of educational programs in educational institutions of all levels and in all types of employment settings, individuals experience situations, which enable them to experience psychological problems. The individuals need to augment information in terms of strategies, which are facilitating in providing solutions to these in a satisfactory manner. As a consequence of implementing strategies in an appropriate manner, normal mind-sets will be promoted. The different types of strategies are related to possession of information in terms of competencies, abilities, job duties, responsibilities, methodologies, procedures, approaches, relationships, forming an effective social circle, alleviating loneliness and so forth. Furthermore, development of professionalism will take place in an appropriate manner.

As a consequence of putting into operation all strategies in an efficacious manner, individuals will incur the feelings of pleasure and satisfaction and promote normal mind-sets. Furthermore, they will render an important contribution in bringing about improvements in their overall personality traits and standards of living. One of the major benefits is, mind-sets of the individuals will be stimulated and they will put in their best efforts in implementing job duties and responsibilities in their personal and professional lives. Hence, it is well-understood; promoting normal mind-sets is essential in development of professionalism. Therefore, promoting normal mind-sets is one of the significant measures to be put in operation in development of professionalism.

Being well-informed in terms of Job Duties and Responsibilities

The individuals, belonging to all occupations, communities and socio-economic backgrounds need to be well-informed in terms of job duties and responsibilities. These are put into operation within personal lives, pursuance of educational programs in educational institutions of all levels and in all types of employment settings. These are complicated and manageable, these are implemented in less amount of time or can be more time-consuming and these are carried out on one's own or through working in co-ordination

with other members. Furthermore, information needs to be augmented in terms of techniques of implementing these in a satisfactory manner. In addition, individuals will have to lead to up-gradation of different types of skills and abilities. Furthermore, inculcation of traits of expertise and reliability is the key in generating desired outcomes. As a consequence, they will put into practice all types of job duties and responsibilities in an efficacious manner.

It is understood to a major extent that individuals aspire to be successful in their job duties and responsibilities. As a consequence of doing well in these, individuals will contribute in achieving their desired goals and objectives. Furthermore, they will meet the expectations of family and community members. In this manner, development of professionalism will take place. The individuals are able to augment information in terms of all types of job duties and responsibilities through communicating with family members, teachers, classmates, employers, supervisors and colleagues; conducting research through utilizing various sources; personal and professional experience and daily life routine of the individuals. Therefore, being well-informed in terms of job duties and responsibilities is an eminent measure to be put in operation in development of professionalism.

Generation of Information in terms of Methodologies and Procedures

In putting into operation different types of job duties and responsibilities in a satisfactory manner, individuals need to augment information in terms of different types of methodologies and procedures. The individuals need to acquire an efficient understanding of the concepts. Furthermore, they need to get engaged in regular practice. This is the key in augmenting information and understanding in terms of various types of methodologies and procedures. As a consequence, individuals will lead to up-gradation of confidence levels and overcome the feelings of apprehensiveness and vulnerability. Furthermore, individuals need to hone their competencies and abilities. In this manner, individuals will not only be well-versed in terms of different types of methodologies and procedures, but they will put these into operation in a well-organized manner.

As a consequence of putting into practice different types of methodologies and procedures in an appropriate manner, individuals will be well-prepared in terms of techniques of achieving their desired goals and objectives. Furthermore, they will meet the expectations of family members, teachers and employers. In this manner, development of professionalism will take place. The individuals are able to augment information in terms of different types of methodologies and procedures through communicating with family and community members; getting enrolled in training and development programs; conducting research through utilizing various sources and possession of information in terms of all types of job duties and responsibilities in personal and professional lives. Therefore, generation of information in terms of methodologies and procedures is an expedient measure to be put in operation in development of professionalism.

Utilizing Modern, Scientific and Innovative Methods and Materials

With advancements taking place and with the advent of modernization and globalization, individuals, belonging to all occupations, communities and socio-economic backgrounds are making use of different

types of modern, scientific and innovative methods and materials. These are utilization of tools, devices, apparatus, machinery, equipment, gear and technologies. The individuals need to acquire an efficient understanding of the concepts. Furthermore, they need to get engaged in regular practice. As a consequence, individuals will lead to up-gradation of confidence levels and overcome the feelings of apprehensiveness and vulnerability. Furthermore, individuals will have to hone their skills and abilities in generating desired outcomes.

As a consequence of putting into practice different types of these methods and materials in an appropriate manner, individuals will contribute in achieving their desired goals and objectives. Furthermore, they will meet the expectations of family member and individuals in leadership positions in all types of professional settings. In this manner, development of professionalism will take place in an efficacious manner among individuals. The individuals are able to augment information in terms of different types of these methods and materials through communicating with family members, teachers, classmates, employers, supervisors and colleagues; getting enrolled in training and development programs; conducting research through utilizing various sources and possession of information in terms of all types of job duties and responsibilities. Therefore,utilizing modern, scientific and innovative methods and materialsis a renowned measure to be put in operation in development of professionalism.

Inculcating the Traits of Morality and Ethics

The individuals, belonging to all occupations, communities and socio-economic backgrounds need to inculcate the traits of morality and ethics. These are the traits, which are facilitating in acknowledging and implementing different factors, i.e. differentiating between various types of appropriate and inappropriate factors; reinforcing a constructive approach; forming positive viewpoints in terms of various factors and individuals; promoting calm and composed mind-sets; forming cordial and amiable terms and relationships with other members; augmenting different types of skills and abilities; leading to up-gradation of motivation and concentration levels towards works; putting in efforts to one's best abilities; possessing the abilities to work under stress and carrying out all types of job duties and responsibilities in a well-ordered and disciplined manner. These factors are to be implemented by individuals in personal lives, educational institutions of all levels and in all types of employment settings.

As a consequence of acknowledging and implementing these traits, individuals will do well in their job duties and responsibilities and achieve desired goals and objectives. Furthermore, they will meet the expectations of family members, teachers and employers. In this manner, development of professionalism will take place in an efficacious manner. These traits are facilitating to individuals in strengthening professionalism in their overall personality traits. As a consequence, they will incur the feelings of pleasure and contentment. Throughout the lives of individuals, they need to acknowledge and put into operation the traits of morality and ethics. Therefore,inculcating the traits of morality and ethics is a decisive measure to be put in operation in development of professionalism.

Implementing the Traits of Diligence, Resourcefulness and Conscientiousness

Implementing the traits of diligence, resourcefulness and conscientiousness is essential for individuals,

belonging to all occupations, communities and socio-economic backgrounds. These are the traits, which are facilitating in acknowledging and implementing different factors, i.e. honing analytical and critical-thinking skills; making wise and productive decisions in terms of various factors; being well-informed in terms of job duties and responsibilities; being well-aware in terms of methodologies and procedures; utilizing different types of modern, scientific and innovative methods and materials; augmenting different types of skills and abilities; leading to up-gradation of motivation and concentration levels towards works; putting in efforts to one's best abilities; possessing the abilities to work under stress; providing solutions to various types of problems and carrying out all types of job duties and responsibilities in a well-ordered and disciplined manner. These factors are to be implemented by individuals in personal and professional lives.

As a consequence of acknowledging and implementing these traits, individuals will do well in their job duties and responsibilities and achieve desired goals and objectives. Furthermore, they will meet the expectations of family members, teachers and employers. In this manner, development of professionalism will take place in a satisfactory manner. As a consequence, individuals will be successful in their job duties and responsibilities. Hence, when they will communicate and work with others, they will prove that they are professional in their conduct. Throughout the lives of individuals, they need to acknowledge and put into operation these traits. Therefore, implementing the traits of diligence, resourcefulness and conscientiousness is an imperative measure to be put in operation in development of professionalism.

Augmenting Skills and Abilities

Throughout the lives of individuals, belonging to all occupations, communities and socio-economic backgrounds need to lead to up-gradation of various types of skills and abilities. The different types of skills are communication skills, decision-making skills, critical-thinking skills, analytical skills, problem-solving skills, time-management skills, technical skills, creative skills, leadership skills, negotiation skills, personal skills, presentation skills, professional skills, intellectual skills, artistic skills, public-speaking skills and educational skills. The abilities, which need to be honed are convincing, persuading, planning, organizing, directing, controlling, co-ordinating, leading, negotiating, emotional intelligence, systems thinking, putting in efforts to one's best abilities, possessing the abilities to work under stress, providing solutions to various types of problems and carrying out all types of job duties and responsibilities in a well-ordered and disciplined manner. The different types of skills and abilities are to be implemented by individuals in personal and professional lives (7 Qualities of Truly Authentic People, 2016).

The implementation of different types of skills and abilities is facilitating to individuals in putting into operation various types of job duties and responsibilities in a successful manner. As a consequence, individuals will meet the expectations of family members and individuals in leadership positions in all types of professional settings. Furthermore, development of professionalism will take place in a satisfactory manner. As a consequence, individuals will contribute in bringing about improvements in their overall personality traits and quality of lives. Therefore, augmenting skills and abilities is a favorable measure to be put in operation in development of professionalism.

Providing Solutions to various Problems

In the lives of the individuals in both personal and professional spheres, they experience problems in terms of various factors, i.e. job duties, responsibilities, methodologies, procedures, approaches, techniques, strategies, work pressure, lack of implementation of time-management skills, lack of analytical, critical-thinking and problem-solving skills, unawareness in terms of various subjects and concepts, scarcity of financial, human, technical, material and information resources, lack of infrastructure, amenities and facilities, peer issues, health problems and illnesses, psychological problems and so forth. The individuals need to augment information in terms of strategies, which are facilitating in providing solutions to these in an appropriate manner. Furthermore, these need to be prevented from giving rise to impediments within the course of development of professionalism.

The individuals need to lead to up-gradation of problem-solving skills. These are the skills, which are facilitating in identifying the causes of problems. After the causes are identified, solutions are provided to these in an effective manner. Furthermore, these are to be prevented from giving rise to impediments within the course of development of professionalism. The individuals provide solutions to different types of problems on their own or through obtaining help from family and community members. Hence, formation of pleasant terms and relationships with them is regarded to be of utmost significance. As a consequence of providing solutions to different types of problems, individuals will be successful in their job duties and responsibilities. Furthermore, development of professionalism will take place in an appropriate manner. Therefore, providing solutions to various problems is an advantageous measure to be put in operation in development of professionalism.

Taking out Sufficient Time for all Job Duties and Responsibilities

Within personal lives, within the course of pursuance of educational programs in educational institutions of all levels and in all types of employment settings, individuals are required to carry out number of job duties and responsibilities. They need to take out sufficient amount of time for all job duties and responsibilities. These are implemented in less amount of time or can be more time-consuming. The individuals assign priorities to the job duties and responsibilities. The ones, which are more important are carried out first, whereas, the ones, which are less important are implemented after the completion of more important ones. Procrastination is avoided. Hence, individuals need to lead to up-gradation of time-management skills. These are the skills, which are facilitating in taking out sufficient amount of time for all job duties and responsibilities.

The individuals in this manner will be able to create a balance between personal and professional lives. Furthermore, they will be able to devote sufficient amount of time for all job duties and responsibilities in both personal and professional spheres. As a consequence, individuals will complete their job duties and responsibilities within the stipulated period of time. In addition, achievement of desired goals and objectives in both personal and professional spheres will take place in a satisfactory manner. Furthermore, they will meet the expectations of family members, teachers and employers. In this manner, development of professionalism will take place in a satisfactory manner. The acknowledgment and implementation of time-management skills is essential in development of professionalism. Therefore, taking out sufficient time for all job duties and responsibilities is a useful measure to be put in operation in development of

professionalism.

Advantages of Development of Professionalism

Throughout the lives of individuals, they need to put emphasis on up-gradation of knowledge, competencies and abilities. These are required to be put into practice within personal lives, pursuance of educational programs in educational institutions of all levels and implementation of job duties and responsibilities in all types of employment opportunities. The possession of information in terms of various types of job duties and responsibilities is crucial in development of professionalism. Furthermore, the conduct and decorum of individuals need to be moral and ethical (Ryan, n.d.). Development of professionalism is advantageous to individuals on a comprehensive basis. Therefore, advantages of development of professionalism are promoting enhancement of career prospects; meeting the expectations of family and community members; incurring the feelings of pleasure and contentment; leading to up-gradation of overall personality traits and bringing about improvements in one's overall quality of lives. These are stated as follows:

Promoting enhancement of Career Prospects

Promoting enhancement of career prospects is regarded as one of the major goals of individuals, belonging to all occupations, communities and socio-economic backgrounds. The individuals make selection of careers in accordance to their interests and abilities. The different fields that are selected are education, arts, literature, architecture, business, management, administration, science, technology, medical, engineering, health care, law, journalism and so forth. In all fields, individuals, belonging to all job positions need to be well-informed in terms of job duties and responsibilities. Furthermore, information needs to be augmented in terms of techniques of carrying these out in an effective manner. In addition, individuals will have to lead to up-gradation of different types of skills and abilities. This is facilitated through development of professionalism. Hence, it is considered to be advantageous to individuals on a comprehensive basis. Therefore, promoting enhancement of career prospects is regarded as one of the indispensable advantages of development of professionalism.

Meeting the Expectations of Family and Community Members

As a consequence of development of professionalism, individuals will do well in their job duties and responsibilities in both personal and professional spheres. In this manner, they will achieve desired goals and objectives. Furthermore, they will carry out their job duties and responsibilities in accordance to the expectations of family members, teachers and employers. In this manner, they will incur the feelings of pleasure and contentment. Hence, it is understood on a comprehensive basis that development of professionalism is considered to be advantageous to individuals. Therefore, meeting the expectations of family and community members is one of the significant advantages of development of professionalism.

Incurring the Feelings of Pleasure and Contentment

As a consequence of development of professionalism, individuals will be successful in their works in

both personal and professional lives. In this manner, they will achieve desired goals and objectives. Furthermore, they will carry out their job duties and responsibilities in accordance to the expectations of family members and individuals in leadership positions. In this manner, they will incur the feelings of pleasure and contentment. Hence, it is understood to a major extent that development of professionalism is considered to be advantageous to individuals, belonging to all occupations and fields. Therefore, incurring the feelings of pleasure and contentment is an eminent advantage of development of professionalism.

Leading to Up-gradation of overall Personality Traits

Leading to up-gradation of overall personality traits is an important goal of individuals, belonging to all occupations, communities and socio-economic backgrounds. As a consequence of development of professionalism, individuals will augment information in terms of factors, which are facilitating in achievement of this goal. The different factors are diet and nutrition; exercises and physical activities; yoga and meditation; treating various types of health problems and illnesses; forming an effective social circle; alleviating loneliness and so forth. The implementation of all these factors is facilitating in leading to up-gradation of overall personality traits. Therefore, leading to up-gradation of overall personality traits is an expedient advantage of development of professionalism.

Bringing about Improvements in one's overall Quality of Lives

Bringing about improvements in one's overall quality of life is an essential goal of individuals, belonging to all occupations, communities and socio-economic backgrounds. As a consequence of development of professionalism, individuals will augment information in terms of factors, which are facilitating in achievement of this goal. The different factors are education, careers, employment opportunities, family, relationships, settlement, assets, property, resources, infrastructure, amenities, facilities, travelling, health, well-being and overall personality traits. The implementation of all these factors will enable individuals to achieve this goal. Therefore, bringing about improvements in one's overall quality of life is a renowned advantage of development of professionalism.

Conclusion

The development of professionalism is referred to up-gradation of knowledge, competencies and abilities among individuals. This is facilitated through communicating with family and community members, educational institutions of levels and all types of employment settings. Furthermore, information needs to be augmented regarding measures to be put in operation in development of professionalism. In addition, individuals need to be well-informed in terms of advantages of development of professionalism. Finally, it can be stated, development of professionalism is the key in leading to progression of individuals in their personal and professional lives.

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ECONOMIC POLICY UNCERTAINTY, OIL PRICE UNCERTAINTY AND CORPORATE INVESTMENT IN AN EMERGING ECONOMY

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Abstract

This study aims to propose a research model for investigating the relationship between economic policy uncertainty (EPU), oil price uncertainty (OPU), and corporate investment within an energy sector in an emerging economy, Vietnam. Leveraging a panel dataset of approximately 100 listed Vietnamese energy firms from 2015 to 2025, the study will discern the direct impacts of OPU and EPU on corporate capital investment decisions. Furthermore, it examines the moderating roles of firm size and market volatility in these relationships. The study employs panel regression techniques – including Ordinary Least Squares (OLS) as well as fixed-effects and random-effects models – with robust standard errors clustered at the firm level. The study seeks to provide nuanced insights into how different forms of uncertainty influence investment behavior in a developing economy's critical energy sector. The expected findings will offer valuable implications for corporate managers, policymakers, and investors as they navigate an evolving energy market amid both global and domestic uncertainties.

Keywords: *Corporate Investment; Economic Policy Uncertainty; Emerging Economy; Oil Price Uncertainty.*

1. Introduction

Corporate investment drives long-term growth through capital allocation to productive assets. However, because such investments are irreversible and depend on expected future returns, uncertainty—economic, financial, or policy—often discourages firms from committing resources. Theories like Real Options (Dixit & Pindyck, 1994), Neoclassical Investment (Jorgenson, 1963), and Tobin's q (Tobin, 1969) all explain how uncertainty raises risk premiums, depresses valuations, and delays investment. Empirical evidence (Bloom, 2009; Gulen & Ion, 2016) confirms that heightened uncertainty reduces investment, especially in policy-sensitive and capital-intensive sectors like energy. Ilyas et al. (2021) further show that both economic policy uncertainty (EPU) and oil price uncertainty (OPU) significantly depress investment in global oil firms, with stronger effects in crises. Yet, most research focuses on advanced economies, leaving emerging markets underexplored.

Emerging economies face intensified uncertainty due to weaker institutions, volatile regulations, and

shallow financial systems. In such contexts, EPU and OPU jointly constrain corporate investment. Oil price fluctuations influence costs, inflation, and fiscal stability, while unpredictable policies on tariffs, subsidies, or environmental rules further deter capital formation. Because these markets lack strong policy credibility, their investment reactions differ from those of advanced economies. Vietnam offers an ideal case to examine these dynamics, combining exposure to global oil markets with evolving domestic reforms.

Vietnam's energy industry has transitioned from state control toward liberalization, attracting private and foreign investment through reforms and renewable incentives. However, oil-price volatility, pandemic shocks, and frequent regulatory changes have created uncertainty, particularly amid Vietnam's commitment to net-zero emissions by 2050. While state-owned enterprises continue investing under government direction, private firms often delay spending amid policy ambiguity. Vietnam's hybrid structure—marked by evolving regulations and mixed ownership—modifies traditional investment theories, making it an important case to study how uncertainty interacts with firm heterogeneity and policy transitions.

The main objective of this study is to investigate how economic policy uncertainty (EPU) and oil price uncertainty (OPU) influence corporate investment decisions in Vietnam's energy sector. Although uncertainty is widely recognized as a determinant of investment in advanced economies (Bloom, 2009; Gulen & Ion, 2016; Ilyas et al., 2021), its effects in emerging and transitional contexts remain insufficiently understood. Vietnam's hybrid energy system—characterized by state dominance, gradual market liberalization, and a transition toward low-carbon development—offers a rich empirical setting to explore how uncertainty interacts with institutional and market realities.

To fill the research gaps identified earlier, this study pursues three specific objectives: (1) to quantify the direct impact of EPU and OPU on firm-level investment; (2) to conduct a *sector-specific* empirical analysis of Vietnam's energy industry, capturing contextual and structural sensitivities; and (3) to examine how firm size and market volatility moderate the effects of uncertainty on investment. Together, these objectives advance understanding of investment behavior under uncertainty in emerging markets and generate evidence for both managerial and policy applications.

2. Literature Review

2.1.Theoretical Background

Uncertainty affects investment decisions in complex and sometimes contradictory ways. While traditional theories emphasize its negative influence—reducing firms' willingness to commit to irreversible expenditures—alternative frameworks suggest that uncertainty may also stimulate investment by creating strategic opportunities. This section synthesizes both streams of thought and introduces additional perspectives that explain how firm characteristics and financial conditions can moderate these relationships.

The Real Options Theory (Dixit & Pindyck, 1994) provides the most influential explanation for a negative relationship between uncertainty and investment. It views investment as an option—a right but not an obligation—to commit capital. When projects are costly to reverse and future returns uncertain, firms gain value from waiting for more information before investing. This “option value of waiting” raises the

threshold rate of return required for investment, leading to deferral or reduction of capital spending (Pindyck, 1991). Under this view, both economic policy uncertainty and oil price volatility discourage investment. Policy ambiguity complicates expectations about taxation, regulation, or subsidies, while oil-price swings disrupt cash-flow forecasts and cost structures. Firms respond by delaying or canceling projects until uncertainty resolves (Bloom, 2009).

The Neoclassical Investment Theory, first developed by Jorgenson (1963), explains investment as a function of the expected marginal product of capital relative to its user cost. Firms invest when the expected return exceeds this cost, which includes interest rates, depreciation, and taxes. Uncertainty affects this equilibrium by increasing financing costs and reducing expected profitability, both of which lower the incentive to invest. From this perspective, economic policy uncertainty raises perceived risk premiums and financing costs, while oil-price volatility increases the unpredictability of input costs and inflation expectations. Together, these factors elevate the user cost of capital and discourage new capital formation (Gulen & Ion, 2016).

The Real Options Theory, as originally formulated by Dixit and Pindyck (1994), emphasized the value of waiting under uncertainty. However, subsequent extensions—sometimes referred to as the “opportunity-seeking” interpretation—recognize that flexible firms may also capitalize on uncertainty to secure advantageous positions (Kulatilaka & Perotti, 1998; Trigeorgis, 1996). When uncertainty widens the distribution of potential outcomes, it increases not only the risk but also the potential upside for firms capable of adapting quickly.

The Schumpeterian Growth Theory and related strategic competition frameworks emphasize that uncertainty and volatility can serve as catalysts for innovation and creative destruction (Schumpeter, 1942; Aghion & Howitt, 1992). In competitive markets, uncertainty regarding future technologies, regulations, or prices may stimulate firms to innovate preemptively to gain first-mover advantages or secure favorable policy positioning (Nelson & Winter, 1982).

The Resource-Based View (RBV) (Barney, 1991) emphasizes that firms’ unique resources and capabilities determine their capacity to withstand external shocks. Larger firms generally possess greater financial resources, diversified operations, and stronger relationships with regulators and financiers, allowing them to absorb uncertainty more effectively. Conversely, smaller firms—often constrained by limited liquidity and market access—are more vulnerable to shocks.

From the standpoint of modern portfolio theory, the Capital Asset Pricing Model (CAPM) asserts that investors require higher expected returns to compensate for higher systematic risk (Sharpe, 1964; Lintner, 1965). Under volatile market conditions, investors demand larger risk premiums, which depresses stock valuations and increases firms’ cost of equity. Consequently, heightened volatility diminishes firms’ market capitalization—lowering Tobin’s q —and constrains access to external financing for new projects (Fama &

French, 2004). In contrast, under relatively stable markets, firms and investors may interpret temporary policy or oil price shocks as transitory phenomena, thereby maintaining investment levels. However, during episodes of sustained volatility, market participants reassess risk more conservatively, amplifying the adverse effects of both economic policy uncertainty (EPU) and oil price uncertainty (OPU) on investment.

2.2. Review of Previous Studies

The relationship between uncertainty and corporate investment has been widely explored in the international finance and economics literature. Uncertainty—whether arising from government policy, global markets, or commodity price volatility—affects firm expectations, financing conditions, and ultimately capital spending decisions. This section reviews empirical evidence on economic policy uncertainty (EPU) and oil price uncertainty (OPU) as determinants of investment, drawing from both global and regional contexts, and concludes with insights specific to Vietnam's energy sector. The review is structured into three main parts: (1) global studies, (2) regional and emerging economy evidence, and (3) Vietnam-specific findings, followed by a synthesis highlighting research gaps.

A large body of empirical work supports the view that economic policy uncertainty reduces corporate investment. The seminal study by Bloom (2009) showed that uncertainty shocks lead to significant declines in output and investment across OECD firms, as managers delay capital commitments until policy directions become clearer. Julio and Yook (2012) extended this evidence to political cycles, finding that corporate investment systematically falls during election years in 48 countries, reflecting firms' aversion to policy unpredictability.

In the U.S. context, Gulen and Ion (2016) provided strong empirical support using firm-level data: a one-standard-deviation increase in the EPU index reduces corporate investment by approximately 2%, with the largest effects concentrated in policy-sensitive industries such as energy, construction, and defense. Their findings align with the Real Options Theory, as uncertainty raises the option value of waiting, leading firms to postpone or scale back investment. Similarly, Pastor and Veronesi (2013) emphasized that political uncertainty elevates equity risk premiums, lowering stock valuations and reducing Tobin's q , which further discourages investment.

These global studies converge on a consistent conclusion: higher EPU leads to greater investment caution, delayed project initiation, and increased reliance on internal funds. Such effects are particularly pronounced in sectors heavily influenced by regulatory frameworks—like energy—where firms face additional exposure to tax reforms, environmental regulations, and government subsidies.

Parallel to policy-related uncertainty, oil price uncertainty (OPU) also exerts a profound influence on firm investment behavior. Early macroeconomic analyses by Bernanke (1983) and Pindyck (1991) argued that oil price volatility induces “irreversible investment” behavior—firms hesitate to commit capital when input costs are unpredictable. Hamilton (2003) further documented that oil price shocks explain a large portion of postwar recessions in the United States, as energy cost volatility discourages industrial expansion and capital accumulation.

Empirical firm-level studies reinforce these theoretical claims. Henriques and Sadorsky (2011) found that oil

price fluctuations significantly depress renewable energy stock prices and investment levels, suggesting that energy transitions are highly sensitive to OPU. Ilyas et al. (2021) offered the most comprehensive analysis to date, examining 4,017 oil-sector firms across 18 countries between 1991 and 2017. Their results showed that both EPU and OPU have statistically significant negative effects on corporate investment, with the relationship intensifying during financial crises and in oil-producing countries. Together, these findings provide strong global evidence that both types of uncertainty independently and jointly reduce investment spending. The global literature therefore establishes a robust theoretical and empirical foundation for studying similar effects in emerging markets like Vietnam, where energy sectors are increasingly exposed to external and domestic uncertainty.

Within the Asia-Pacific region, studies have shown that uncertainty effects are generally stronger in emerging markets due to institutional weaknesses and limited policy credibility. Kang, Lee, and Ratti (2014) investigated South Korea and Japan and found that increases in EPU significantly lower firm investment and R&D expenditure, particularly in manufacturing and energy industries. Zhou et al. (2018), focusing on China, reported that EPU negatively affects investment but with a nonlinear pattern—private firms are more sensitive to policy shocks than state-owned enterprises, reflecting differences in financing access and government support.

Other research has examined the transmission of oil price uncertainty in Asian markets. Lee et al. (2020) found that oil price volatility has asymmetric effects on investment, with negative shocks causing larger contractions in capital spending than positive shocks stimulate expansions. Their results are especially relevant for net oil-importing economies such as Vietnam, where price increases directly raise production costs and depress investment. In addition, Nguyen and Dang (2024) provided regional evidence linking EPU and geopolitical risk to stock performance in ASEAN markets, showing that heightened uncertainty weakens profitability and market valuation of listed firms. These findings collectively underscore the vulnerability of Asian firms to both domestic and international uncertainty, magnified by limited hedging mechanisms and underdeveloped financial systems.

Vietnam's transition from a centrally planned to a market-oriented economy has been accompanied by persistent policy volatility, frequent regulatory reforms, and evolving institutional frameworks. Several recent studies have begun to quantify how these dynamics affect firm performance. Phan et al. (2019) found that higher economic policy uncertainty in Vietnam significantly lowers stock market returns and corporate profitability, particularly for firms with high capital intensity. Vo and Tran (2021) extended this analysis by showing that both domestic and global EPU indices increase firms' financing costs and reduce investment propensity. Similarly, Nguyen et al. (2023) reported that macroeconomic and fiscal policy uncertainty dampens capital formation across manufacturing and utilities sectors.

Research on oil price uncertainty in Vietnam has largely focused on its macroeconomic and sectoral effects. Le and Bui (2020) demonstrated that crude oil price fluctuations have a negative impact on the profitability and investment levels of PetroVietnam and downstream refining firms. Hoang et al. (2022) found that global oil shocks are transmitted to Vietnam's stock and energy markets, amplifying volatility and reducing industrial output. Similarly, Doan and Nguyen (2023) analyzed renewable energy projects and reported that

both oil price volatility and policy uncertainty surrounding feed-in tariffs discourage new investment in the solar and wind sectors. These studies illustrate that oil price uncertainty directly affects Vietnam's energy firms through multiple channels: operational costs, revenue forecasts, and investment expectations. However, most of the existing research focuses on isolated effects—either EPU or OPU—and relies primarily on sector-level or macroeconomic data. Firm-level, multi-dimensional analysis of how both uncertainties interact remains largely absent from the Vietnamese context.

Overall, the empirical literature provides strong evidence that uncertainty—both in policy and commodity markets—reduces investment by raising risk perceptions and delaying decision-making. Yet, several important research gaps remain, particularly in the context of Vietnam's energy sector. These gaps reveal that while the global literature provides a strong theoretical and empirical base, country-specific institutional factors can meaningfully alter the uncertainty–investment relationship. Vietnam's unique blend of state control, policy transition, and energy market exposure makes it an ideal context to extend existing research. Accordingly, this study aims to bridge these gaps by providing firm-level evidence on how economic policy and oil price uncertainties influence corporate investment, and how these effects vary with firm size and market volatility in Vietnam's energy sector.

2.3. Hypothesis Development

The first hypothesis is grounded in both the Real Options Theory (Dixit & Pindyck, 1994) and the Neoclassical Investment Theory (Jorgenson, 1963). Both frameworks converge on the premise that heightened uncertainty—whether arising from macroeconomic policy or commodity price volatility—discourages investment by raising the perceived risk and the cost of capital.

According to Real Options Theory, firms facing uncertain future returns treat investment as a reversible decision with an “option value of waiting.” When uncertainty about taxes, regulations, or energy prices increases, firms postpone capital commitments until clearer information emerges (Pindyck, 1991). Bloom (2009) empirically confirmed this behavior, showing that uncertainty shocks trigger sharp declines in investment and output as firms defer irreversible expenditures.

From the Neoclassical perspective, uncertainty increases the user cost of capital, incorporating higher risk premiums and financing costs. In this framework, firms reduce investment when expected returns fall below this inflated cost (Gulen & Ion, 2016). Similarly, oil price volatility alters input costs and profitability expectations, making it difficult for energy firms to forecast future cash flows (Hamilton, 2003).

Empirical studies provide robust support for this negative association. Ilyas et al. (2021) demonstrated that both EPU and OPU significantly reduce investment across global oil firms, while Gulen and Ion (2016) found that a one-standard-deviation increase in policy uncertainty reduces U.S. firm investment by approximately 2%. Together, these findings suggest that in energy-dependent and policy-sensitive environments, heightened uncertainty systematically suppresses capital formation. Hence, it is expected that both EPU and OPU will exert negative and statistically significant effects on the investment levels of Vietnamese energy firms.

H1: Oil price uncertainty (OPU) and economic policy uncertainty (EPU) each have a negative and

significant effect on corporate investment in Vietnamese energy firms.

The second hypothesis draws upon the Resource-Based View (RBV) of the firm (Barney, 1991; Wernerfelt, 1984), which posits that firm-specific resources and capabilities determine resilience to external shocks. Larger firms generally possess greater financial strength, diversified operations, and stronger institutional relationships, allowing them to maintain investment even when uncertainty is high.

This moderating role of size has also been noted in extensions of the Real Options Theory, where firms with greater flexibility or risk tolerance have a lower option value of waiting (Kulatilaka & Perotti, 1998). Such firms can pursue strategic investments during uncertain times, viewing volatility as an opportunity rather than a deterrent (Trigeorgis, 1996).

Empirical literature supports this asymmetry. Bloom (2009) and Rizvi et al. (2022) showed that large or state-linked enterprises often continue investing under uncertainty due to superior access to financing and implicit policy backing, while smaller firms delay or curtail projects. In developing economies, where capital markets are shallow, larger firms' financial buffers provide additional protection against shocks.

Accordingly, firm size is expected to moderate the uncertainty–investment relationship, such that the negative effects of EPU and OPU are weaker for larger firms, which can sustain investment despite adverse conditions, while smaller firms exhibit stronger reductions in capital spending.

H2: Firm size moderates the effects of uncertainty on investment, such that the negative impacts of OPU and EPU are weaker for larger firms.

The third hypothesis reflects insights from financial market theories—specifically, the Capital Asset Pricing Model (CAPM) (Sharpe, 1964; Lintner, 1965) and the Financial Accelerator Theory (Bernanke, Gertler, & Gilchrist, 1999). Both frameworks describe how financial instability amplifies the real effects of uncertainty through credit, valuation, and sentiment channels.

Under the CAPM, higher market volatility raises the risk premium required by investors, which in turn depresses stock valuations and increases firms' cost of equity (Fama & French, 2004). In this context, uncertainty shocks such as unpredictable policy changes or oil price swings become more damaging because they compound the elevated financing costs created by volatile market conditions.

The Financial Accelerator Theory complements this view by showing how market volatility and falling asset prices tighten credit conditions, further discouraging investment (Kiyotaki & Moore, 1997). In addition, behavioral finance models suggest that heightened volatility triggers loss aversion and herd behavior among investors, causing abrupt shifts in funding and liquidity (Barberis, Shleifer, & Vishny, 1998).

Empirical studies confirm these amplifying dynamics: periods of financial turbulence—such as the 2008 global crisis—magnify the investment-reducing effects of policy and commodity shocks (Bloom, 2009; Gulen & Ion, 2016). Therefore, when market volatility rises, the combined pressures of uncertainty and financial instability lead to sharper declines in corporate investment.

Based on these arguments, it is hypothesized that market volatility amplifies the negative influence of EPU and OPU on investment. Under high-volatility conditions, firms become more risk-averse, raising the hurdle rate for investment and further deferring capital commitments.

H3: Market volatility amplifies the effects of uncertainty on investment, such that under high volatility, the negative impacts of OPU and EPU are stronger.

3. Research Methodology

3.1. Research Model

The econometric framework applies a three-model panel regression approach—Pooled Ordinary Least Squares (OLS), Fixed Effects (FE), and Random Effects (RE)—to investigate the effects of Economic Policy Uncertainty (EPU) and Oil Price Uncertainty (OPU) on corporate investment among Vietnamese listed energy firms from 2015 to 2025. This approach is adapted from established empirical models used in uncertainty–investment studies (Bloom, 2009; Gulen & Ion, 2016; Ilyas et al., 2021).

The empirical models used in this study are defined as follows:

Model (1): Direct Effects

$$INV_{it} = \beta_0 + \beta_1 EPU_t + \beta_2 OPU_t + \beta_3 Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it}$$

Model (2): Moderating Effects

$$\begin{aligned}
 INV_{it} = & \beta_0 + \beta_1 EPU_t + \beta_2 OPU_t \\
 & + \beta_3 (EPU_t \times SIZE_{it}) + \beta_4 (OPU_t \times SIZE_{it}) \\
 & + \beta_5 (EPU_t \times VOL_t) + \beta_6 (OPU_t \times VOL_t) \\
 & + Controls_{it} + \mu_i + \lambda_t + \varepsilon_{it}
 \end{aligned}$$

Where:

INV_{it} = corporate investment of firm i in quarter t

EPU_t = economic policy uncertainty index

OPU_t = oil price uncertainty

$SIZE_{it}$ = firm size

VOL_t = market volatility

μ_i = firm-specific (individual) effects

λ_t = time-specific effects

ε_{it} = idiosyncratic error term

3.2. Variable Measurement

Dependent Variable

Corporate Investment (INV): Corporate investment is the primary dependent variable, capturing firms' long-term capital allocation behavior. It is measured as capital expenditure (CapEx) divided by total assets,

following standard practice in investment studies (Jorgenson, 1963; Bloom, 2009; Gulen & Ion, 2016).

Independent Variable

Economic Policy Uncertainty (EPU): EPU reflects the unpredictability of government policy actions that affect business decisions. It is measured using the Vietnam Economic Policy Uncertainty Index, based on the Baker, Bloom, and Davis (2016) methodology.

Oil Price Uncertainty (OPU): OPU captures the volatility in global crude oil markets, which directly impacts the cost structure and expected profitability of energy firms. It is measured as the standard deviation of daily Brent crude oil returns over the previous twelve months, sourced from the U.S. Energy Information Administration (EIA).

Moderating Variables

Firm Size (SIZE): Firm size is measured as the natural logarithm of total assets.

Market Volatility (VOL): Market volatility captures the general instability of the financial environment, measured as the standard deviation of daily VN-Index returns over the previous quarter.

Control Variables

To ensure robust estimation, several firm-specific and macroeconomic controls are included:

Leverage (LEV): Total debt to total assets; higher leverage constrains investment due to financial distress risk (Modigliani & Miller, 1958).

Cash Flow (CF): Operating cash flow to total assets; captures liquidity and internal financing capacity (Fazzari, Hubbard, & Petersen, 1988).

Sales Growth (SG): Quarterly change in sales revenue; proxies for firm expansion potential and demand conditions.

Tobin's Q (Q): Market value of equity plus book value of debt divided by total assets; controls for investment opportunities.

Macroeconomic Variables: GDP growth, inflation, and short-term interest rates are sourced from the World Bank, reflecting overall economic health and monetary conditions influencing investment.

3.3. Data Collection and Analysis

3.3.1. Data Collection

The study employs a comprehensive firm-level panel dataset to examine the effects of economic policy uncertainty (EPU) and oil price uncertainty (OPU) on corporate investment in Vietnam's energy sector. The sample consists of approximately 100 listed energy companies drawn from Vietnam's three primary stock exchanges: the Ho Chi Minh Stock Exchange (HOSE), the Hanoi Stock Exchange (HNX), and the UPCoM market. The dataset includes firms operating in oil and gas exploration, electricity generation and transmission, and renewable energy—sub-sectors most directly exposed to energy price fluctuations and policy dynamics.

Firm-level financial data—including capital expenditures, total assets, sales growth, Tobin's q , leverage, and cash flow—are obtained from Refinitiv Eikon (Thomson Reuters), a reliable global database frequently used in financial and energy-sector research (Ilyas et al., 2021). The key dependent variable, corporate investment (INV), is measured as the ratio of capital expenditure to total assets, following established literature (Jorgenson, 1963; Bloom, 2009).

To control for macroeconomic influences, GDP growth, interest rates, and inflation rates for Vietnam are sourced from the World Bank Development Indicators. The full dataset covers the period 2015–2025, at a quarterly frequency, allowing sufficient variation to capture short-term and long-term responses to uncertainty shocks. This period includes major global and domestic events—such as the oil price collapse of 2020, the COVID-19 pandemic, and Vietnam's renewable transition policies—that provide a rich empirical context for testing uncertainty–investment dynamics.

3.3.2. Data Analysis

All data management and estimation are conducted using Stata and R, covering quarterly observations from 2015 to 2025 (up to Q3 2025), ensuring accurate and replicable results.

Descriptive Statistics

Means, standard deviations, and correlation matrices summarize variables (INV, EPU, OPU, SIZE, VOL, leverage, Tobin's Q , and other controls), highlighting how investment intensity varies with uncertainty shocks.

Panel Data Analysis

Pooled OLS offers baseline results, while Fixed Effects (FE) and Random Effects (RE) models account for firm-specific heterogeneity and efficiency. Regressions include uncertainty variables, firm characteristics, and interaction terms to test moderation hypotheses.

Model Selection Tests

Model choice is guided by standard diagnostics—F-tests (OLS vs. FE), Breusch–Pagan LM tests (OLS vs. RE), and Hausman tests (FE vs. RE)—to identify the most appropriate specification for Vietnam's energy data.

Diagnostic Tests

Multicollinearity is examined using the Variance Inflation Factor (VIF), heteroskedasticity via the Breusch–Pagan test (robust errors applied if significant), and autocorrelation through the Durbin–Watson statistic. Robustness checks include alternative OPU volatility measures and sub-sample estimations by firm size and ownership type.

4. Conclusion

The present study attempts to design a research framework for assessing how Economic Policy Uncertainty (EPU) and Oil Price Uncertainty (OPU) influence corporate investment in Vietnamese energy firms from 2015 to 2025 and to what extent these effects are conditioned by firm-specific and market-level

characteristics. The study is expected to extend uncertainty–investment theory to an emerging market with hybrid institutional features. It deepens understanding of how uncertainty operates in capital-intensive, policy-dependent sectors. Practically, the current study will help managers design better investment and risk strategies, assists policymakers in crafting stable regulations, and informs investors about the risk–return profile of Vietnam’s energy sector.

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BANK-SPECIFIC AND MACROECONOMIC DETERMINANTS OF NON-PERFORMING ASSETS FOR INDIAN BANKS: AN EMPIRICAL ANALYSIS*

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Abstract

The Indian banking sector has undergone significant transformations since the 1991 financial reforms. Despite successive policy interventions, persistent non-performing assets, particularly in public sector banks, continue to challenge the system's resilience. This study addresses a critical research gap by systematically examining the impact of heterogeneity among Scheduled Commercial Banks from 2005 to 2024. Using an unbalanced panel the analysis explores trends in banks' NPAs and their effects across bank groups. To investigate the drivers, panel regression models with alternative specifications are employed, incorporating both bank-level indicators and macroeconomic variables. By benchmarking PSBs against foreign banks the study isolates merger-related gains from broader sectoral trends. The analysis highlights both the benefits and limitations of consolidation in enhancing resilience among PSBs. This paper provides new empirical insights into the bank-specific and macroeconomic determinants of NPAs, offering policy-relevant evidence to strengthen asset quality and enhance institutional sustainability in a dynamic financial landscape.

JEL Classification: C23, E31, E43, G21

Keywords: Cost of deposits, Inflation, NPA, Panel data, Return on assets, SCBs

1. Introduction

The evolution of India's banking sector has been closely tied to the country's broader economic and financial reforms, particularly those initiated after the 1991 Balance of Payments (BoP) crisis. This crisis exposed structural inefficiencies and compelled policymakers to adopt transformative reforms aimed at liberalizing the economy and modernizing the financial sector. Recognized as critical enablers of growth and stability, these reforms set the stage for significant changes in India's banking system.

* The views expressed in this article are those of the authors and do not necessarily reflect the views of their affiliated institutions.

1.1 Financial Sector Reforms

Guided by the recommendations of the Narasimham Committees (1991, 1998), the financial sector reforms sought to strengthen the banking system. The first committee introduced measures such as reducing statutory preemptions (CRR and SLR), implementing prudential norms for income recognition and asset classification, and advocating for reduced government ownership in public sector banks (PSBs). These initiatives aimed to improve financial health, enhance transparency, and foster a competitive, market-driven banking environment. The second committee built on these reforms by addressing emerging challenges, including the need for bank consolidation, stronger corporate governance, improved risk management, and solutions for rising non-performing assets (NPAs). It also proposed the establishment of Asset Reconstruction Companies (ARCs) and measures to bolster capital adequacy, providing a roadmap for a more resilient and efficient banking sector.

The liberalization of the Indian economy during this period further accelerated the transformation of the banking sector. Increased participation by private and foreign banks introduced competition, innovation, and advancements in technology and customer service, compelling traditional banks to modernize and expand. Concurrently, the Reserve Bank of India (RBI) strengthened regulatory and supervisory frameworks to safeguard financial stability. Despite these advancements, challenges such as rising NPAs, governance weaknesses, and external vulnerabilities persisted, underscoring the need for continued reforms.

The Global Financial Crisis of 2008 highlighted the importance of a resilient banking system, prompting policymakers to initiate another wave of reforms. Between 2016 and 2019, large-scale consolidations reduced the number of PSBs from 27 to 12, creating larger institutions with enhanced economies of scale, improved management, and stronger balance sheets. These mergers aimed at improving operational efficiency and enabling PSBs to compete in a rapidly evolving financial landscape. However, the persistent issue of NPAs, coupled with governance and credit risk vulnerabilities, remained a significant challenge to the sector's stability.

1.2 Nature of the Problem

At the center of the banking sector's challenges lies the issue of non-performing assets, which remain a critical indicator of fragility. NPAs are influenced by a complex interplay of bank-specific factors, such as governance practices, credit risk management, and capital adequacy, as well as macroeconomic determinants, including GDP growth, interest rate fluctuations, and external shocks. While structural reforms have helped address some of these issues, the persistence of NPAs highlights underlying vulnerabilities in both institutional practices and external economic conditions. A deeper understanding of these determinants is essential to identifying effective strategies for reducing NPAs and strengthening the resilience of India's banking system.

2. Literature Review and Research Gap

The past two decades, from 2005 to 2024, represent one of the most dynamic and reform-intensive phases in Indian banking history. The era witnessed the twin balance sheet (TBS) crisis, the Asset Quality Review (AQR), post-liberalization consolidation and a series of subsequent structural reforms. Existing literature on Indian commercial banks, particularly on Non-Performing Assets (NPAs), asset quality, and profitability,

reveals consistent evidence of a widening gap between public and private sector banks. This divergence is often attributed to institutional inefficiencies and governance challenges within the public sector banks.

2.1 Literature Review

Impact of Financial Reforms: The impact of financial reforms and the financial health of Indian banking system have been widely analyzed. Banerjee et al. (2004) have analyzed the impact of financial reforms, noting significant improvements in operational efficiency and financial stability, although with lingering challenges in public sector banks. Scholars such as Mohan (2006) and Reddy (2002) highlighted how these reforms reduced financial repression, introduced prudential norms, and laid the foundation for consolidation and competition within the banking industry.

The global financial crisis (2008–09) resulted in slower economic growth, reduced investments, and declining exports. However, the Indian banking system demonstrated resilience during this period (Subbarao, 2009). In the post-crisis years, banks experienced a steep rise in non-performing assets (NPAs), prompting the recapitalization of public sector banks and the subsequent merger of weaker banks.

Recapitalization and Consolidation of Banks: In order to deal with increasing NPAs, mergers and acquisitions (M&A) are valuable strategies to foster growth, expansion, and stability in the banking sector. The impact of bank merger and acquisition has been studied by several authors such as Anand and Singh (2008) and Kotnal (2016). The consolidation of public sector banks between 2016 and 2019 marked a significant structural change, reducing the number of public sector banks from 27 in 2017 to 12 by 2019. Maji (2019) and Rafi and Kumar (2021) highlighted a sharp escalation in NPAs between 2014 and 2018. The studies cautioned that repeated recapitalizations and restructuring may provide temporary relief but risk undermining long-term fiscal discipline and taxpayer trust.

Broader Institutional Perspectives: The deterioration of asset quality, particularly after 2012, has spurred extensive empirical research into the drivers of NPAs. Singh (2013), Murari (2014), Ibrahim and Thangavelu (2014), Debnath and Dash (2015) and Das and Dey (2018) analyzed the factors contributing to the rise in NPA of commercial banks. While composition of NPAs varied across bank categories, the main drivers were found to be government-led “mass waiver of interest/installments”, weak appraisal systems, inefficient recovery mechanisms as well as macroeconomic slowdown. Rajan (2016) and RBI Annual Reports attributed the rise in NPAs to factors such as credit misallocation, infrastructural issues, and weak monitoring frameworks. Similarly, Arora (2021) reaffirmed a strong correlation between total advances and gross NPA (GNPA) ratios across bank groups, emphasizing that inefficiencies in credit sanctioning and disbursement by PSBs undermined investor confidence and overall financial stability. Similar studies comparing PSBs and private banks (PVTs), such as Sil and Balmiki (2020) and Saraswat and Saifi (2024), further reinforced this evidence. Both studies reported significantly higher GNPA and net NPA (NNPA) ratios for PSBs compared to PVTs, highlighting persistent disparities across bank groups.

Macroeconomic Determinants: As the NPA crisis deepened, researchers began exploring both macroeconomic and micro-level determinants. Das and Dey (2017) investigated the interplay between corporate debt restructuring (CDR) and NPAs, concluding that CDR efforts often failed to achieve their intended outcomes, particularly in PSBs. Using the panel data of selected banks authors, such as Al-Homaidi et al. (2018) and Das and Uppal (2021) demonstrated that profitability is significantly influenced by internal

factors, such as NPAs, capital adequacy, and non-interest income, as well as macroeconomic variables such as GDP growth and inflation. Das and Dey (2022) noted that exchange rate, FDI and GDP are positively correlated with NPAs of commercial banks. The authors adopted co-integration and error correction models explaining the impact of the macro variables on NPAs. Expanding this line of inquiry, a series of panel regression studies were conducted (Das, 2021; Das, 2023; Das, 2025) on determinants of NPAs across 43 to 45 scheduled commercial banks, spanning the period from 2005 to 2020. The studies consistently found that NPAs decline with higher return on assets (ROA) and interest income but increase with greater non-interest income and secured lending.

2.2 Research Gap

Existing studies on non-performing assets (NPAs) often rely on pooled or fixed-effects models, overlooking how alternative model specifications might influence the interpretation of NPA determinants. This methodological limitation creates a blind spot in understanding how heterogeneity at the bank level (e.g., public sector banks [PSBs], private sector banks [PVTs], and foreign banks [FRBs]) and time level shapes asset quality outcomes. A more nuanced approach is needed to systematically examine how different model specifications affect the drivers of NPAs.

Additionally, while several studies have assessed the impact of PSB mergers, few have rigorously disentangled structural improvements from broader macroeconomic trends. The absence of a stabilizing control group in many analyses limits the ability to establish causal relationships. Furthermore, most existing studies focus on a subset of banks or a limited number of institutions, either within a single bank group or across groups. This narrow scope restricts the generalizability of findings, particularly given the dynamic and evolving nature of India's banking sector.

3. Objectives

This study addresses existing limitations by utilizing a comprehensive unbalanced panel dataset, encompassing banks that have been closed, merged, or newly established during the sample period from 2005 to 2024. This approach captures the full spectrum of institutional and temporal heterogeneity, providing a more nuanced understanding of NPA trends and their determinants. Foreign banks (FRBs), which have not undergone consolidation and operate under distinct regulatory and operational conditions, serve as a natural benchmark for comparative analyses—a perspective often underexplored in the literature.

By integrating methodological rigor, comprehensive panel data, and comparative benchmarking, this research advances the understanding of NPAs, banking consolidation, and the efficacy of structural reforms in India's banking sector. The study focuses on the following objectives:

- To investigate bank-specific determinants of NPAs and their variations across bank groups, with foreign banks serving as a benchmark. Bank and time fixed effects are employed to isolate and identify these effects.
- To analyze the evolution of non-performing assets (NPAs) in Indian banks during the study period, with a focus on pre- and post-merger phases of public sector banks.
- To examine macroeconomic determinants, in addition to bank-specific factors, contributing to NPAs and their differences across bank groups, benchmarking foreign banks.

4. Data Sources and Methodology

The SCBs, excluding RRBs, account for nearly 98% of the total balance sheet size of all SCBs, while RRBs contribute around only 2%. The detailed balance sheet data for RRBs are not readily available on the RBI website. For simplicity, the term SCBs in this study hereafter refers exclusively to SCBs excluding RRBs.

The analysis covers all Scheduled Commercial Banks (SCBs) operating in India during the period 2005–2024, including those that were closed or merged in the study period (i.e., unbalanced panel). As of 2024, the data comprises of 94 SCBs, consisting of 12 Public Sector Banks (PSBs), 21 Private Sector Banks (PVTs), 45 Foreign Banks (FRBs), 12 Small Finance Banks (SFBs), and 4 Payments Banks (PBKs), with data sourced from the Database on Indian Economy (DBIE) available publicly on the Reserve Bank of India (RBI) website.

By narrowing the scope to SCBs, the analysis captures the dynamics of institutions that are most integrated into national and global financial networks as well as most responsive to policy reforms and market changes.

4.1 Data Sources

This study relies on a comprehensive dataset that combines bank-level financial data and macroeconomic indicators to analyze the structural evolution, profitability, and non-performing assets (NPAs) of Scheduled Commercial Banks in India.

Bank-specific data, including balance sheet information and performance indicators, is sourced from the Reserve Bank of India (RBI) online database on the Indian Economy (DBIE). This data set includes key variables such as total assets, liabilities, profitability metrics (e.g., return on assets, return on equity), asset quality indicators (e.g., gross NPAs to total advances) and operational efficiency measures (e.g., cost-to-income ratio). These variables are critical for understanding the financial health and operational dynamics of banks.

To incorporate the broader economic environment, macroeconomic indicators such as inflation, bank rate, cash reserve ratio (CRR), and exchange rate fluctuations are included. Most of these indicators are sourced from the RBI's database, while additional variables, such as inflation and USD/INR exchange rates are obtained from the websites of International Monetary Fund (IMF) and the World Bank. The combination of bank-level and macroeconomic data provides a holistic view of the factors that influence the performance and resilience of the banking sector.

4.2 Model Specifications

The primary analytical framework is based on the fixed effects (FE) model, which controls for unobserved, time-invariant characteristics specific to each bank, such as governance practices, management quality, or institutional culture. The fixed effects model is formulated as follows:

$$Y_{it} = \alpha + \beta X_{it} + \gamma Z_t + FE_{it} + \epsilon_{it}$$

where:

Y_{it} : Dependent variable (e.g., ROA, NNPA) for bank i at time t , α : Constant or intercept,

X_{it} : Vector of bank-level explanatory variables (e.g., asset–liability structure, capital adequacy, operational efficiency),

Z_t : Vector of macroeconomic variables (e.g., GDP growth, inflation, repo rate, CRR),

β, γ : Coefficients of the explanatory variables,

FE_{it} : Bank-(i) and time (t)-specific fixed effects, capturing unobserved heterogeneity,

ϵ_{it} : Error term.

The inclusion of macroeconomic variables ensures that the model captures the influence of the external economic environment on banking sector performance. By combining bank- specific and macroeconomic variables, the study provides a comprehensive analysis of the factors influencing the NNPA ratio.

To examine the relationship between structural evolution, profitability, and net non-performing assets (NPAs), this study employs a **panel data approach**. Panel data, which tracks the same entities over time, allows for controlling unobserved heterogeneity and capturing both cross-sectional and temporal variations. Fixed-effects regression models are employed to identify the key determinants of the Net Non-Performing Assets (NNPA) ratio and assess their differential impact across bank groups, thereby providing insights into the sources of fragility within the Indian banking system.

4.3 Variables of Interest

The key variables used in the analysis are as follows:

Dependent Variable:

- **NNPA Ratio** = (Gross NPAs–Provisions) / Gross Advances.

Independent Variables:

- **Bank-Level Indicators:** Cost of deposits (CoD), Ratio of priority sector advance (PSA) to total advances, ratio of term loans to total advances, ratio of interest income (II) to total assets, return on assets (ROA).
- **Macro-economic Variables:** USD/INR exchange rate volatility, inflation, central bank policy rate and cash reserve ratio (CRR).

Control Variables: Bank ownership type (public, private, foreign). Bank and time (year) - specific fixed effects are adopted to isolate bank specific and macroeconomic impacts, respectively.

Description of Independent Variables:

Ratio of priority sector advances (PSA) to total advances: The ratio of priority sector advances reflects the proportion of lending directed toward sectors such as agriculture, small businesses, and weaker sections, which are often more susceptible to income volatility and credit default risks. Banks with higher exposure to these sectors typically experience greater credit risk due to the limited repayment capacity of borrowers. Hence, an increase in this ratio is expected to deteriorate asset quality. The coefficient is expected to be **positive**, indicating that higher priority sector lending is associated with higher NNPA levels.

Ratio of term loans to total advances: A higher share of term loans indicates a greater focus on long-term, often project-based lending. While such loans are generally riskier due to their maturity structure and exposure to investment cycles, banks with a higher proportion of term lending tend to have lower NNPA ratios. This outcome likely reflects stronger appraisal standards, collateral coverage, and monitoring mechanisms associated with term loans compared to short-term credit. Thus, the coefficient for term loans to total advances is expected to be **negative**.

Ratio of interest income (II) to total assets: This ratio serves as a measure of a bank's income-generating efficiency relative to its total assets. A higher ratio reflects stronger earning capacity and better asset utilization, often indicative of sound credit management and lower default risk. Therefore, banks with higher

interest income relative to assets are expected to exhibit better asset quality. The coefficient is expected to be **negative**, as higher interest income relative to total assets should correspond with lower NNPA.

Return on Assets (ROA): ROA captures a bank's overall profitability and managerial efficiency in utilizing its assets. A higher ROA indicates strong operational performance, effective credit appraisal, and sound risk management, which collectively reduces the likelihood of loan defaults. Thus, more profitable banks are generally expected to maintain lower non-performing asset levels. The coefficient is expected to be **negative**, suggesting that higher profitability is associated with lower NNPA.

Cost of Deposits (CoD): The cost of deposits reflects the average interest expense incurred on mobilizing funds. When the cost of deposits rises, banks face compressed margins, which may encourage riskier lending to sustain profitability. Additionally, higher funding costs can reduce financial flexibility and weaken the institution's ability to absorb shocks. The coefficient is expected to be **positive**, indicating that higher deposit costs are likely associated with increased NNPA.

End Quarter Exchange Rate (USD/INR exchange rate): Depreciation of the domestic currency raises repayment burdens for borrowers with foreign currency liabilities and increases import costs, squeezing margins and weakening debt-servicing capacity. This effect is particularly pronounced in sectors with significant foreign exposure. The coefficient is expected to be **positive**, implying that currency depreciation tends to increase NNPA through higher external debt servicing costs.

Inflation: Higher inflation reduces the real income of borrowers and elevates production and operating costs, thereby constraining repayment ability. Moreover, inflation often leads to higher interest rates, increasing the cost of credit and worsening asset quality. The coefficient is expected to be **positive**, as higher inflation is likely to be associated with increased NNPA.

Central Bank Policy Rate: The policy rate set by the central bank influences overall borrowing costs in the economy. An increase in the policy rate raises lending rates, potentially worsening borrowers' debt servicing capacity and thereby increasing the probability of defaults. However, in certain contexts, tighter monetary policy can curb excessive credit growth and risky lending. The coefficient is expected to be **positive**, as higher policy rates generally contribute to increased NNPA due to higher borrowing costs.

Cash Reserve Ratio (CRR): The CRR determines the proportion of deposits banks must hold as reserves with the central bank. A higher CRR restricts liquidity and reduces banks' lending capacity, which can tighten financial conditions for borrowers and elevate repayment stress, particularly during periods of economic slowdown. The coefficient is expected to be **positive**, as an increase in CRR may indirectly contribute to higher NNPA levels.

5. Empirical Analysis

5.1 Descriptive Statistics

The balance sheets of India's Scheduled Commercial Banks (SCBs) expanded nearly twelve- fold between end-March 2005 and end-March 2024, from INR 23,555 billion to INR 280,806 billion, highlighting the sector's growing economic footprint. While balance-sheet growth signals expansion, it does not necessarily imply financial strength or resilience; assessing it relative to macroeconomic indicators such as the Gross Domestic Product (GDP) offers a truer picture.

Between 2005 and 2024, SCBs underwent reform-driven growth, crisis-tested resilience, and post-pandemic adjustment. Bank assets rose from 64% of GDP in 2005 to a peak of 88% in 2014, then eased to 74% by 2023 amid structural stress before recovering to 77.5% in 2024 with renewed credit demand and digital intermediation. Overall, the balance-sheet trajectory mirrors the sector's structural evolution and its sensitivity to economic cycles, policy reforms, and systemic challenges.

Size and Growth of Balance Sheet by Bank Groups

Examining bank asset growth relative to GDP from 2005-2024 reveals distinct trajectories across Scheduled Commercial Bank (SCB) categories. While aggregate trends show overall sectoral resilience, balance sheet expansion varies sharply among public sector banks (PSBs), private sector banks (PVTs), and foreign banks (FBKs), which together hold about 95% of SCB assets.

PSBs, once dominant with nearly 75% of assets in FY2005, saw their share fall to around 55% by FY2024 despite repeated state-led mergers and recapitalizations. PVTs nearly doubled their share from 18% to 38% on the back of stronger governance, technology adoption, and customer-focused strategies. FBKs maintained a modest 7-8% share but expanded their asset base more than elevenfold, leveraging niche strengths in corporate and cross-border finance. These shifts mark a structural reconfiguration of India's banking landscape, where market share, efficiency, and adaptability increasingly determine institutional relevance.

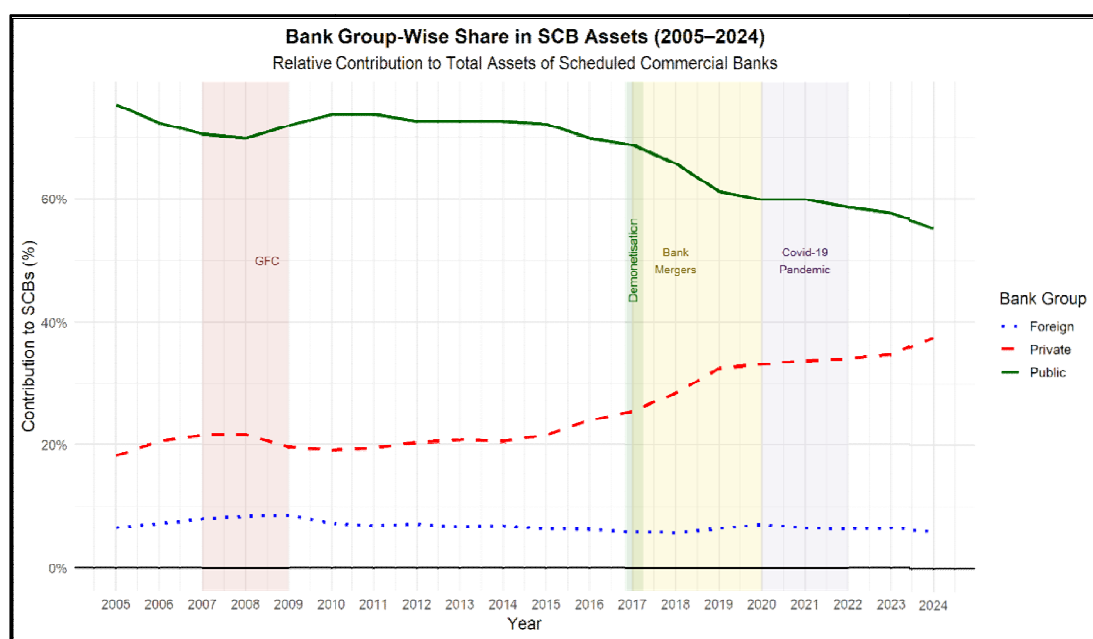


Fig. 1: Share in Assets by Bank Groups

NPAs by Bank Group

The NPA trajectory of Scheduled Commercial Banks (SCBs) shifted notably over the study period. During the Global Financial Crisis, NPAs of PSBs declined, while those of PVTs and FBKs rose. Overall, SCB NNPA fell to 2.2% by 2008 but surged to 11.2% by 2018 amid aggressive PSB-led lending and weak provisioning. With PCRs below 50%, NNPA peaked at 6%, exposing systemic fragility. Post-2019, reforms such as the IBC, stricter provisioning, and balance sheet repair halved NNPA to 3.9% and pushed NNPA

below 1% by 2023. Although PSBs bore the brunt of mid-2010s stress, PVBs and FBKs adjusted faster, underscoring a sectoral shift toward greater prudence and resilience.

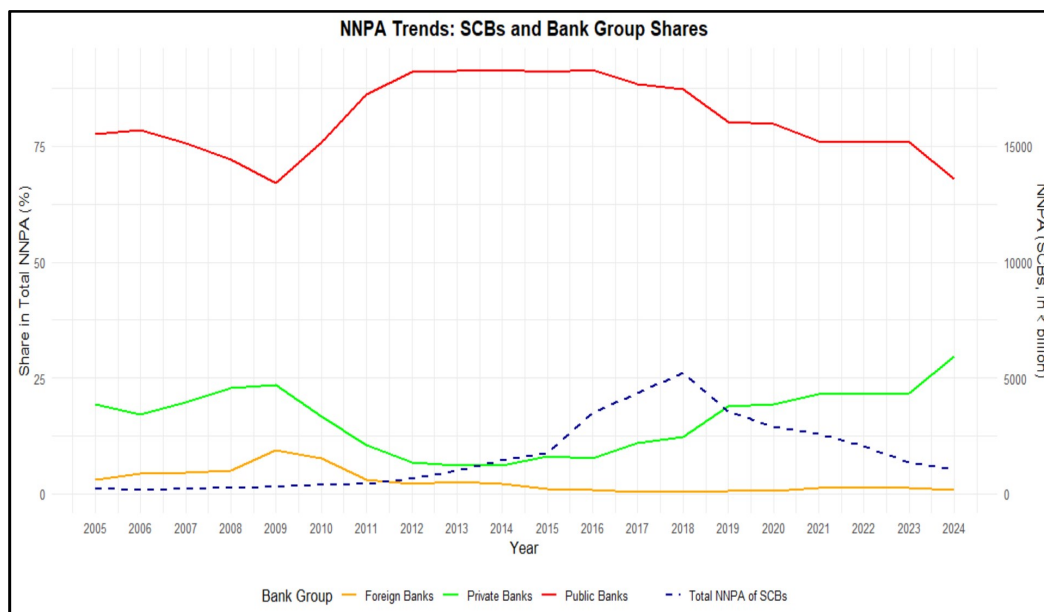


Fig. 2: Visualizations of NNPA for all SCBs and Bank Groups

The concentration of the mid-2010 NPA crisis in Public Sector Banks (PSBs), whose GNPA share consistently exceeded their asset share peaking at 88% of total NPAs despite holding only about 70% assets of SCBs. This imbalance underscores the disproportionate exposure of PSBs to asset quality stress, especially between 2013 and 2017. In contrast, private banks (PVTs) and foreign banks (FBKs) maintained healthier portfolios, with PVTs NPA share in single digits through 2014 and FB's contribution falling below 2% post-2016. During the recovery phase (2019–2024), PSBs' NPA share declined to 71%, while PVTs rose to 27%, aligning with their growing asset base. FBKs continued to lead in asset quality, holding just 1.4% of NPAs against 11% of assets in 2024.

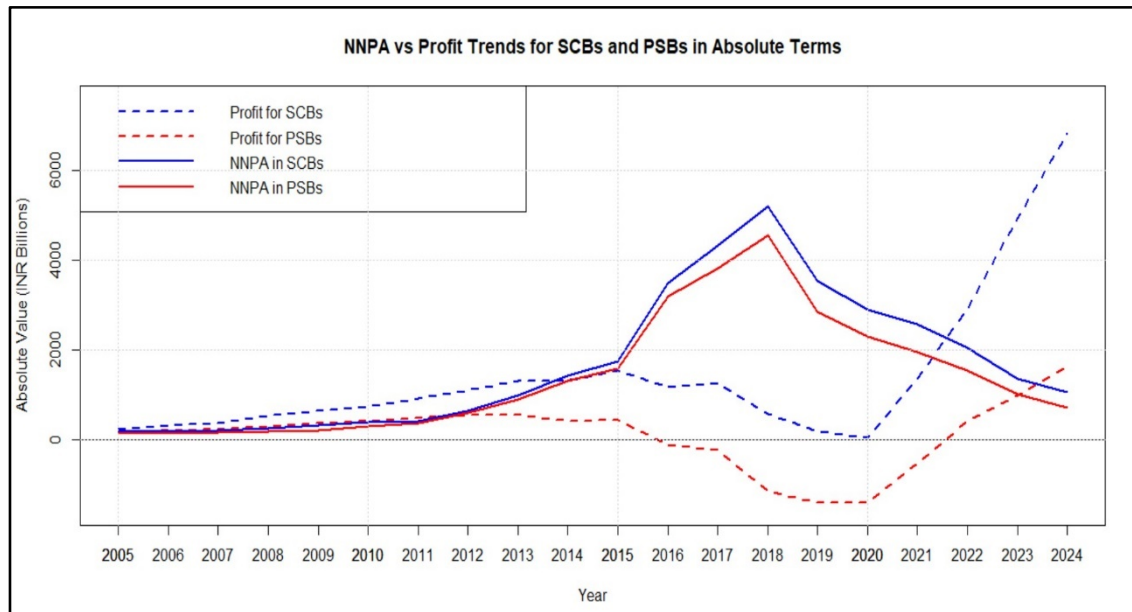


Fig. 3: Visualizations of NNPA and Profitability for all SCBs and PSBs in Absolute Terms

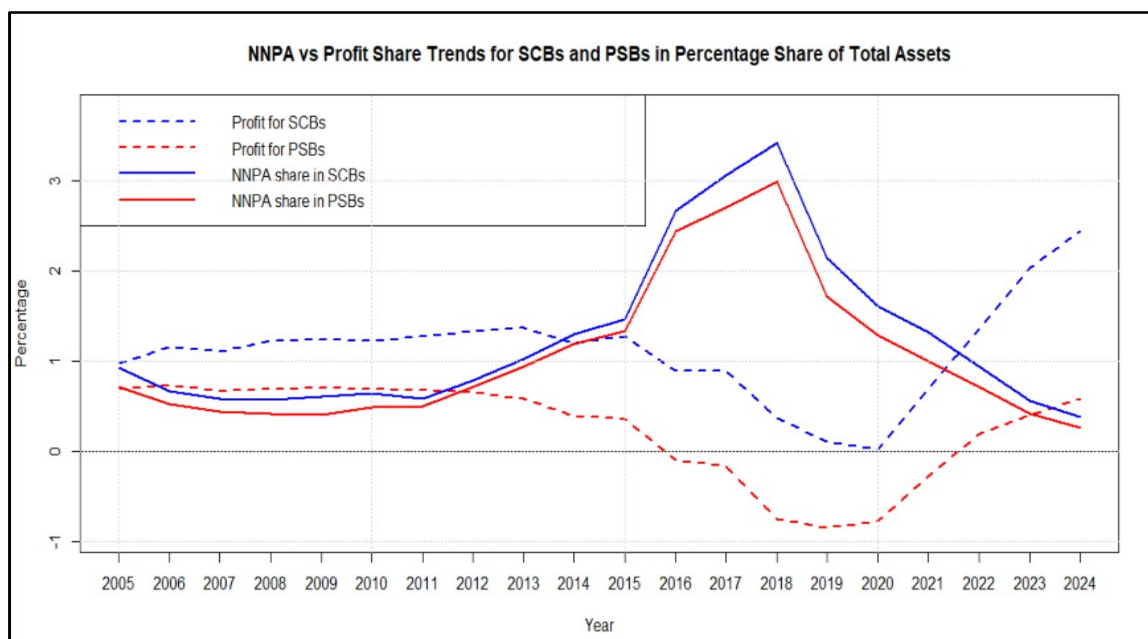


Fig. 4: Visualizations of NNPA & Profitability for all SCBs & PSBs in Percentage Share of Total Assets

5.2 Summary Statistics, Correlation Matrix and Multicollinearity Check

The summary statistics and correlation coefficients of all variables used in estimating the determinants of NPAs are presented in Table I (See: Annexure).

Table I: Summary Statistics for SCBs, PSBs, PVTs and FBs

Summary Statistics: SCBs including SFBs and PBKs								
Variables	Obs	Mean	Median	Min	Max	SD	Skewness	Kurtosis
1. NNPA to GA	1,252	2.62	1.34	-0.05	98.79	4.85	9.99	157.07
2. CoD	1,731	5.07	5.18	0.00	32.63	2.05	1.33	22.72
3. PSA to TA	1,646	37.02	34.32	0.03	100.00	17.68	1.52	6.30
4. TL to TA	1,661	48.10	49.64	0.00	100.00	24.80	-0.05	2.54
5. II to total assets	1,771	7.25	7.31	0.02	17.96	2.23	0.69	6.03
6. ROA	1,771	0.86	0.95	-26.22	17.86	2.23	-2.77	44.33
7. Fx rate change	1,774	-3.69	-3.13	-27.41	11.40	7.88	-0.86	4.85
8. Inflation, Change	1,638	-0.01	-0.54	-2.89	3.35	1.71	0.26	2.29
9. CBPR, Change	1,638	-0.02	0.00	-3.25	1.51	0.99	-1.46	6.45
10. CRR, Change	1,638	0.03	0.00	-1.23	2.58	0.83	1.13	5.04
Summary Statistics: Public Sector Banks (PSBs)								
1. NNPA to GA	456	2.98	1.83	0.11	16.89	3.04	1.86	6.56
2. CoD	457	5.69	5.63	2.35	8.11	1.07	0.04	2.25
3. PSA to TA	458	35.16	35.48	9.51	65.04	6.89	-0.04	4.19
4. TL to TA	458	55.62	54.22	30.97	100.00	10.00	0.77	4.30
5. II to total assets	457	7.71	7.67	3.26	9.79	0.91	-0.30	3.54
6. ROA	458	0.41	0.66	-5.49	2.01	0.92	-2.18	9.79
7. Fx rate change	458	-3.59	-1.94	-27.41	11.40	8.70	-0.86	4.29
8. Inflation, Change	428	-0.05	-0.54	-2.89	3.35	1.76	0.42	2.27
9. CBPR, Change	428	0.00	0.00	-3.25	1.51	1.01	-1.76	7.19
10. CRR, Change	428	0.05	0.00	-1.23	2.58	0.89	1.12	4.62
Summary Statistics: Private Sector Banks (PVTs)								
1. NNPA to GA	424	1.70	1.13	0.01	16.69	1.77	2.89	17.64
2. CoD	442	5.83	5.83	0.76	8.74	1.28	-0.13	3.05
3. PSA to TA	442	36.75	34.79	3.29	98.58	12.54	1.53	8.24
4. TL to TA	442	57.57	59.61	12.00	99.32	18.17	-0.07	2.13
5. II to total assets	442	8.38	8.32	2.35	15.64	1.33	0.58	6.65
6. ROA	441	0.83	1.05	-20.35	4.46	1.47	-7.38	100.39
7. Fx rate change	442	-3.42	-1.94	-27.41	11.40	8.12	-0.94	4.84
8. Inflation, Change	410	-0.10	-0.55	-2.89	3.35	1.72	0.36	2.32
9. CBPR, Change	410	-0.04	0.00	-3.25	1.51	0.97	-1.52	6.80
10. CRR, Change	410	0.02	0.00	-1.23	2.58	0.87	1.16	4.82
Summary Statistics: Foreign Banks (FRBs)								
1. NNPA to GA	303	3.56	1.10	-0.05	98.79	8.72	6.65	59.28
2. CoD	749	4.19	4.05	0.00	32.63	2.50	2.57	26.41
3. PSA to TA	676	35.25	30.82	0.03	100.00	21.82	1.46	5.16
4. TL to TA	685	32.54	28.34	0.00	100.00	25.74	0.82	3.12
5. II to total assets	789	5.89	6.03	0.02	12.68	1.76	-0.09	3.60
6. ROA	787	1.18	1.27	-26.22	17.86	2.79	-1.61	26.13
7. Fx rate change	789	-3.90	-3.13	-27.41	11.40	7.55	-0.81	4.97
8. Inflation, Change	731	0.07	-0.04	-2.89	3.35	1.71	0.18	2.30
9. CBPR, Change	731	0.00	0.00	-3.25	1.51	0.99	-1.38	6.18
10. CRR, Change	731	0.04	0.00	-1.23	2.58	0.78	1.11	5.30
Notes: Obs is short form for Observations. NNPA=Net NPA; GA=Gross Advances; CoD=Cost of Deposits; PSA = Priority Sector Advances; TA=Total Advances; TL=Term Loans; II = Interest Income; ROA=Return on Assets; Fx rate change=USD/INR rate change is the different in forex rate of per USD to INR in end-March of year t compared end-March of year (t-1); Changes in annual inflation, central bank policy rate(CBPR) and Cash Reserve Ratio (CRR) are also derived for year t compared end-March of year (t-1).								
Sources: Database on Indian Economy (DBIE), Reserve Bank of India; IMF; World Bank; Authors' Calculations.								

Preliminary regressions were run on the full set of explanatory variables, following which those exhibiting high multicollinearity as indicated by elevated Variance Inflation Factors (VIFs) were excluded from the final specification. The final set of regressors satisfy the commonly accepted VIF threshold ($VIF < 5$),

ensuring that the estimated coefficients are not adversely affected by the problem of multicollinearity and that the regression results are robust and statistically reliable. (See: Table II)

Table II: Correlation Matrix and Multicollinearity Check

Correlation Matrix										
Variables	Var 1	Var 2	Var 3	Var 4	Var 5	Var 6	Var 7	Var 8	Var 9	Var 10
1. NNPA to GA	1									
2. CoD	-0.058	1								
3. PSA to TA	0.078	-0.107	1							
4. TL to TA	-0.115	0.184	0.041	1						
5. II to total assets	-0.159	0.572	0.174	0.455	1					
6. ROA	-0.322	-0.146	0.085	-0.046	0.047	1				
7. Fx rate change	0.050	-0.134	0.016	0.007	-0.099	-0.027	1			
8. Inflation, Change	0.068	0.070	-0.010	-0.040	0.020	-0.019	0.135	1		
9. CBPR, Change	0.144	0.078	-0.017	-0.040	0.017	-0.071	0.170	0.000	1	
10. CRR, Change	-0.021	0.169	-0.022	-0.034	0.132	0.038	-0.850	-0.195	-0.020	1
Statistical Measure		Multicollinearity Check								
Variance Inflation Factor (VIF)		Var 2	Var 3	Var 4	Var 5	Var 6	Var 7	Var 8	Var 9	Var 10
		2.26	1.27	1.46	3.1	1.14	4.25	1.07	1.1	4.33

See "Notes" and "Sources" in Table I.

5.3 Data Analysis and Findings

The empirical analysis is conducted in two steps. In the first step, the effects of five bank- level indicators (as described in Section 5.2) on the Net Non-Performing Assets (NNPA) are analyzed. The second step extends the analysis by examining the impacts of time-varying macroeconomic variables in conjunction with the bank-level indicators.

Figures 2, 3 and 4 highlight that Public Sector Banks (PSBs) account for the majority share of NPAs, significantly affecting the financial health and profitability of the Indian banking sector as a whole. The baseline regression investigates the influence of bank-level indicators on NNPA, as presented in Table III.

Table III: Determinants of Net NPAs – SCBs versus PSBs, 2005–2024

VARIABLES	Scheduled Commercial Banks (SCBs)				Public Sector Banks (PSBs)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CoD	0.198 (0.238)	0.252* (0.150)	0.131 (0.279)	0.233 (0.186)	0.935*** (0.314)	1.153*** (0.292)	0.212 (0.240)	0.470* (0.250)
PSA to TA	0.039*** (0.012)	0.057*** (0.012)	0.039*** (0.010)	0.045*** (0.012)	0.054** (0.021)	0.105*** (0.027)	0.045*** (0.016)	0.056*** (0.020)
TL to TA	-0.010 (0.008)	-0.020** (0.009)	-0.005 (0.006)	-0.012 (0.010)	- 0.037*** (0.010)	- 0.068*** (0.017)	-0.013 ** (0.007)	-0.042*** (0.012)
II to total assets	-0.301 (0.208)	-0.140 (0.174)	-0.285 (0.189)	-0.041 (0.166)	-0.932** (0.378)	- 0.949*** (0.332)	-0.344 (0.291)	-0.168 (0.261)
ROA	-0.962*** (0.215)	-1.054*** (0.154)	-0.843*** (0.169)	-0.846*** (0.129)	- 2.266*** (0.293)	- 2.125*** (0.309)	- 1.348*** (0.263)	-1.077*** (0.265)
Constant	3.544*** (0.833)	1.871* (0.960)	3.453*** (0.587)	1.030 (0.990)	5.946*** (1.229)	4.661** (1.981)	4.130*** (1.078)	2.422* (1.326)
Observations	1,223	1,217	1,223	1,217	456	456	456	456
R-squared	0.190	0.654	0.254	0.711	0.644	0.677	0.833	0.865
Bank FE	No	Yes	No	Yes	No	Yes	No	Yes
Time FE	No	No	Yes	Yes	No	No	Yes	Yes

See “Notes” and “Sources” in Table I. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

While the model estimates without bank and time fixed effects explain relatively little for Scheduled Commercial Banks (SCBs) (see column 1), the rise in NNPA is primarily driven by bank-specific factors (columns 2 and 5), such as loan disbursement practices and recovery management.

Most bank-level indicators exhibit the expected signs, with several statistically significant at conventional levels. Specifically, the results confirm that an increase in the cost of deposits and priority sector advances (PSA) is associated with a rise in NNPA. In contrast, return on assets (ROA) shows a consistently strong and negative relationship with NNPA, indicating that more profitable banks tend to manage their asset quality better. The coefficients on term loans and interest income ratios are also negative, though their significance varies across models. These findings underscore the critical role of effective loan management, recovery strategies, and operational efficiency in mitigating the growth of NPAs.

Table IV: Determinants of NPAs – Comparison Across Bank Groups, 2005–2024

VARIABLES	SCBs		PSBs		PVTs		FRBs	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CoD	0.252*	0.233	1.153***	0.470*	-0.003	0.230	0.177	0.111
	(0.150)	(0.186)	(0.292)	(0.250)	(0.152)	(0.198)	(0.314)	(0.345)
PSA to TA	0.057***	0.045***	0.105***	0.056***	0.015*	0.013	0.064**	0.072**
	(0.012)	(0.012)	(0.027)	(0.020)	(0.009)	(0.008)	(0.029)	(0.031)
TL to TA	-0.020**	-0.012	-0.068***	-0.042***	-0.008	-0.008	0.001	0.008
	(0.009)	(0.010)	(0.017)	(0.012)	(0.008)	(0.006)	(0.017)	(0.021)
II to total assets	-0.140	-0.041	-0.949***	-0.168	-0.173	-0.159	0.070	-0.022
	(0.174)	(0.166)	(0.332)	(0.261)	(0.190)	(0.168)	(0.288)	(0.328)
ROA	-1.054***	-0.846***	-2.125***	-1.077***	-0.703***	-0.623***	-0.643***	-0.598***
	(0.154)	(0.129)	(0.309)	(0.265)	(0.213)	(0.167)	(0.153)	(0.155)
Constant	1.871*	1.03	4.661**	2.422*	3.653***	2.172***	0.135	0.426
	(0.960)	(0.990)	(1.981)	(1.326)	(0.954)	(0.824)	(1.556)	(1.847)
Observations	1,217	1,217	456	456	422	422	271	271
R-squared	0.654	0.711	0.677	0.865	0.558	0.664	0.768	0.787
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	Yes	No	Yes	No	Yes

See “Notes” and “Sources” in Table I. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The comparison of the determinants of NNPA across bank groups, as presented in [Table IV](#), reveals how institutional structure, bank ownership and their respective business models affect the outcomes of asset quality. These variations provide deeper insights into whether the drivers of NPAs are systemic or group-specific, thereby reinforcing the robustness of the earlier results.

The results indicate that Public Sector Banks (PSBs) experience the strongest impact on asset quality, primarily driven by priority sector advances, term loan composition, and profitability (ROA). This reflects their greater exposure to policy-driven and subsidized lending segments, which tend to carry higher default risk. In contrast, private and foreign banks exhibit greater resilience owing to stronger profitability, prudent credit appraisal, and more effective risk management practices. The findings confirm that while all banks are influenced by systemic changes, institutional efficiency and operational discipline largely determine the vulnerability of bank groups to asset quality deterioration.

During the last two decades, all bank groups have been affected by the issue of rising NPAs ([Fig. 2](#)). Following several systemic measures, such as the Asset Quality Review of 2015, the large-scale consolidation of public banks was undertaken to improve asset quality and enhance the stability of the Indian banking system. The comparison of NNPA determinants across bank groups during the pre-merger period (2005–2019), as presented in [Table V](#), helps clarify the extent of stress within the system and whether weaknesses were rooted primarily in structural, managerial or policy-driven factors.

Table V: Determinant of NPAs During Pre-Merger (2005-2019) - Comparison Across Bank Groups

VARIABLES	SBI group		NATs		PVTs		FRBs	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CoD	-0.501*	-0.698*	1.604***	0.425	-0.407***	-0.081	0.345	0.363
	(0.258)	(0.389)	(0.376)	(0.306)	(0.150)	(0.177)	(0.345)	(0.339)
PSA to TA	0.046	0.032	0.187***	0.119***	0.006	-0.005	0.101***	0.105**
	(0.035)	(0.043)	(0.041)	(0.032)	(0.014)	(0.013)	(0.038)	(0.042)
TL to TA	0.007	-0.010	-0.058**	-0.042***	-0.022**	-0.018**	-0.003	-0.012
	(0.032)	(0.033)	(0.026)	(0.016)	(0.009)	(0.008)	(0.022)	(0.027)
II to total assets	0.905***	1.135***	-1.772***	-0.545	0.181	0.114	0.155	0.181
	(0.256)	(0.363)	(0.460)	(0.347)	(0.190)	(0.173)	(0.296)	(0.339)
ROA	-4.039***	-3.123***	-1.917***	-0.944***	-0.547***	-0.511***	-0.739***	-0.745***
	(0.265)	(0.646)	(0.365)	(0.263)	(0.195)	(0.141)	(0.155)	(0.164)
Constant	-1.529	-1.416	5.304*	3.626**	4.083***	2.775***	-1.865	-1.931
	(3.297)	(3.486)	(2.706)	(1.604)	(1.057)	(0.962)	(1.818)	(2.261)
Observations	90	88	300	300	315	315	209	209
R-squared	0.928	0.948	0.731	0.893	0.698	0.782	0.808	0.822
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	Yes	No	Yes	No	Yes

See "Notes" and "Sources" in Table I. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The findings reveal that both SBI and Nationalized Bank groups experienced severe deterioration in asset quality in the pre-merger phase. While higher costs of deposits (CoD) and large shares of priority sector advances (PSA) reaffirm the burden of policy-mandated lending on asset quality, the strongly negative statistical significance of ROA consistently underscores that profitability remains a key buffer against credit risk. The interest income (II) to total assets ratio shows divergent patterns: positive and significant for the SBI group, suggesting a reliance on interest income during periods of stress but negative for nationalized banks, where weak income generation coincided with worsening asset quality. Private and foreign banks display relatively better performance, characterized by moderate CoD, lower PSA exposure, and stable profitability, indicating superior risk assessment and credit discipline.

Although the consolidation of PSBs was expected to yield operational synergies and improved risk management, it is premature to conclude that the merger strategy has successfully mitigated the NPA problem. The post-merger period, spanning only 5 years, provides limited data making granular analysis difficult. As more post-merger observations become available, future research will be better positioned to evaluate whether these structural reforms have led to sustainable improvements in asset quality or if underlying institutional inefficiencies and credit-governance issues continue to warrant policy attention.

To complement the bank-level analysis, macroeconomic variables are incorporated in the models to assess the extent to which the fluctuations in external economic conditions impact NPA levels.

Table VI: Macroeconomic Effect, SCBs versus PSBs, 2005-2024

VARIABLES	Scheduled Commercial Banks (SCBs)			Public Sector Banks (PSBs)		
	(1)	(2)	(3)	(4)	(5)	(6)
CoD	0.252*	0.233	0.196	1.153***	0.470*	1.371***
	(0.132)	(0.186)	(0.183)	(0.375)	(0.250)	(0.299)
PSA to TA	0.057***	0.045***	0.058***	0.105**	0.056***	0.133***
	(0.016)	(0.012)	(0.013)	(0.043)	(0.020)	(0.031)
TL to TA	-0.020*	-0.012	-0.016*	-0.068***	-0.042***	-0.060***
	(0.012)	(0.010)	(0.009)	(0.020)	(0.012)	(0.018)
II to total assets	-0.140	-0.041	-0.101	-0.949**	-0.168	-1.178***
	(0.165)	(0.166)	(0.196)	(0.422)	(0.261)	(0.351)
ROA	-1.054***	-0.846***	-1.089***	-2.125***	-1.077***	-2.023***
	(0.201)	(0.129)	(0.156)	(0.320)	(0.265)	(0.308)
Fx rate change			0.030*			0.084***
			(0.017)			(0.021)
Inflation, Change			0.088**			0.265***
			(0.038)			(0.051)
CBPR, Change			0.226***			-0.029
			(0.059)			(0.082)
CRR, Change			0.273			0.785***
			(0.167)			(0.215)
Constant	1.871	1.030	1.681	4.661*	2.422*	3.981*
	(1.289)	(0.990)	(1.049)	(2.712)	(1.326)	(2.079)
Observations	1,217	1,217	1,128	456	456	427
R-squared	0.654	0.711	0.539	0.677	0.865	0.710
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	Yes	No	No	Yes	No

See "Notes" and "Sources" in Table I. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Although the results in columns 1 and 3 of [Table VI](#) show that the explanatory power of the model decreases from 65.4% to 53.9%, the rate of change of inflation, central bank policy rate and USD/INR exchange rate have statistically significant impact on higher NNPA levels for SCBs in addition to the bank specific factors. However, for PSBs, a stark divergence is observed in both explanatory power and sensitivity to macroeconomic factors. While the R^2 values for PSBs remain relatively high, it does not decline with the inclusion of macroeconomic variables (columns 4-6).

This contrast implies that macro-level conditions such as exchange rate movements, inflation, and monetary policy play a more direct role in shaping asset quality outcomes for PSBs than for the broader SCB group. This reiterates the structural and policy-linked nature of PSBs' lending portfolios, which are more exposed to sectors sensitive to economic cycles and government interventions.

The results highlight that macroeconomic fluctuations exacerbate credit risk primarily in public sector institutions, while private and foreign banks exhibit greater insulation due to diversified balance sheets, stronger internal risk management and market-oriented credit practices. This reinforces the broader conclusion that systemic shocks translate unevenly across ownership structures, with PSBs remaining more vulnerable to macro-financial stress.

To further explore whether the influence of macroeconomic conditions varies across institutional structures, the analysis compares the differential impact of macro variables across major bank groups. For PSBs, the sensitivity to macroeconomic conditions have already been discussed in detail under Table VI. The substantial heterogeneity in macroeconomic sensitivity across bank groups, reflecting differences in funding structures, risk appetite, and operational flexibility is presented in Table VII.

Table VII: Macroeconomic Effect, Comparison Across Bank Groups, 2005–2024

VARIABLES	PSBs		PVTs		FRBs	
	(1)	(2)	(3)	(4)	(5)	(6)
CoD	0.470*	1.371***	0.23	0.078	0.111	0.153
	(0.250)	(0.299)	(0.198)	(0.146)	(0.345)	(0.362)
PSA to TA	0.056***	0.133***	0.013	0.024***	0.072**	0.058*
	(0.020)	(0.031)	(0.008)	(0.009)	(0.031)	(0.030)
TL to TA	-0.042***	-0.060***	-0.008	-0.003	0.008	-0.002
	(0.012)	(0.018)	(0.006)	(0.007)	(0.021)	(0.018)
II to total assets	-0.168	-1.178***	-0.159	-0.26	-0.022	0.154
	(0.261)	(0.351)	(0.168)	(0.181)	(0.328)	(0.316)
ROA	-1.077***	-2.023***	-0.623***	-0.712***	-0.598***	-0.622***
	(0.265)	(0.308)	(0.167)	(0.193)	(0.155)	(0.179)
Fx rate change		0.084***		-0.009		0.006
		(0.021)		(0.013)		(0.045)
Inflation, Change		0.265***		-0.014		-0.098
		(0.051)		(0.029)		(0.129)
CBPR, Change		-0.029		0.182***		0.117
		(0.082)		(0.056)		(0.163)
CRR, Change		0.785***		-0.041		-0.131
		(0.215)		(0.130)		(0.454)
Constant	2.422*	3.981*	2.172***	3.207***	0.426	-0.316
	(1.326)	(2.079)	(0.824)	(0.930)	(1.847)	(1.630)
Observations	456	427	422	391	271	254
R-squared	0.865	0.710	0.664	0.543	0.787	0.575
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No	Yes	No

See “Notes” and “Sources” in Table I. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The private sector banks show muted response to macroeconomic conditions as only central bank policy rate emerges as significant and positive, indicating that tighter monetary policy conditions may be associated with elevated NNPA levels. A smaller coefficient as compared to PSBs indicate better resilience to inflation and exchange rate volatility, supported by more diversified portfolios and agile risk management practices.

The absence of strong macro sensitivity in case of foreign banks suggests that their asset quality dynamics are primarily driven by firm-level and international market factors rather than domestic policy or inflationary movements in India. The macroeconomic variables are largely insignificant for FRBs, reflecting their limited domestic exposure and globally diversified risk profiles.

The pre-merger analysis provides valuable evidence on how various bank groups responded to external shocks and policy changes prior to consolidation. These variations underscore that the structural

vulnerabilities observed earlier were not only institutional but also macro- sensitive, particularly in the case of state-owned banks ([Table VIII](#)).

Table VIII: Macroeconomic Effect During Pre-Merger, 2005-2019: Comparison Across Bank Groups

VARIABLES	SBI group		NATs		PVTs		FRBs	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CoD	-0.698*	-0.405	0.425	1.711***	-0.081	-0.283**	0.363	0.423
	(0.389)	(0.356)	(0.306)	(0.361)	(0.177)	(0.143)	(0.339)	(0.383)
PSA to TA	0.032	0.053	0.119***	0.263***	-0.005	0.012	0.105**	0.101**
	(0.043)	(0.046)	(0.032)	(0.045)	(0.013)	(0.013)	(0.042)	(0.042)
TL to TA	-0.010	0.003	-0.042***	-0.048*	-0.018**	-0.015**	-0.012	-0.014
	(0.033)	(0.037)	(0.016)	(0.028)	(0.008)	(0.008)	(0.027)	(0.024)
II to total assets	1.135***	0.781**	-0.545	-1.859***	0.114	0.066	0.181	0.213
	(0.363)	(0.365)	(0.347)	(0.501)	(0.173)	(0.177)	(0.339)	(0.317)
ROA	-3.123***	-3.930***	-0.944***	-1.723***	-0.511***	-0.558***	-0.745***	-0.777***
	(0.646)	(0.316)	(0.263)	(0.359)	(0.141)	(0.174)	(0.164)	(0.187)
Fx rate change		0.047**		0.110***		-0.000		0.029
		(0.022)		(0.025)		(0.014)		(0.049)
Inflation, Change		0.068		0.343***		-0.020		-0.187
		(0.076)		(0.061)		(0.031)		(0.156)
CBPR, Change		-0.050		-0.080		0.189***		0.193
		(0.107)		(0.112)		(0.044)		(0.188)
CRR, Change		0.421*		1.311***		0.114		0.084
		(0.231)		(0.237)		(0.136)		(0.494)
Constant	-1.416	-0.989	3.626**	2.399	2.775***	3.641***	-1.931	-2.483
	(3.486)	(3.612)	(1.604)	(2.707)	(0.962)	(0.996)	(2.261)	(1.967)
Observations	88	82	300	279	315	285	209	192
R-squared	0.948	0.937	0.893	0.778	0.782	0.694	0.822	0.636
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	Yes	No	Yes	No	Yes	No	Yes	No

See "Notes" and "Sources" in Table I. Robust standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

For the SBI group, the significance of the USD/INR exchange rate and CRR changes emerge as significant, indicating that exchange rate volatility and liquidity tightening amplified credit risk during this period. The noticeable increase in R^2 after incorporating these variables suggests that macroeconomic factors substantially improved the explanatory power of the model for SBI, pointing to a higher sensitivity of its asset quality to systemic shocks.

Nationalized banks showed stronger sensitivity to macro-financial indicators. Inflation, ex- change rate movements, and CRR changes all emerge as significant, highlighting the exposure of this group to broad policy and monetary shifts. These banks, already burdened by large mandated priority sector lending (PSA), appear to have faced amplified asset quality stress during periods of macroeconomic tightening. The negative and significant ROA coefficient continues to reaffirm that profitability remains the strongest internal buffer against NPA formation.

Meanwhile, private and foreign banks show limited or no significant macroeconomic sensitivity, underscoring the relative resilience of their balance sheets and better risk diversification.

Taking together, these results provide evidence that public sector banks bore a disproportionate burden of macro-financial stress in the pre-merger period. Private and foreign banks, on the other hand, operated with relatively stronger buffers and adaptive business models that limited the spillover of macro stress. This divergence underscores why the government's post-2019 consolidation strategy was centered on PSBs aimed at improving operational efficiency, enhancing capital strength, and reducing macroeconomic vulnerability in the most systemically exposed segment of the banking sector.

6. Concluding Remarks

The findings of this study highlight the multifaceted nature of non-performing assets (NPAs) in the Indian banking sector, shaped by both bank-specific factors and macroeconomic conditions. Using a comprehensive unbalanced panel dataset, this research provides new insights into the determinants of NPAs across public, private, and foreign banks. While structural reforms, including public sector bank consolidations, have improved operational efficiency and capital adequacy in some cases, governance weaknesses and credit risk vulnerabilities persist, particularly in public sector banks. Benchmarking against foreign banks underscores the role of institutional and regulatory differences in shaping asset quality.

The study also emphasizes the influence of macroeconomic factors, such as inflation, exchange rate fluctuations, bank rate and cash reserve ratio on NPA levels, highlighting the need for coordinated policy responses to address both institutional and systemic vulnerabilities. Strengthening credit appraisal and risk management systems, enhancing transparency in asset quality reporting, and promoting efficient recovery mechanisms are critical in curbing future NPA accumulation. Likewise, incentivizing diversified and sustainable funding structures can reduce dependence on high-cost borrowings, while targeted interventions in public sector banks through governance reforms and performance-linked accountability are essential for durable improvement. Finally, leveraging technology and advanced analytics for early warning systems and credit monitoring can further strengthen the sector's resilience against emerging risks.

In conclusion, this research contributes to the literature on banking sector resilience by providing evidence-based insights into the interplay between institutional factors, macroeconomic conditions, and asset quality. These findings offer valuable guidance for policymakers aiming to strengthen the stability and sustainability of India's banking sector.

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BEHAVIORAL FACTORS, INDIVIDUAL INVESTORS' DECISION AND INVESTMENT PERFORMANCE IN AN EMERGING MARKET

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Abstract

The study attempts to develop a research model for discovering the influence of behavioral factors on investment decisions and investment performance of individual investors in the Vietnamese stock market. Four main groups of behavioral factors are considered: Heuristic, Prospect, Market and Herding - psychological factors. The study employs quantitative research methods. Online survey questionnaire is distributed to individual investors in the Vietnamese stock market. The data will be processed and analyzed using statistical tools including SPSS and AMOS through the methods of Exploratory Factor Analysis (EFA), Confirmatory Factor Analysis (CFA) and Structural Equation Modeling (SEM). The results of the study are expected to show how behavioral factors affect the investment decision-making process and investment performance of individual investors. Based on the findings, the study will provide useful suggestions for investors, policy makers and financial education institutions in better understanding investor psychology and improving the rationality of financial decisions in the Vietnamese stock market.

Keywords: *Behavioral Finance, Heuristic, Prospect, Herding, Investment Decision Making, Investment Performance*

1. Introduction

Behavioral Finance is a field of study that combines finance and psychology to explain why investors do not always make decisions in a completely rational manner as traditional financial theories assume. Many investors are influenced by emotions, subjective perceptions and psychological biases when participating in the market. In Vietnam, the stock market is growing rapidly and attracting increasing number of individual investors. However, most of these investors often make decisions based on emotions, crowd trends or unverified information instead of fundamental analysis, leading to low investment efficiency. Therefore, it is necessary to study behavioral factors affecting investment decisions and investment efficiency to better understand the behavior of Vietnamese investors. This study will focus on four main factors including Heuristic, Prospect, Market, and Herding, to evaluate their impact on investment decisions and investment performance of individual investors in the Vietnamese stock market.

Traditional financial theories such as the Efficient Market Theory (EMH) or Modern Portfolio Theory (MPT) assume that investors always act rationally and that the market always fully reflects information. However, a large body of empirical evidence from behavioral finance has shown that investors are often influenced by emotions, cognitive distortions, and psychological biases when making decisions. In Vietnam, due to the characteristics of an emerging market and the large proportion of individual investors involved, investment decisions are often strongly influenced by herd mentality, overconfidence or fear of loss. Meanwhile, domestic research on this topic is still limited and has not clearly analyzed the relationship between behavioral factors and investment results. Therefore, this study was conducted to answer the question: “How do behavioral factors such as Heuristic, Prospect, Market and Herding affect investment decisions and investment performance of individual investors in the Vietnamese stock market?”

The general objective of the study is to examine the impact of behavioral factors on investment decisions and investment performance of individual investors in Vietnam. First, the study identifies the main behavioral factors affecting individual investors' investment decisions. Second, the study analyzes the level of influence of Heuristic, Prospect, Market and Herding factors on the investment decision-making process. Next, the study evaluates the impact of these behavioral factors on individual investors' investment performance. Finally, recommendations are proposed to help investors limit the negative impact of behavioral biases, thereby improving investment performance.

2. Literature Review

1. Review of Theories

The theoretical basis for this study combines theories from the field of traditional finance with key contributions from behavioral finance. First, behavioral finance grew out of pointing out the limitations of the assumption of a perfectly rational person in classical economics; authors such as Selden, Ricciardi and Simon, Statman, as well as Zaleśkiewicz have emphasized that human financial decisions are strongly influenced by psychological factors, emotions, and cognitive limitations. Behavioral finance not only explains market anomalies such as the January effect, bubbles, and crashes, but also provides a theoretical framework for analyzing systematic deviations in investor behavior.

An important theory is Kahneman and Tversky's Prospect Theory. This theory describes how people perceive gains and losses as disproportionate because losses have a greater impact than gains and explains behaviors such as risk avoidance in the event of gains but risk acceptance in the event of losses. Prospect Theory provides the foundation for understanding phenomena such as loss aversion, regret aversion, and mental accounting, which directly influence trading decisions and portfolio adjustments.

The theory of heuristics and bounded rationality describes how people apply simple rules to make quick decisions in environments with insufficient information. Common heuristics mentioned include overconfidence, representativeness, anchoring, mnemonic and player fallacy. These heuristics help reduce the cognitive load, but at the same time lead to systematic biases in probability estimation, risk assessment and investment selection.

Overconfidence is considered a major cognitive bias as investors tend to overestimate their own knowledge and predictive ability, which leads to increased trading, higher risk taking, and can negatively impact actual

investment performance. Conversely, on a larger scale, overconfidence can also promote innovation and entrepreneurship as it increases risk taking.

Representativeness and anchoring shed light on how investors use psychological models and starting points to evaluate stocks, leading to ignoring new information or possibly misjudging true probabilities. Availability bias causes investors to base their probabilities on what is easy to remember (e.g., information from the media), while gambler's fallacy causes confusion about the independence of random events, influencing buy-hold or sell decisions (Tversky & Kahneman, 1974; Boynton, 2003).

Herding Theory (Banerjee, 1992; Devenow & Welch, 1996) explains the phenomenon in which investors copy the actions of the crowd when private information is scarce or unreliable. Herding behavior can increase price volatility and create bubbles or large declines when the crowd turns (Ouarda et al., 2013; Gavrilakis & Floros, 2022).

The market and environmental factors theory (AMH/EMH, along with the business cycle literature) emphasizes that macroeconomic factors, liquidity, stock exposure, and global integration all influence expected risk and return (Hamilton & Lin, 1996; Reinganum, 1988; Levine & Zervos, 1998). Combining these theories provides a better understanding of how behavioral factors (heuristics, prospect, herding) interact with market factors to shape investment decisions and resulting stock performance.

In brief, the theoretical framework of this study focuses on: (1) cognitive and emotional mechanisms (heuristics, prospect-related biases), (2) the influence of group behavior (herding), and (3) market conditions. All of these influence investment decisions and further influence investment performance. These connections will serve as the basis for developing the hypotheses and research models in the following sections.

2. Review of Previous Studies

Many studies have confirmed the typical influence of heuristic biases on trading decisions and behavior. Parveen et al. (2020) in Pakistan showed that overconfidence increases trading volume and significantly affects investment decisions; Barber & Odean (1999) also found that individual investors overtrade due to overconfidence, leading to reduced actual profits. Other studies (Benartzi & Thaler, 2007; Tversky & Kahneman, 1974) provide evidence that anchoring, availability, and representativeness distort probability judgments and stock values. In Vietnam, small-scale studies also recorded similar phenomena, but few studies synthesized multiple types of heuristics at the same time on a large sample of individual investors.

Shefrin & Statman (1985) discovered the phenomenon of disposition effect because investors hold losing stocks longer and sell winning stocks too soon. This is a direct manifestation of loss aversion and regret aversion. Many subsequent works (Barberis & Huang, 2001; Benartzi & Thaler, 2007) confirmed that Prospect Theory explains these behaviors better than EUT. Mental accounting (Thaler, 1999) is proven to reduce the efficiency of portfolio rebalancing when investors separate capital sources according to psychological "accounts". Studies in developed markets show that these biases affect transaction structure and performance, but in emerging markets like Vietnam, there is still a lack of studies that combine loss aversion, regret and mental accounting on a large sample.

The theoretical foundations of Banerjee (1992) and Devenow & Welch (1996) and subsequent studies (Ouarda et al., 2013; Gavrilakis & Floros, 2022) show that herding exists in many markets, especially when

information is asymmetric or transaction costs are low. Some studies also show that herding can temporarily improve portfolio decisions (due to copying experts) but in the long run, it increases systematic risk. In Vietnam, evidence of herding appears partly in certain industry booms (e.g., “fever” of industry stocks), but there is still a lack of quantitative studies that combine individual behavioral factors and market variables. Research on the impact of market variables (price volatility, economic downturns, liquidity, and degree of integration) shows that these factors shape the environment in which investors operate (Hamilton & Lin, 1996; Krishnan & Brooker, 2002). Reinganum (1988) and Levine & Zervos (1998) show that stock classification by value, size, and liquidity has different effects on performance. These results emphasize that behavioral factors do not operate in isolation— they interact with market conditions and stock characteristics to shape decisions and ultimate performance.

3. Hypothesis Development

The preceding review and discussion show that: (1) many studies confirm the negative impact of overconfidence and some other heuristics on performance due to excessive trading; (2) Prospect Theory (loss aversion, regret, mental accounting) explains well the behavior of selling/holding stocks; (3) herding increases volatility and can affect both decisions and performance; (4) market variables moderate the magnitude and direction of the influence of behavioral biases. However, there are some obvious gaps. First, many studies separate each type of bias without a comprehensive model showing the interaction between heuristics, prospect and herding. In the context of Vietnam, where individual investors account for a large proportion, there is a lack of studies that simultaneously investigate multiple behavioral factors and market variables to understand the dual impact on decisions and performance. Furthermore, there is a lack of updated evidence on the magnitude and direction of influence of each bias under different market conditions (normal vs. crisis), and on how these factors interact with stock characteristics (size, liquidity, integration).

Based on the above review of related theories and studies, the following hypotheses are proposed.

H1: Heuristics have a positive influence on individual investors' investment decisions

H2: Prospect theory positively affects investment decisions of individual investors

H3: Market factors have a positive influence on investment decisions H4: Herd behavior has a positive influence on investment decisions

H5: Heuristics have a positive impact on investment performance.

H6: Prospect theory has a positive impact on investment performance.

H7: Market factors have a positive impact on investment performance.

H8: Herding behavior has a positive impact on investment performance.

3. Research Methodology

1. Research Design

This study will employ a quantitative research design to examine the effects of behavioral factors on individual investors' decision making and investment performance in the Vietnam stock market. A survey method will be used to collect data from individual investors trading on the Ho Chi Minh City Stock Exchange (HOSE), Hanoi Stock Exchange (HNX), and UPCoM market. The quantitative approach is considered appropriate because it enables statistical analysis and hypothesis testing to determine the

relationships among behavioral factors such as Heuristic, Prospect, Market, and Herding, and their effects on Investment Decision-Making and Investment Performance.

2. Variable Measurement

The measurement scales for each variable will be adapted from Cao et. al. (2021) and other related financial behavioral studies. Each construct will be measured using several observed items on a 5-point Likert scale, ranging from 1 (Strongly Disagree) to 5 (Strongly Agree). The variables in this study will be measured as follows:

Heuristic factors: Representativeness, Overconfidence, Anchoring, Gambler's Fallacy, and Availability Bias.

Prospect factors: Loss Aversion, Regret Aversion, and Mental Accounting.

Market factors: Stock price changes, market information, past trends, customer preferences, and company fundamentals.

Herding factors: The influence of other investors' decisions on investment behavior.

Investment Decision-Making: The process by which investors gather, evaluate, and act on information when making decisions.

Investment Performance: Investors' perceived return rate and satisfaction with their investment outcomes.

3. Data Collection And Analysis

Data will be collected using an online survey questionnaire distributed through social networks, investment forums, and investor communities. The target population will include individual investors who actively participate in trading on the HOSE, HNX, and UPCoM exchanges. A non-probability convenience sampling method will be used due to the accessibility of respondents. The expected sample size will be around 200–250 valid responses, which is considered sufficient according to Hair et al. (2010), who recommends a minimum of 5–10 observations per variable. Prior to the main survey, a pilot test will be conducted with approximately 10 investors, including academics and experienced, to refine the questionnaire in terms of wording, clarity, and relevance.

After collecting the data, all valid responses will be processed and those with incomplete information or subjective opinions will be eliminated before analysis. Using SPSS and AMOS software, the study intends to conduct quantitative analysis steps, and the data analysis process is carried out in many stages to ensure the reliability and value of the scale, as well as to test the research model and proposed hypotheses.

First, descriptive statistics will be conducted to summarize the demographic characteristics of the survey sample such as gender, age, education level, income and investment experience. Next, the reliability test of the scale using Cronbach's Alpha coefficient will be performed to assess the level of internal consistency between observed variables in the same factor group. According to the standard of Nunnally & Bernstein (1994), the scale is accepted when the

Cronbach's Alpha coefficient is greater than 0.6 and the Corrected Item–Total Correlation coefficient is greater than 0.3. Variables that do not meet the requirements will be eliminated before performing the factor

analysis step. After the scale ensures reliability, Exploratory Factor Analysis (EFA) will then be done to determine the latent structure of behavioral variable groups. EFA analysis helps to reduce the number of observed variables and check the convergence of variables in the same factor. The method of extracting coefficients uses Principal Axis Factoring (PAF) combined with Promax rotation, and only factors with Eigenvalue > 1 and factor loading greater than 0.5 are retained in the model. Next, confirmatory factor analysis (CFA) is conducted to assess the suitability of the measurement model. CFA helps to test the convergent validity and discriminant validity of the scales and confirm that the observed variables accurately reflect the corresponding theoretical concepts. The indices used to assess the suitability of the model include Chi-square/df (< 3), GFI (Goodness of Fit Index > 0.9), CFI (Comparative Fit Index > 0.9), TLI (Tucker–Lewis Index > 0.9), and RMSEA (Root Mean Square Error of Approximation < 0.08). Structural equation modeling (SEM) will be applied to examine the causal relationships between the independent variables (Heuristic, Prospect, Market, Herding) and two dependent variables (Investment Decision-Making, and Investment Performance) after the measurement model is confirmed. Hypotheses H1 to H8 will be tested at the 5% significance level ($p < 0.05$). Standardized Regression Weights (β) will be used to determine the relative influence of each behavioral factor on investment decisions and performance. Finally, the analysis results will be summarized and interpreted to clarify the relationship between behavioral factors and investment performance of individual investors in the Vietnamese stock market.

4. Conclusion

The present study aims to design a research framework for investigating how behavioral factors influence individual investors' investment decisions and performance in the Vietnamese stock market. Based on behavioral finance theories and empirical results, the study mainly focuses on four main behavioral dimensions – Mindset, Prospects, Market Factors and Herd Psychology – and assesses their direct impact on both investment decisions and investment results. The research model and hypotheses are developed to reflect the psychological characteristics and context of Vietnamese investors, who often operate in an emerging and volatile market environment. The study applies a quantitative approach by collecting survey data from individual investors, followed by statistical analyses including reliability testing,

factor analysis and Structural Equation Modeling (SEM). The study findings are expected to provide insights into how behavioral biases influence investment behavior in Vietnam, thereby providing implications for investors, financial advisors and policymakers. Overall, the study's main purpose is to build a clear theoretical foundation, a sound research framework and a systematic methodological approach, ensuring feasibility and academic value for the later stages of the research.

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A SOCIO-TECHNICAL MODEL FOR TRANSFORMING COLLABORATIVE KNOWLEDGE INTO INFORMING PROCESSES FOR STRATEGIC ORGANIZATIONAL DECISION MAKING

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ABSTRACT

E-Communities of Practice (E-CoPs) are becoming fundamental socio-technical ecosystems of distributed knowledge creation, collaborative learning as well as organisational intelligence in digitally transformed companies. With growing adoption of data-driven and intelligent decision technologies in organisations, formal integration of human-centred and knowledge-rich collaboration environments with formal decision systems a critical research challenge has emerged. This research paper suggests that E-CoPs can facilitate knowledge-based leadership- and strategically-based decision making through the integration of key dimensions such as human capital, collaborative infrastructures, and structured problem-solving and decision-making practices. The E-CoPs create explicit and tacit knowledge bases that are not fully utilized by traditional Decision Support Systems (DSS): this is the result of the ongoing interaction. The extent of informal, experience-based knowledge that is incorporated in the formal decision making processes of organisations has remained a limitation to the effectiveness, transparency and flexibility of most of the available decision systems. Towards this direction, this paper suggests a knowledge-based integration framework that integrates E-CoPs flows of knowledge with Collaboration Support Systems (CSS), and Intelligent DSS (IDSS). The suggested framework allows the systematic conversion of the distributed, practice-based knowledge into practical organisational intelligence.

Keywords: *Informing Processes; e-Communities of Practice; Knowledge Co-Creation; Socio-Technical Decision Systems; Organizational Intelligence; Collaborative Knowledge Networks*

1. INTRODUCTION

In an environment marked by fast digital transformation and tightening global competition, organizations increasingly view knowledge as one of their resource bases for innovation, resilience and long-term performance (Vial, 2019; Kraus et al., 2022). The ability to be able to create, share and mobilize knowledge constantly has therefore become essential part of prying up organizational advantage. Within this landscape Communities of Practice (CoPs) have re-emerged as an important organizational mechanism to enable social learning, collaborative problem solving and the sharing of a common expertise (Wenger-Traynor and

Wenger-Traynor, 2020). Their role is also not static and traditional in its nature but has a role as a dynamic structure in which experience-based knowledge and professional identities develop.

At the same time, improvements in artificial intelligence, cloud-based collaboration platforms and data-based decision technologies have transformed the way organizations orchestrate their work and how they process information (Leonardi, 2021; Berente et al., 2022; Vial et al., 2024). This accelerated pace of technology has added to a long standing strategic dilemma, that while organizational knowledge is getting ever more complex and specialized, its relevance is declining ever more rapidly. Organizations must thus build adaptive learning capability and embrace the right tools to facilitate rapid sense making and intelligent decision making (Nonaka, 2021; Nonaka and Toyama, 2021). Consequently, there has been a strong need for digitally supported E-CoPs that enable the upscaling of knowledge exchange across organizational boundaries.

These challenges are particularly notable in Small and Medium Enterprises (SMEs) where limited financial and technological resources can be seen to be a limit on investments in advanced knowledge management infrastructures (OECD, 2023). In many such organizations, the knowledge is still dispersed among the informal communication channels, or saved in unstructured repositories that lack semantic organization, intelligent retrieval, and analysis capabilities (Scuotto et al., 2021). The lack of sound collaboration and decision support systems makes it hard for employees to access valuable shared expertise or respond appropriately to increasing business complexity.

From a knowledge management perspective in contemporary times, organizations can be thought of as networks of CoPs, each of which contributes its own, pixel-like domains of expertise as collaborative communities (Wenger-Trayner and Wenger-Trayner, 2020; Scarso and Bolisani, 2023). Through continued interaction, these communities evolve their shared practice, problem-solving strategies, and new information. CoPs therefore play several roles, such as helping circulate and interpret knowledge, preserve the tacit know-how that cannot be fully captured by formal systems, professional competence building and anchoring the identities of members in the wider organizational context (Kane et al., 2019). Importantly, innovation tends to occur at the intersections between different communities, as different perspectives appear to converge and recombine knowledge in new ways.

Despite the proliferation of CSS and IDSS, organizations still face difficulties in linking in a systematic way the rich, practice based knowledge generated within E-CoPs to formal decision-making infrastructures (Power et al., 2022; Watson and Wixom, 2020). While explicit knowledge is commonly embedded into analytical and rule-based decision processes, tacit knowledge and experiential knowledge, often of greatest value to provide strategic insight, is underutilized by conventional decision systems (Alavi and Leidner, 2020). This disconnect limits the potential of the application of intelligent decision technologies to support informed, transparent and adaptive organizational action.

In face to this gap, the present research examines how knowledge generated within E-CoPs can be integrated in intelligent organizational decision environment. Inspired by the new advances of collaborative intelligence, knowledge-driven systems and artificial intelligence enabled decision-support (Berente et al., 2022; Power et al., 2022; Malone, 2021; Duan et al., 2023), the paper presents a knowledge-driven formalism for unifying explicit and tacit knowledge in a single decision architecture. The framework is

intended to strengthen decision quality of organizations, improve strategic alignment and responsiveness to dynamic and uncertain business situations.

The rest of this paper takes the following form. Section under review the recent research on E-CoPs, collaboration technologies, knowledge management and intelligent decision systems. Section 3 analyses organizational and technological challenges that are associated with the digital collaboration and knowledge integration and examines leadership and strategic planning through E-CoPs-informed decision processes. Section 4 presents the proposed framework and Section 5 concludes the study in terms of the topic for future research.

2. RELATED WORK

2.1 E-CoPs as Knowledge Co-Creation Ecosystems

E-CoPs are exploiting networked digital technologies so that collaboration and knowledge sharing across geographical, organizational and temporal boundaries can take place. In contrast to traditional, place-based communities, the engagement in E-CoPs is largely motivated by common professional interests and aims and problem-solving processes instead of the physical space and the formal organization (Wenger-Trayner and Wenger-Trayner, 2020; Scarso and Bolisani, 2023). It is possible to note that recent literature intends to conceptualize E-CoPs as an ecosystem of dynamic knowledge co-creation, where interaction, digital platforms, and social learning intersect to support distributed organizational intelligence and value creation (Vial, 2019; Nonaka and Toyama, 2021; von Krogh, 2023; Majchrzak et al., 2023; Chatterjee et al., 2022).

Conventional societies are characterized by the fixity of membership, set standards and well-defined social organization. Conversely, e-Cop are more fluid and flexible in terms of membership and changing patterns of participation based on the relevance of tasks and collaborative needs (Scarso and Bolisani, 2023; Li et al., 2021). Digital spaces lessen the social and hierarchical restrictions that encourage greater individual contribution of knowledge, self-organization, and the manifestation of informal leadership (Leonardi, 2021). Modern digital collaboration platforms are becoming the so-called social space of such groups, which facilitates asynchronous and synchronous communication, common repositories, and joint problem solving (Berente et al., 2022; Watson and Wixom, 2020; Oliveira et al., 2019).

Past studies point out that successful creation of virtual and hybrid communities has patterned life cycles. Initial models highlighted like formation, conflict, collaborative performance and dissolution. More current empirical research proves that E-CoPs are still developing in consecutive stages of initiation, engagement, knowledge integration, and transformation in digitally mediated spaces (Wenger-Trayner and Wenger-Trayner, 2020; Scarso and Bolisani, 2023; Majchrzak et al., 2023). Such temporal dynamics play a critical role in comprehending the process of trust, level of participation, and the productivity of knowledge being cultivated over time in digital collaboration environments.

Process-based learning and knowledge development in e- CoPs are extensively understood as phenomena. The modern knowledge construction and co-creation frameworks focus on stages concerning intention preparation, commitment building, collaborative bargaining, and knowledge standardization (Nonaka and Toyama, 2021; Bresciani et al., 2024). Gradually, the interaction between participants leads to the

emergence of a common vocabulary, customs, routines, and digital artefacts that help create the emerging body of knowledge of the community (Scarso and Bolisani, 2023; Chatterjee et al., 2022).

In terms of knowledge-management, Communities of Practice should be considered as socio-technical forms of learning whereby people attain knowledge by engaging in valid practice in real professional activities (Wenger-Trayner and Wenger-Trayner, 2020; Alavi and Leidner, 2020). Such communities are not only member-based (consisting of amateurs and professionals) but also digital artefacts, tools, workflows, and collaborative infrastructures that facilitate the creation and transfer of knowledge (Watson and Wixom, 2020; Faraj et al., 2018). Collaboration, facilitation, and problem-based interaction are all forms of constructivist learning, and they continue to play a key role in knowledge building in real and online CoPs (Cabrera and Cabrera, 2020).

Recent publications also highlight the idea that the E-CoPs are essential in facilitating the tacit knowledge sharing that cannot be easily documented in the formal repositories (Nonaka and Toyama, 2021; Alavi and Leidner, 2020; Li et al, 2021). The use of e-cohort as a form of continuous interaction, social learning, joint problem solving, and reflective dialogue facilitates the transfer of experience across organizational and professional boundaries (Scarso and Bolisani, 2023; Cabrera and Cabrera, 2020). As cloud platforms, social enterprise systems and AI-assisted collaboration tools mature, E-CoPs are emerging as the scalable digital knowledge co-creation ecosystems integrated into the larger organizational knowledge infrastructures and digital ecosystems (Vial, 2019; Berente et al., 2022; Chatterjee et al., 2022; Duan and Vasarhelyi, 2022; Bresciani et al, 2024).

2.2 CSS as Enablers of Knowledge Co-Creation in E-CoPs

Although E-CoPs are the social and psychological basis on knowledge co-creation, their successful functioning in the digital formats highly depends on the technological infrastructures, which facilitate communication and cooperation. Here, CSS become the main facilitating layer in which the co-creation of knowledge is realized in E-CoPs.

CSS are one fundamental technology layer of a facilitator layer that is used to support interaction, coordination and creation of knowledge in physical and virtual Communities of Practice. Initial investigation of collaboration technologies had concentrated on groupware and computer-supported cooperative work, although the recent investigations have concentrated on cloud-based solutions, social enterprise systems, and AI-enhanced collaboration environments as the most common infrastructures that support the modern E-CoPs (Leonardi, 2021; Watson and Wixom, 2020; Oliveira et al., 2019; Maruping et al., 2019). These systems possess inbuilt capabilities of communication, sharing of contents, coordination, and collaborative problem solving which supports the maintenance of community contact both spatially and over the temporal dimensions.

The existing literature is moving towards conceptualizing CSS as socio-technical facilitators of collective intelligence, but not a communication tool. CSS enable the co-creation, diffusion, and recombination of knowledge in an organizational ecosystem through the confluence of social interaction mechanisms and digital affordances (Majchrzak et al., 2023; Chatterjee et al., 2022; Faraj et al., 2018; Benbya et al., 2020). Enterprise social networks, collaborative working areas, and knowledge-sharing portals have enabled

community members to externalize experience, share knowledge and mutually refine practices in real-time (Scarso and Bolisani, 2023; Watson and Wixom, 2020; Cabrera and Cabrera, 2020; Recker et al., 2021).

The use of CSS in E-CoPs had a profound effect on the intensity of participation, the development of trust and knowledge sharing behaviour. According to empirical research, discussion forums, shared repositories, version control systems, and tools of synchronous collaboration have been found to increase individual activity and the social capital of virtual communities (Li et al., 2021; Cabrera and Cabrera, 2020; Oliveira et al., 2019; Recker et al., 2021). Furthermore, the contextual factors that influence the successful use of CSS in collaborative contexts have been identified to be leadership support, moderation mechanisms, and platform usability (Berente et al., 2022; Scarso and Bolisani, 2023; Tarafdar and Breathnach, 2022).

The current developments in data analytics and artificial intelligence are further changing the role of CSS in e-coops. Recommendation systems, automated content classification, expertise-location services, and talking agents are increasingly integrated into intelligent collaboration platforms to assist in the knowledge discovery and decision-making process (Leonardi, 2021; Power et al., 2022; Duan and Vasarhelyi, 2022; Benbya et al., 2020; Faraj et al., 2024). These features make CSS transcend passive exchange of information to active mediation of collaborative knowledge processes to improve efficiency and strategic value.

In terms of knowledge-management, CSS serve as the main digital infrastructure where explicit knowledge is the focus of capturing, storing, and spreading, and at the same time, as the social process of knowledge exchange, tacit knowledge (Nonaka and Toyama, 2021; Alavi and Leidner, 2020; Cabrera and Cabrera, 2020; Recker et al., 2021). The interaction of structured knowledge repositories and unstructured social interaction space enables e-cop to be able to balance the codified knowledge management with the experiential learning and informal sense-making.

Recent studies, despite the potential, also show that there are still challenges related to the implementation of CSS in E-CoPs. Among them, there can be the problem of information overload, uneven participation, the lack of digital skills, data privacy, and the mismatch between technological design and community practices (Scuotto et al., 2021; Majchrzak et al., 2023; Oliveira et al., 2019; Maruping et al., 2019; Standaert et al., 2020). Resource constraints and disjointed digital policies tend to limit the successful institutionalization of collaboration support infrastructures in SMEs especially (OECD, 2023; Scuotto et al., 2021; Tarafdar and Breathnach, 2022).

In general, the entire literature seems to have settled on the idea that CSS serve as invaluable facilitators of modern E-CoPs and define the way knowledge is generated, exchanged, and utilized in digitally mediated settings (Scarso and Bolisani, 2023; Watson and Wixom, 2020; Chatterjee et al., 2022; Bresciani et al., 2024; Benbya et al., 2020). Nevertheless, the successful alignment of CSS with the rest of organizational knowledge management and intelligent decision support architectures is still a research gap, which encourages further exploration of knowledge-based and AI-supported collaborative structures.

2.3 Leadership in E-CoPs for Knowledge Co-Creation

Leadership has also been widely accepted as a key success driver in the formation, sustainability and performance of E-CoPs. The initial leadership models of E-CoPs focused on the formal designation of facilitators, coordinators, or sponsors as a method of creating a baseline governance system (Nonaka and

Toyama, 2021; OECD, 2023; Alavi and Leidner, 2020). These role oriented views determine the leadership as a structuring attribute which determines the norm of participation, distribution of responsibilities and the initial developmental path of the community. Nevertheless, modern studies tend to suggest that e-leadership in E-CoPs is far more than the role assignment and must be perceived as dynamic and socially constructed process that changes through the community life cycle (Bresciani et al., 2024; Hoch et al., 2019).

Recent sources emphasize that the success of leadership in E-CoPs should not be limited to the initial role identification but depends on the process of leadership practices execution, negotiation, and redistribution throughout the period of development as new challenges and opportunities arise (Hoch et al., 2019; Uhl-Bien and Arena, 2018). Contextual, political and organizational factors mediate leadership behaviours and inappropriate fits between formal leadership functions and actual leadership competences can have a severe limiting effect on the effectiveness of community performance and knowledge co-creation outcomes (Chatterjee et al., 2022; Tarafdar and Breathnach, 2022). Consequently, the existing views tend to embrace distributed and relational models of leadership when elaborating on the collective exercise of influence, coordination, and accountability in digitally mediated communities (Uhl-Bien and Arena, 2018; Cortellazzo et al., 2019).

Virtual and digital leadership research also highlights the roles of relational and communicative practices in knowledge sustenance in E-CoPs. Instead of being considered as controllers of information flows, leaders are perceived as facilitators of interaction, trust, and openness, which encourages the inclusion of participation, psychological safety, and common sense-making (Cortellazzo et al., 2019; Contreras et al., 2020). Research indicates that transparency, constant feedback, and the conscious development of trust are the key preconditions of successful leadership in online teamwork settings (Cabrera and Cabrera, 2020; Tarafdar and Breathnach, 2022; Cortellazzo et al., 2019). Such dynamics of relations foster the development of collective identity and enhance the social capital needed to maintain the process of knowledge co-creation.

Regarding socio-technical aspects of E-CoPs, leadership also goes hand-in-hand with the architecture and management of the virtual processes that interfere the collaboration. The ways of appropriating collaboration technologies, institutionalizing norms of participation, and embedding power relations into spaces of digital interaction are influenced by leaders (Berente et al., 2022; Standaert et al., 2020; Kane et al., 2021). The governance systems, policies of moderation, and methods of digital engagement determine the degree to which CSS reinforce or reinforce structural asymmetries.

The E-CoPs leadership is also linked to the wider organizational adaptation and renewal processes as found in strategic leadership research. Leaders are particularly important in understanding environmental cues, harmonizing organizational strategy with community wisdom, and using collective intelligence in long-term organizational sustainability in turbulent and digitally transformed environments (Vial, 2019; Kraus et al., 2022; Uhl-Bien and Arena, 2018). Perceptions of E-CoPs leaders towards the environmental change, technological opportunity, and organizational misfit have a strong impact on the degree of using knowledge generated by E-CoPs to learn strategically and renew the organization (Duan and Vasarhelyi, 2022; Cortellazzo et al., 2019).

In general, new literature is united in its perception of leadership in E-CoPs as a multi-level, distributed, and digitally mediated phenomenon, which involves formal roles, relational practices, and socio-technical governance practices (Leonardi, 2021; Maruping et al., 2019; Oliveira et al., 2019). Instead of being hierarchical controllers, modern E-CoPs leaders are orchestrators of knowledge co-creation, which facilitates interaction, enables trust, and aligns community learning processes to overall organizational goals.

3. E-COPS IN KNOWLEDGE-DRIVEN BUSINESS MANAGEMENT

3.1 *Integrating Information Technology and Business Knowledge*

Recent empirical evidence shows that relational and cognitive misalignment is more often seen as a reason behind the ineffectiveness of knowledge sharing between business and IT functions than technological fragmentation by itself (Bresciani et al., 2022; Osterloh and Frey, 2020). Professional, epistemic, and knowledge-sharing differences usually create barriers to communicating, which cannot be addressed by only increasing IT integration. These discrepancies give rise to two ongoing Knowledge Management Business IT interface challenges: (a) the creation of a mutual strategic awareness and (b) the operationalization of efficient inter-functional knowledge-sharing systems.

In terms of the former challenge, it is always found that IT units focus on technological optimization, whereas business functions are concerned with the responsiveness, market agility, and immediate operational performance (Peppard and Ward, 2019; Bharadwaj et al., 2020). IT solutions are often sought quickly and lack strategic direction by business leaders, which promotes poor alignment and the lack of a shared mindset of one team (Mittal et al., 2024; Li et al., 2021). The domain illiteracy between the parties limits the ability of both parties to co-define issues and co-develop solutions, thus inhibiting the strategic use of digital capabilities.

The second obstacle is that of knowledge-sharing asymmetry between business and IT societies. Previous research indicates that there are continuous communication failures, conflicting types of knowledge sharing, and incongruent documentation and sense-making patterns (Li et al., 2021; Leonardi and Vaast, 2017). These asymmetries are further compounded in digitally transformed organizations where technological and business knowledge have more interdependencies. Without the long-term cross-boundary communication and mutual meaning-making, digital initiatives are often destined to lack meaning and be misunderstood, violently opposed and poorly learnt by organizations.

A paradigm of Knowledge Management literature has traditionally been IT-centric, codification-focused and can be traced back to the original application of artificial intelligence and expert systems. This approach regards knowledge as a formalized object which can be stored and transferred by means of repositories and information systems (Cabrera and Cabrera, 2020; Faraj et al., 2018). The modern empirical research proves that a significant share of KM studies is still concentrated on explicit knowledge, systematic databases, and implementations based on tools (Alavi and Leidner, 2020; Cabrera and Cabrera, 2020; Bharadwaj et al., 2020). As much as these strategies aid in scalability and standardization, they are constrained in their ability to capture tacit knowledge, experience and knowledge that is socially embedded.

Later KM studies take a socio-technical, practice-based approach, and focus on the fact that organizational knowledge is created through interaction between people, technologies, process, relationships and shared

practice (Nonaka and Toyama, 2021; Bresciani et al., 2024; Bresciani et al., 2022). In this perspective, knowledge cannot be merely something in the form of data or documents; it is constantly performed in the form of a dialogue, collaboration, and problem-solving in place. The research on digital collaboration tools and E-CoPs also testifies to the fact that professionals tend to seek more informal networks, conversational communication, and peer learning contexts as the means of complex knowledge sharing rather than strictly codifying it (Cabrera and Cabrera, 2020; Oliveira et al., 2019; Leonardi and Vaast, 2017).

In knowledge-based business sectors, the interaction between IT and business expertise is hence in a more co-creation of knowledge than a one-way flow of information (Majchrzak et al., 2023; Chatterjee et al., 2022; Khin and Ho, 2019). Boundary-spanning positions shared cognitive frames, and digitally mediated interaction spaces, which facilitate sustained interpretation, negotiation, and recombination of heterogeneous knowledge are necessary to facilitate good integration. Leadership support, trust, and platform governance mechanisms further influence the degree of the role of IT-business knowledge integration in terms of the organizational learning, strategic alignment, and innovation capacity (Cortellazzo et al., 2019; Kane et al., 2021; Bharadwaj et al., 2020; Bresciani et al., 2022).

On the whole, the literature leads to a similar conclusion that effective Information Technology and business knowledge integration towards knowledge co-creation requires a sensitive balance between technological infrastructures and socio-relational processes. As much as IT platforms create structural conditions of knowledge capture and exchange, relational alignment, shared understanding, and cross-functional collaboration are what ultimately influences the success of knowledge-driven business management.

3.2 Requirements and Challenges of Collaboration Technologies

The modern studies on collaboration technologies focus on their contribution to knowledge co-creation in socially dynamic and cognitively complex settings. The initial empirical studies proved that collaboration practices, strategies, and mutual understanding in such settings can only be enhanced by means of more than traditional communication tools. The recent extensive research demonstrates that digitally mediated collaboration in the context of management, engineering, and learning is marked by the high cognitive load, heterogeneous stakeholder involvement, and quickly evolving artefacts of knowledge (Oliveira et al., 2019; Maruping et al., 2019; Benbya et al., 2020; Faraj et al., 2021). All these conditions introduce a complex of consistent technological and socio-technical demands that should be satisfied by contemporary CSS.

Among the most common issues that are reported is the problem of dealing with cognitive overhead and information overload. Ecosystems of collaboration mediated digitally produce enormous amounts of diverse data, such as ideas, arguments, documents, annotations, and traces of social interaction (Watson and Wixom, 2020; Maruping et al., 2019; Faraj et al., 2021). The participants are not able to create a consistent mental representation of the collaborative state without scalable mechanisms of filtering, prioritization, and contextualization. Recent articles highlight that there has been an increasing demand to use AI to curate content, rank them by relevance, and provide real-time analytics to ease the cognitive load and facilitate informed participation (Duan and Vasarhelyi, 2022; Benbya et al., 2020; Dellermann et al., 2019; Dwivedi et al., 2023). Ineffective information overload management may seriously jeopardize the effectiveness of collaboration and the quality of decision made.

The second significant need is associated with the expression and control of social behaviour in collaboration platforms. Knowledge co-creation is an inevitable component entrenched within social structures consisting of individuals, groups, and inter-organizational relations. Adaptive modelling and visualization of user profiles, group dynamics, and interaction patterns, as well as changing communities, have thus become central research issues (Oliveira et al., 2019; Recker et al., 2021; Kallinikos et al., 2013). Modern collaboration systems are increasingly based on social network analytics and behaviour-aware services, to capture the non-static view of social relations and mediate interaction and influence adaptively.

The other critical crunch is the support of various and changing modes of collaboration. It is always empirically demonstrated that collaborative knowledge creation is gradual, as ideas are refined by means of numerous iterations, the meanings negotiated, and the emerging concepts gradually formalized (Leonardi, 2021; Duan and Vasarhelyi, 2022; Benbya et al., 2020). Very strict interaction models can push knowledge, which remains tacit, ambiguous or challenged, into premature formalization. On the other hand, lack of higher-level representations restricts the ability of the system to accommodate high-level functionality of the system like reasoning, supervising and decision support. Modern platforms should thus sacrifice informality in knowledge emergence and formalization in support of computations to provide flexible hybrid interaction models which adapt to the maturity of the collaboration process (Oliveira et al., 2019; Faraj et al., 2021; Dellermann et al., 2019).

Another basic requirement of collaboration technologies in E-CoPs is the exploitation of tacit knowledge. Experience, intuition, and insight through practice are all tacit knowledge that is hard to externalize and formalize and prevails in most professional collaboration situations (Nonaka and Toyama, 2021; Alavi and Leidner, 2020). The recent studies emphasize the increasing importance of narrative-based interaction and multimodal communication, as well as AI-based knowledge elicitation methods, to aid in the expression of tacit expertise in the virtual world (Cabrera and Cabrera, 2020; Benbya et al., 2020; Mesgari and Faraj, 2020). Devoid of these capabilities, collaboration technologies will only reap a small share of the knowledge that communities produce.

The incorporation of past types of knowledge resources is also a longstanding issue of technology and governance. The collaborative processes are getting more and more multitasking across different platforms such as the enterprise social networks, document management system, messaging systems and repositories on the external web. The process of knowledge co-creation involves the smooth integration and subsequent reuse of the results of the previous collaboration processes and, at the same time, the problem of provenance, trust, access control, and protection of intellectual property (Oliveira et al., 2019; Standaert et al., 2020; Kallinikos et al., 2013). Contemporary collaboration architectures thus focus on interoperability, metadata management, and secure lineage tracking of knowledge.

Lastly, modern collaboration technologies are progressively anticipated to possess dynamic data processing and decision support capabilities. In addition to supporting interaction, platforms are currently infused with intelligent services to support real-time analytics, trend detection, an argument aggregation, and estimate outcomes (Power et al., 2022; Duan and Vasarhelyi, 2022; Dellermann et al., 2019; Goes, 2018; Seeber et al., 2023). These strengths enable CSS to proceed to the proactive mediation of collaborating sense-making and decision-making processes, helping participants to derive practical knowledge of the interaction patterns.

Such intelligent functions are especially vital to be integrated in organizational settings where the results of collaborative efforts directly feed the strategic and operation decision making.

The current literature sources are united in the opinion that the successful collaboration technologies to enable knowledge co-creation should meet a highly complex system of interdependent cognitive, social, technical, and governance needs. Although digital platforms offer the framework underpinning collaboration, it is the ability to respond to information overload, social change and dynamics, multiple forms of collaboration, tacit knowledge process, and intelligent decision support that eventually defines their usefulness to E-CoPs and knowledge-based business management.

3.3 Motivational Drivers of Knowledge Co-Creation through Digital Interaction

Co-creation of knowledge based on digital interaction is fundamentally defined by the motivation logic according to which people will either contribute, hide, or remake their knowledge in collaborative settings. To us, there is no single economic reason behind knowledge exchange that can be narrowed down to self-interest, collective purpose, moral obligation, and social identity; rather, it is a dynamic response to all of them, contingent upon organizational context and digital platform design (Cortellazzo et al., 2019; Contreras et al., 2020; Osterloh and Frey, 2020; Gerard et al., 2023).

The tendency to consider knowledge sharing on a transactional basis is in place when knowledge is implicitly acquired as a possession or as a proprietary asset. Contribution in these environments is often conditional upon anticipated individual payoffs, tangible (career progression, monetary benefits) or intangible (reputation, status, reciprocity). This reasoning positions knowledge exchange as an economic decision, dictated by perceived cost-benefit analysis (Osterloh and Frey, 2020; Bock et al., 2019). Nevertheless, this point of view is not enough to interpret the long-term and voluntary trend of contributions in numerous successful e-Communities of Practice.

Conversely, in case knowledge is viewed as a collective good, the motivation will change towards pro-social and community-driven motivation. People do not participate because they are officially expected to contribute, but because they are part of the community, they have a duty towards its success, and they have a sense of purpose in the group. According to this rationale, co-creation of knowledge is an act of common purpose, professional care, and moral duty, and no longer a market action (Cabrera and Cabrera, 2020; Cortellazzo et al., 2019; Gagne et al., 2020).

We suggest that the conflict between these two motivation logics is highly exaggerated in the digital interaction environment. To the extent that social presence is diminished, anonymity is reinforced, and weak relational visibility, opportunistic behaviour or free-riding behaviour can be aggravated (Contreras et al., 2020; Bock et al., 2019). Conversely, properly designed digital platforms that help increase the visibility of contribution, peer recognition, community feedback, and trust-building mechanisms can build intrinsic motivation and solidify collective identity (Benbya et al., 2020; Cortellazzo et al., 2019; Gagne et al., 2020). Therefore, the motivation within E-CoPs is not only an individual attribute but an emergent feature of the socio-technical system (Bresciani et al., 2024; Bresciani et al., 2022; Osterloh and Frey, 2020).

Organizational wise, the increasing dependence on extrinsic incentive plans to fuel knowledge sharing should be rethought. However, short-term compliance can be obtained with the help of the rewards, but

over-reliance on such systems leads to the danger of turning knowledge co-creation into a competition, transactional behaviour. This may erode trust, fracture community cohesion, and eventually destroy the very processes of learning and innovation that organizations are aiming to foster (Recker et al., 2021; Bock et al., 2019; Van Knippenberg and Sitkin, 2019). Psychological safety, mutual trust, perceived fairness, and strong sense of belonging, in our opinion, would significantly contribute to sustainable knowledge co-creation than the instrumental rewards alone (Cortellazzo et al., 2019; Gagne et al., 2020).

We also argue that leadership is critical in the determination of the motivational climate of digital knowledge ecosystems. Leaders send implicit cues about the kind of behaviour to like and reward by using communication patterns, recognition patterns, governance patterns and platform policies. In cases where leadership focuses on openness, learning, and collective success, motivational energy will lean towards knowledge co-creation as opposed to knowledge protection (Hoch et al., 2019; Cortellazzo et al., 2019; Kane et al., 2021; Van Knippenberg and Sitkin, 2019).

In general, we locate the motivation of knowledge co-creation via digital interaction as a strategic organizational resource, as opposed to a secondary behavioural variable. It cannot be cultivated effectively without the coherent alignment of technology design, leadership practices, organizational culture and incentive structures (Bresciani et al., 2022; Osterloh and Frey, 2020; Gagne et al., 2020; Van Knippenberg and Sitkin, 2019; Kankanhalli et al., 2021).

4. A LEADERSHIP-CENTRED DECISION-MAKING FRAMEWORK FOR STRATEGIC PLANNING THROUGH E-COPS

The human premise outlined in the preceding section forms the motivation dynamics on which knowledge co-creation via E-CoPs can be made possible. Nonetheless, motivation is not enough to change collaborative knowledge into strategically actionable intelligence. It is necessary to have a systematic socio-technical process that directs a systematic flow of community generated knowledge into organizational decision making processes. Here the decision -making model that we currently propose is leadership-based and as such operationalizes how E-CoPs, CSS and DSS can be incorporated into the integrated strategic planning framework.

The essence of the contribution of this work is represented by the shift of the traditional data-driven decision making to the knowledge-driven, E-CoPs-based decision making framework where E-CoPs and CSS proactively enrich the organizational Decision Support System (DSS). The framework institutionalizes the way explicit organizational information and practice based; socially constructed knowledge is organized into a single decision-making pipeline coordinated by the leadership.

In the conventional decision-making paradigm as illustrated in the left section of Fig. 1, formal data repositories and ordered analytical processing is the key driver of organizational decisions. The operational data is obtained both in-house and outside, and is stored in organizational databases, which serves as the DSS inputs in the form of numerical values. Under this paradigm, the rationality of decisions is established by the historical records, preset rules, and quantifiable performance measures. Human experience is involved in the process indirectly by way of model configuration, and interpretation of outputs of the system after hoc. Even though this methodology can provide consistency, traceability and computational rigor, it is

also fundamentally limited in terms of its capacity to embrace tacit, contextualized judgement and experience. These restrictions are especially acute in the strategic and semi-structured decision-making scenarios, which are marked by uncertainty and dynamism of the environment.

Fig.1, (right section), presents the new element of the proposed framework E-CoPs-based knowledge formation as part and parcel of decision making. In this case, E-CoPs serve as distributed units of knowledge-production, in which professionals understand issues together, share their experience and create actionable knowledge. Each community mediates interaction through CSS (CSS), which facilitates both structured and unstructured communication, arguing, negotiating alternatives, and sense-making. This interaction does not involve a simple transfer of knowledge but rather co-creation, which is a synthesis of individual knowledge and the socially constructed meaning. This is clearly reflected in the model as the Forming Knowledge layer, which converts raw opinions, arguments, and experiential input into knowledge that can be used by the organization.

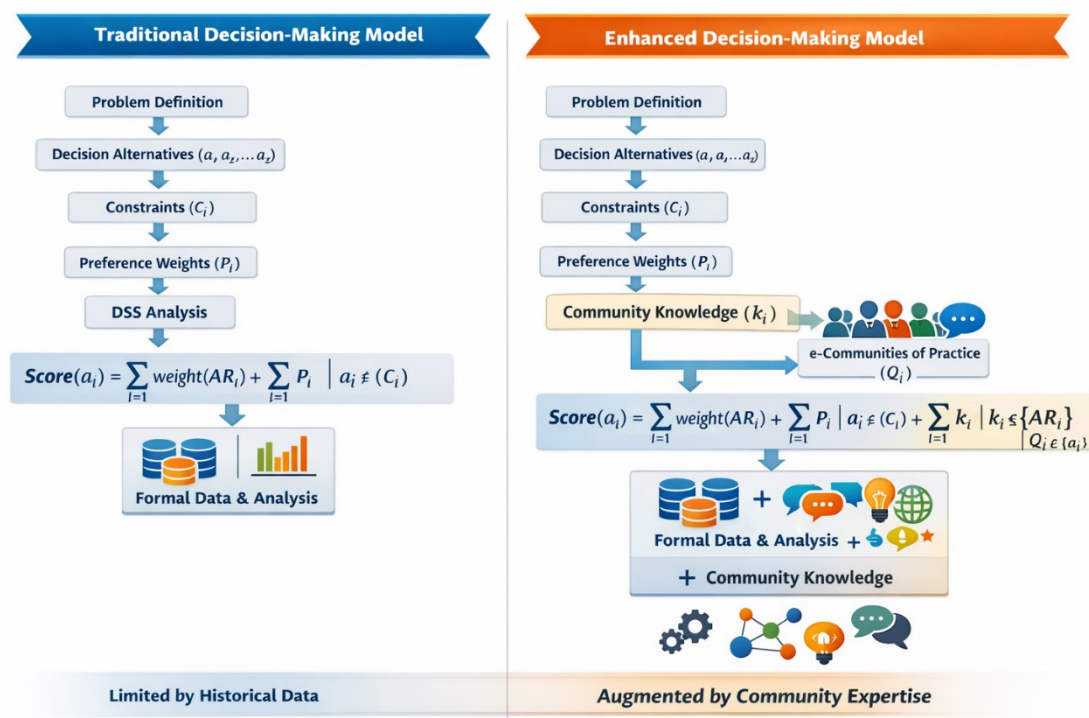


Figure 1. Our proposed knowledge-driven decision-making framework.

The main novelty of the framework is the direct inclusion of E-CoPs-based knowledge into the DSS represented by the two-way flow of knowledge between the Forming Knowledge element and the DSS core as shown in Fig. 1. In contrast to traditional DSS architecture that nearly relies on structured databases, the proposed architecture enables the DSS to act on hybrid knowledge, simply put, formal quantitative data, semi-structured collaborative data, and partially articulated tacit knowledge. This hybridization makes the DSS a knowledge-enhanced decision system, with the ability to reason context-sensitively, as well as synthesize statistical data and the overall human wisdom (Dellermann et al., 2019; Duan and Vasarhelyi, 2022; Xu et al., 2024). The results of a decision are therefore a manifestation of the overlap between data technology and community-based intelligence and not just the result of numerical inferences.

Leadership is embedded in the structural context, as the orchestrating system that aligns generation of knowledge through collaboration to organizational strategy. The system is not passively used by leaders but is actively constructed by them to create knowledge co-creation and decision making, in a socio-technical environment. They are tasked with the legitimization of strategic Communities of Practice, provision of resources of collaboration infrastructures, outlining of governing principles to participation and knowledge reuse, and theming that the community-based generated insights are translated to the executive decision-making level. The leadership also controls feedback of the decision results to the communities, hence perpetuating endless organization learning and avoiding isolation of community knowledge.

In this context strategic planning is no longer a top down, periodic management task. Rather, it is rationalized in a sense of a never-ending knowledge-decision feedback loop, in which organizational data, the creation of knowledge in communities and executive interpretation are coupled repeatedly. The decisions made based on the DSS, as shown in Fig. 1, change future community practices but the community knowledge constantly transforms the knowledge base on which the next decision is made. This creates a process of self-reinforcement learning where strategic adaptation, innovation and organizational intelligence continuously coat each other with time.

The suggested framework directly operationalizes the main theoretical concepts that have been formed in the course of this paper, that is, Communities of Practice as socio-cognitive ecosystems, knowledge co-creation as an interaction-oriented process, the tacit-explicit knowledge duality, CSS as socio-technical mediators, DSS as computational reasoning cores, and leadership as the strategic alignment force. Through the combination of these aspects to produce a single architectural construct, the framework shifts to an actionable decision paradigm at the system level, in preference to the descriptive knowledge-management theory. The critical value of the framework is the structural linkage of collaborative human knowledge development and intelligent decision support. As opposed to the classical DSS models, which either externalize human expertise or make it a post-processing variable, the suggested system will incorporate collective judgement into the decision pipeline. Thus, it expands on classical DSS theory, mediates between knowledge management, collaboration systems, and strategic leadership and offers a scalable template of knowledge-based strategic decision making in digitally transformed organizations.

In the traditional decision-making process, (shown in Fig. 1), the process is structured by a series of actions that involve: formal problem definition, assessment of a finite number of decision alternatives ($a_1, a_2, \dots, a_n$), decision constraints specification (C_i) and assignment of weighted arguments in favour or against each decision alternative ($weight(AR_i)$) and specification of user preferences (P_i). These stages are operationalized with the help of traditional DSS that are based on formalized data and predetermined analysis models. In this classical DSS environment, the total performance rating of every alternative is calculated based on:

$$score(a_i) = \sum_{i=1}^n weight(AR_i) + \sum_{i=1}^n (P_i) | a_i \notin \{c_i\} \quad (1)$$

Under this formulation, the alternatives (a_i) are evaluated on basis of a collection of decision arguments, with the constraint set that is predetermined by the decision maker. The arguments applied in the evaluation

process are usually obtained based either on the existing repositories of the organizational knowledge or previously solved similar cases as per a case-based reasoning paradigm. As a result, the quality and breadth of the resultant decision recommendations is necessarily constrained by availability, completeness, and relevance of historical and explicitly codified knowledge.

The suggested decision model builds more on this traditional logic by considering knowledge generated in E-CoPs in a systematic manner. Informal, experience-based knowledge is increasingly being expressed, screened and converted into explicit, decision-relevant knowledge structures through the mediation of CSS. Supposing that k_i is the knowledge generated by a particular Community of Practice (Q_i) this new contribution of knowledge is incorporated formally into the alternative evaluation function as represented in:

$$score(a_i) = \sum_{i=1}^n weight(AR_i) + \sum_{i=1}^n (P_i) | a_i \notin \{c_i\} + \sum_{i=1}^n k_i | k_i \subseteq \{AR_i\} | Q_i \in \{a_i\} \quad (2)$$

The proposed model provides the coexistence of historical data, formalized preferences, and socially constructed expertise because it enhances the traditional DSS scoring mechanism with the knowledge produced by the community. Consequently, the ultimate judgment of the decision options does not remain bound by already existing bodies of knowledge but is dynamically augmented by specialist, context-dependent information generated during collaborative practice. This outreach goes a long way in improving the ability of the system to support semi-structured and unstructured decision issues which are historically challenging to resolve with purely data-driven DSS solutions.

5. CONCLUSIONS AND FUTURE RESEARCH DIRECTIONS

Summarizing this, the major goal of this work was to conduct the systematic investigation of E-CoPs and their role in organizational decision-making and strategic planning. During the research, we presented the huge advantages which can be produced by organized cooperation at the inner organizational environment, particularly, related to the knowledge co-creation, joint sense-making, and improvement of the quality of decisions. A special focus was made on the internal culture of Communities of Practice, the dynamics of the knowledge management process and the beneficial influence of collaborative knowledge on executive and strategic decisions.

One of the key findings of this publication is that knowledge should not be viewed as a commercial object whose processes are controlled by the market laws, or extrinsic incentives. Although CSS (CSS) and online knowledge platforms offer the technical framework to support large-scale interaction, their success is determined, in the end, by the motivation and culture principles of an establishment. Systems that are over-reliant on extrinsic rewards run the risk of turning moral obligation and professional commitment into limited self-interest activities, sabotaging trust, reciprocity and free-flowing knowledge sharing among communities. Conversely, organizations, which develop a culture in which knowledge is viewed as a common good, are in a better place to sustain a process of knowledge exchange, diffusion of innovation, and problem-solving.

This study also indicates that the organizational members should be actively involved in E-CoPs, which is institutionally facilitated and culturally validated. They should not just involve professionals. In fact, this

incorporation of less experienced members, novices, and peripheral participants is very important in minimizing knowledge concentration, enhancing faster learning, and dispersing knowledge in the organization. The process of involvement also relieves the cognitive and temporal load on a few specialists and the knowledge sharing capability is also enhanced. Simultaneously, the organizations are also encouraged to promote the norms of generalized reciprocity in the form of members contributing to the organization not only when they can provide expertise but they should also be encouraged to notice, admit, and publicly appreciate the contributions made by others.

The significant organizational implication of the work is the redefinition of the concept of talk and interaction in E-CoPs. Against the conventional understanding of communication reduction of productive work, our data contributes to the observation that collaborative conversation is productive work in knowledge-based organizations. When employees are given time, digital infrastructure, and managerial assistance to engage with communities of practice, the direct outcome of such interactions is increased knowledge flows, innovation capacity and strategic awareness. However, the engagement in such communities is time consuming, especially to the professionals who are very experienced. Therefore the availability of institutional slack time becomes one of the key requirements of maintaining a long-term community involvement and avoiding the stagnation of the knowledge base.

In addition to these socio-organizational aspects, the given work also contributes to the theoretical and systemic aspects by the offered framework of leadership perspective-based, knowledge-driven decision-making. The framework bypasses the shortcomings of data-only decision making by directly incorporating the knowledge that is created within E-CoPs into the computational heart of the DSS. It operationalizes how tacit, community of experience based knowledge can be transformed into explicit, decision-relevant knowledge to allow semi-structured and unstructured strategic problems to be systematically treated. By so doing, the framework re-framing of DSS as knowledge-enhanced systems of shared intelligence, as opposed to standalone analytical instruments.

Leadership is revealed as a determining factor as the organizing engine of this socio technological ecosystem. Leadership facilitates transformation of distributed expertise into organized organizational action with the help of governance structures, legitimization of participation, resource allocation, and strategic alignment of community activities. Strategic planning, in this view, ceases being an infrequent top-down endeavour but is an ongoing, highly interactive process that develops as the communities, collaboration technologies and executive decision structures reciprocate.

The present study needs to be followed in several complementary directions in the future. One of the main research paths is the direct relationship between E-CoPs and organizational leadership that needs to be empirically studied. It is necessary that future research determines and corroborates a group of predominant indicators that can measure the leadership initiatives, motivation forces, and dynamics of participation in digital communities. Such indicators might then be processed with the help of suitable statistical and computational methods to evaluate their effect on the vitality of the community, diffusion of knowledge, and effectiveness of decision making. Specific focus should be placed on the structure of incentive and recognition systems that will turn independent people into active members of the community and gradually develop a sustainable collaborative culture.

The second important area of future research is related to the interoperability of the heterogeneous information systems of the organizational decision-making ecosystem, such as, Management Information Systems (MIS), Executive Information Systems (EIS), DSS, Analytical Support Systems (ASS), and CSS (CSS). The communication between these systems still experiences a set of enduring issues surrounding the data representation, semantic compatibility, interface design, and communication protocols. Further efforts in this direction are needed in the future to develop standardized data formats, compatible interfaces, and common models of communication that can allow frictionless integration and real-time knowledge sharing between these systems. Such interoperability is likely to become invaluable in achieving the intensity of system use and the overall efficiency of organizational decision making.

Also, the high pace of artificial intelligence, machine learning, and large language model development creates new research opportunities to automate E-CoPs-generated knowledge extraction, structuring, and semantic enrichment. The paper can be improved in future research by examining how intelligent agents integrated into CSS systems can aid in argument analysis, knowledge validation, pattern identification, and decision recommendation to further reinforce the cognitive abilities of the suggested system.

Overall, this work provides a conceptually consistent and systematically implementable framework on how to incorporate e-Companies of Practice in the making of decisions in organizations. It offers an effective framework on which researchers and practitioners can improve knowledge-based strategic management in digitally transformed organizations by integrating leadership, knowledge co-creation, collaboration technologies and intelligent decision support into one architectural vision.

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INVESTIGATION OF FACTORS AFFECTING NON-REVENUE WATER IN SHIRAZ WATER AND WASTEWATER COMPANY USING DATA MINING METHODS

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Abstract

One of the duties and responsibilities of water and wastewater companies is to provide clean and potable water for the community. In this regard, it should be noted that not all water produced in a water supply system can be utilized, and typically, some losses occur in the system, referred to as non-revenue water. Shiraz Water and Wastewater Company, as one of the major and well-resourced companies in the water and wastewater industry, has placed special emphasis on addressing water loss. In the present study, data mining techniques have been employed to identify and predict the factors affecting non-revenue water in this company. To this end, the factors influencing non-revenue water in Shiraz Water and Wastewater Company were first identified based on the opinions of the company's experts and specialists. These factors were then analyzed and ranked using the decision tree algorithm. According to the results, the three main factors affecting non-revenue water are: 1) under-recording of water meters (faulty meters), 2) unauthorized connections (water theft), and 3) aging of water transmission and distribution networks and equipment.

Keywords: Non-revenue water, Shiraz Water and Wastewater Company, Delphi method, Data mining methods, Decision tree technique

1- Introduction

Water consumption in Iran is more than per capita water consumption in places that are similar to Iran in terms of climate and social and economic life, and therefore this issue requires special attention to water consumption management (Mozafari&Taherdoost,2023).Iran is a low-precipitation country. According to studies, while the global average annual rainfall is approximately 850 millimeters, in Iran, this figure is 250 millimeters, which is less than one-third of the global average. Additionally, the global average annual evaporation capacity is 700 millimeters, whereas statistics indicate that this figure for Iran is 2,100 millimeters, demonstrating that annual evaporation in Iran is three times the global average. These statistics highlight that water resource scarcity in Iran is severe and critical. Given the consequences of climate change and the looming threat of drought over the Iranian plateau, it is essential to enhance water use efficiency and prevent water loss for any reason (Ajdari Bajestani, 2021).

The scarcity of water resources in the semi-arid country of Iran has consistently been a fundamental challenge in the development of economic and social activities. The primary goal of reducing water loss in

arid and semi-arid regions is to combat water scarcity and protect the environment due to droughts and water resource limitations. However, another significant objective relates to its economic aspect (ZeydabadiNejad et al., 2021). Reducing water loss to an economically optimal level leads to lower costs for water supply, transmission, treatment, energy, investment in new infrastructure, and other related expenses, while also improving service quality and increasing companies' revenue (Silva et al., 2025).

One of the key indicators in the management of potable water loss is non-revenue water. The primary reasons for examining this indicator include ensuring water supply, conserving water resources, reducing pressure on existing water resources in the region, and ultimately utilizing saved water in other sectors (karema et al., 2025). Non-revenue water refers to the difference between the net volume of water entering the network and the water consumed over a specific period. In a more comprehensive definition, non-revenue water is the portion of produced water for which no payment is received from subscribers, encompassing water losses (apparent, real, and authorized unmetered consumption) (Yehia, 2023). Non-revenue water is a critical indicator for assessing network efficiency, and fortunately, over the past two decades, it has gained attention nationwide, with programs to reduce non-revenue water prioritized by water and wastewater companies (Al-Ali, 2022). Water loss in distribution networks and household connections is one of the most significant challenges in many Iranian cities. Given the value of water as the most essential element of life and Iran's location in the arid belt of the Northern Hemisphere, implementing managerial measures to reduce water loss in water and wastewater companies has become imperative (Yehia, 2023).

Non-revenue water consists of three main components:

1. **Real Losses:** These refer to water losses that are genuinely wasted and not used directly or indirectly. Examples include leaks in water transmission networks and main water lines, leaks in subscriber connections and meters, leaks in network control valves, and water overflow from reservoirs (Yehia, 2023).
2. **Apparent Losses:** These are water losses where the water is actually used by consumers and not physically wasted (appearing to be lost), but no revenue is generated for the water supplier, making it part of non-revenue or unaccounted-for water. Examples include water consumed through unauthorized connections, water used but not recorded due to meter reader errors, and water used but not accounted for due to faulty meter performance (Yehia, 2023).
3. **Authorized Unbilled Consumption:** This refers to water uses that are permitted but generate no revenue for water and wastewater companies. Examples include water used by subscribers without meters, water used in water and wastewater treatment processes, and water used for firefighting (Yehia, 2023).

In the past two decades, addressing non-revenue water and planning for its reduction have been more seriously prioritized by water and wastewater companies. In this regard, real and apparent losses, which typically constitute a higher percentage of non-revenue water, have received greater attention, while authorized unbilled consumption has been given less focus (Mlewa et al., 2025).

On the other hand, due to the rapid advancement of information technology, the volume of data stored in databases is increasing rapidly, necessitating powerful tools for analyzing stored data and converting it into usable information and knowledge for organizations. In the past, analysts typically extracted useful

information from recorded data manually. However, due to the slow and costly nature of manual data analysis, there has been a shift toward automated, indirect analysis using computational methods. Data mining is a tool that has been widely used in recent years to extract information, identify relationships, and discover patterns within vast amounts of data (Kantardzic, 2011). Data mining refers to the extraction of knowledge from large databases and is an exploratory and iterative process during which new information is discovered, existing hypotheses are refined, and new hypotheses are proposed.

One of the most widely used and effective data mining algorithms is the decision tree, which is popular due to its advantages, such as handling high-dimensional data, good accuracy, performing classification without requiring extensive computations, generating understandable rule sets, and being easy and cost-effective to build and implement. This algorithm is highly appealing in supporting data mining-related decision-making where insight and explanations are critical, as it directly generates rules from data. These rules provide a comprehensible level of solutions for humans, which is unique to symbolic models. In fact, these rules are in the form of "if...then" statements and can be used to predict the class of new data samples (Han et al., 2011). Given the importance of non-revenue water in water and wastewater companies and the identification of factors affecting it, this study employs the decision tree, as one of the data mining techniques, to predict the factors influencing non-revenue water in Shiraz Water and Wastewater Company.

2- Research Methodology

Shiraz Water and Wastewater Company was established with the aim of sustainably providing drinking and sanitary water needs, as well as collecting, transferring, treating, and safely disposing of wastewater. Annually, it produces approximately 210 million cubic meters of water from surface sources, such as the Doroudzan Dam, and groundwater sources, such as limestone and alluvial wells, for around 892,000 subscribers. Considering the scope of this company's operations in Shiraz and while examining the status of drinking water production and consumption in this region, the present study utilizes the Delphi method and decision tree technique to identify and investigate the factors affecting non-revenue water in this company.

The present study is an applied research aimed at identifying and predicting the factors affecting non-revenue water, with Shiraz Water and Wastewater Company selected as a case study. However, given the general nature of the selected indicators for implementing this method, all water and wastewater companies can benefit from the results of this research. Within the framework of the proposed method, the factors influencing non-revenue water are first identified using the Delphi technique based on the opinions of experts and specialists from Shiraz Water and Wastewater Company. After preprocessing and preparing the available data, the decision tree algorithm is implemented, considering the effectiveness of each factor as the output variable.

The statistical population of the study includes all managers, experts, and specialists of Shiraz Water and Wastewater Company with more than 5 years of experience. The sample size was calculated using the formula for a finite population sample size, as follows:

$$n = \frac{\frac{z^2 pq}{e^2}}{1 + \frac{1}{N} \left(\frac{z^2 pq}{e^2} - 1 \right)} \quad (1)$$

Where the test statistic follows a normal distribution, set at 1.96 for a 95% confidence level, the probability of success (p) and the probability of failure (q) are both 0.5, and the standard error is considered to be 0.08. With a population size of 250, the minimum sample size is calculated to be 151, which is consistent with the Krejcie and Morgan (1970) table. The aforementioned sample was selected using the simple random sampling method, and the questionnaire was distributed among the individuals. The reason for using the simple random sampling method is to ensure that all individuals in the population have an equal chance of being selected, thereby reducing the impact of other variables.

3. Discussion and Results

After implementing the methodology described in the research method introduction, this section of the study addresses the discussion and analysis of the obtained results.

3-1. Identification of Factors Affecting Non-Revenue Water

To determine the factors influencing non-revenue water, a set of effective indicators was initially extracted based on the opinions of 10 experts from the Shiraz Water and Wastewater Company, each with over 10 years of experience in this field, selected using the snowball sampling method (as members of the Delphi panel). Subsequently, three rounds of the Delphi technique were conducted. In each round, the importance of the factors was assessed using a Likert scale, and the average responses of the panel members from previous rounds, along with each individual's response, were separately communicated to the respondents. The scale used in this study was a five-point Likert scale, comprising the options: very low impact = 1, low impact = 2, moderate impact = 3, high impact = 4, and very high impact = 5. Accordingly, the value of 3 was designated as the neutral point, with the disagreement range defined from 1 to 3 and the agreement range from 3 to 5 (Mozafari et al., 2022).

In the first round, the initial list of factors was provided to all panel members to determine the importance of each factor. Additionally, they were asked to add and suggest any additional indicators to the list beyond those already included. Analysis of the open-ended questions in the first-round questionnaires revealed that the factors proposed by the respondents were conceptually aligned with the factors already identified from the literature. Since the average score of all factors in the first round was above 3, no factors were eliminated, and the second-round questionnaire, including the previous opinions and the average scores of the panel experts from the first Delphi round, was distributed to each panel member. In the analysis of the second-round questionnaires, the average responses to all questions fell within the agreement range, and no factors were eliminated for the third round. In the third round, the opinions of each member from the previous round were shared with the other members, and they were asked to reassess each factor. After the completion of this round and achieving consensus, the Delphi technique was concluded with the finalization of the selected indicators. Based on the results of the three rounds of the Delphi technique, consensus was reached among the panel members for the following reasons, and further rounds were deemed unnecessary: The standard deviation of the experts' responses decreased from 0.806 in the first round to 0.712 in the second round, and further to 0.601 in the third round. The average responses for all indicators were above 3,

falling within the agreement range. Additionally, the average showed an upward trend, increasing from 3.08 in the first round to 4.11 in the second round, and then to 4.94 in the third round. Consequently, the factors affecting non-revenue water in the Shiraz Water and Wastewater Company were reviewed and validated using the Delphi technique, that are:

- Unauthorized connections (water theft)
- Aging of transmission and distribution networks and water equipment
- Insufficient impact of established laws and regulations regarding non-revenue water
- Use of low-consumption faucets Inappropriate and non-standard pipes and fittings
- Untrained meter readers and reading errors
- Lack of pressure measurement and management in the drinking water network
- Lack of public awareness and education
- Under-registration by meters (faulty meters)
- Billing error
- Reservoir overflows
- Prolonged duration of incidents and identification of critical points
- Mobile water supply consumption
- Consumption from free withdrawal taps
- Revenue loss due to pipe bursts
- Cleaning of water supply networks and storage reservoirs
- Invisible leaks in the network and connections

3-2. Determination of Input and Output Variables for Decision Tree Implementation

To implement the decision tree for identifying factors affecting non-revenue water in the Shiraz Water and Wastewater Company, the C5 decision tree was utilized based on the type of data. In this type of decision tree, typically one or more variables are designated as inputs, and one variable is designated as the output (Mozafari et al., 2022). For the implementation of the C5 decision tree in this study, the input variables consist of the factors affecting non-revenue water (17 factors). The amount of non-revenue water is considered the output variable.

3-3. Implementation of the Decision Tree

To implement the decision tree algorithm, it should be noted that, in terms of dataset composition, the number of training data is always greater than the test data. In this study, 70% of the total data was allocated to the training set, while 30% was designated as the test set. The C5 decision tree was then utilized to extract knowledge and rules from the data related to the subscribers of the Shiraz Water and Wastewater Company. For constructing the decision tree, the factors affecting non-revenue water, totaling 17 factors, were considered. The SPSS Modeler software was used to partition the dataset and implement the decision tree, achieving an accuracy of 77.965%. The prediction accuracy of this decision tree for the training and test data is presented in Table 1.

Table 1: Prediction Accuracy of the Decision Tree

	Training Set	Test Set
Correct	% 89/52	% 66/41
Incorrect	% 10/48	% 33/59

Based on the software outputs, it was concluded that among the 17 initial features considered as inputs, the following variables, in order of importance, have the greatest impact on the target variable (non-revenue water):

1. Under-registration by meters (faulty meters)
2. Unauthorized connections (water theft)
3. Aging of transmission and distribution networks and water equipment
4. Lack of pressure measurement and management in the drinking water network
5. Lack of public awareness and education
6. Invisible leaks in the network and connections
7. Inappropriate and non-standard pipes and fittings
8. Untrained meter readers and reading errors
9. Prolonged duration of incidents and identification of critical points
10. Use of low-consumption faucets
11. Insufficient impact of established laws and regulations regarding non-revenue water
12. Reservoir overflows
13. Consumption from free withdrawal taps
14. Mobile water supply consumption
15. Revenue loss due to pipe bursts
16. Billing errors
17. Cleaning of water supply networks and storage reservoirs

The decision tree algorithm generates a tree-like structure as its output, where each path from the root node to a leaf node can be interpreted as a rule (Mozafari and Abbasi Naseroo, 2021). In this study, the C5 decision tree algorithm was employed to identify and predict non-revenue water in the Shiraz Water and Wastewater Company.

4. Conclusion

Iran is located on the global arid belt, with precipitation levels significantly low, approximately one-third of the global average. Consequently, water scarcity has consistently been a fundamental challenge in the development of economic and social activities. In the modern global perspective, water is regarded as a socio-economic commodity and, more critically, as a basic human need. Given this perspective, alongside transformations in the economics of natural resources and the introduction of new approaches to the rational and efficient use of resources, the application of economic and social knowledge and considerations in planning and managing water supply and demand has gained significant importance. Studies on reducing non-revenue water aim primarily to identify the components of non-revenue water, categorized into two

main types: apparent losses, which include unauthorized consumption, data and system management errors, and inaccuracies in metering equipment; and real losses, encompassing leaks from the network, transmission lines, reservoir overflows, storage tank leaks, and subscriber connection leaks. Secondly, these studies focus on directing all operational activities—such as network rehabilitation, transmission line upgrades, subscriber connection repairs, replacement of faulty or unauthorized meters, and more—toward controlling and reducing non-revenue water. The limited precipitation, coupled with the rapid population growth that has led to severe constraints on renewable water resources and increased water demand in the country, has made demand management and consumption pattern reform more essential than ever. One of the most critical methods for managing consumption is reducing non-revenue water and water losses in water supply systems. Non-revenue water is defined as the difference between the volume of water produced and the volume of water measured for consumption .

On the other hand, the volume of data stored in organizational databases is growing at an unprecedented rate. Organizations have realized over time that, beyond occupying storage space, these data offer little benefit or practical use without proper analysis. In this context, data mining, by discovering knowledge and extracting hidden patterns from databases, significantly aids organizations in understanding their customers, predicting their value, and improving decision-making processes, increasing revenue, and reducing losses. One of the challenges faced by water and wastewater companies in recent years is the increasing water loss, which can have significant economic and non-economic impacts. Therefore, in this study, data mining techniques, specifically the decision tree algorithm, were employed to identify and predict the factors affecting non-revenue water in the Shiraz Water and Wastewater Company. The decision tree algorithm is a practical and effective technique that not only identifies and describes objectives but also predicts future conditions. This algorithm has various types that can be applied depending on the nature of the data.

In this study, to identify and predict the factors affecting non-revenue water in the Shiraz Water and Wastewater Company, 17 features were considered as input variables, and the amount of non-revenue water was designated as the output variable for the decision tree. The accuracy of the C5 decision tree was 77.965%, which indicates a suitable level of reliability for referencing its results. According to the obtained outputs, it was also concluded that among the input variables, the following have the greatest impact on the target variable (the amount of non-revenue water), in order of importance: 1. Under-registration by meters (faulty meters), 2. Unauthorized connections (water theft), and 3. Aging of transmission and distribution networks and water equipment. To achieve the research objectives of identifying and reducing water loss in Shiraz, the following recommendations are proposed:

- Comprehensive surveying of subscribers, organizing and standardizing connections; upgrading water facilities and equipment in households, with particular emphasis on monitoring faulty meters and unauthorized connections. Implementing Chapter 16 of the National Building Regulations and making necessary revisions at specified intervals to enforce consumption management policies is essential.
- Utilizing high-precision meters and, if funding is secured, procuring and using smart meters while replacing faulty meters and those with high error rates due to prolonged use.

- Implementing public education programs to promote water consumption reform and foster a culture of conservation.
- Employing visual and auditory media, environmental advertising, public educational programs, training for housewives, and organizing continuous conservation programs and festivals in schools and kindergartens to encourage young learners to save water, as well as engaging specific community groups, using educational catalogs, and issuing promotional warnings in this regard.
- Adopting water-saving equipment and methods to improve water-related appliances and facilities, and upgrading household sanitary systems and equipment.
- Using low-consumption faucets in public places.
- Rehabilitating and upgrading aging networks and connections, and creating density maps of network and connection incidents.
- Identifying and addressing invisible leaks in the network and connections (active leak control).
- Constructing suitable reservoirs in accordance with relevant standards and inspecting inlet and outlet valve chambers of reservoirs to address potential leaks.
- Periodically testing reservoirs for leaks and using control valves, electric actuators, height gauges, and automation systems to ensure proper management and prevent reservoir overflows.
- Conducting leak detection operations, prioritizing aging networks, old urban areas, high-pressure zones, and areas with unsuitable soil structures, as well as redesigning and reengineering the distribution network.
- Utilizing greywater for flush tanks, garden irrigation, and other purposes.

Like any research, this study was not exempt from obstacles and challenges, and the researcher faced certain limitations. Notably, in some instances, certain respondents did not demonstrate a sense of responsibility in accurately completing and returning the questionnaires. This was one of the issues encountered by the researcher. Additionally, in some cases, due to work-related commitments, some respondents hastily completed certain questionnaires.

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IMPLEMENTING TIME-MANAGEMENT SKILLS: ESSENTIAL IN AUGMENTING PRODUCTIVITY AND PROFICIENCY IN JOB DUTIES AND RESPONSIBILITIES

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Abstract

The individuals, belonging to all occupations, communities and socio-economic backgrounds are required to carry out number of job duties and responsibilities in personal and professional lives. Some can be completed in less amount of time, whereas, others are completed in more amount of time, hence, they need to acknowledge and implement time-management skills. These are the skills, which are facilitating in taking out sufficient amount of time for all types of job duties and responsibilities. Furthermore, individuals will augment information in terms of different types of methodologies and procedures to generate desired outcomes. The family members, educators and employers are individuals, who are imparting information in terms of meaning and significance of these skills. As a consequence of acknowledging and implementing these skills, individuals will contribute in completing various types of job duties and responsibilities within the required time-frame. Furthermore, they will contribute in meeting the expectations of individuals in leadership positions and family members. Hence, these skills are advantageous to individuals to a major extent in both personal and professional lives. Hence, it is understood on a comprehensive basis that leading to up-gradation of these skills is essential in leading to progression of individuals. Therefore, implementing time-management skills is essential in augmenting productivity and proficiency in job duties and responsibilities. The main concepts that are taken into account in this research paper are, understanding the meaning and significance of implementing time-management skills, measures to put into practice in implementing time-management skills and advantages of implementing time-management skills.

Keywords: *Implementing, Individuals, Job Duties, Personal, Professional, Progression, Responsibilities, Time-Management Skills*

Introduction

The individuals, belonging to all occupations, communities and socio-economic backgrounds have one of the major goals of bringing about improvements in their overall quality of lives. As a consequence of being wholeheartedly committed towards achievement of this goal, implementing time-management skills is regarded to be of utmost significance. These are the skills, which enable the individuals to make use of the time in a productive and efficient manner (Time Management Skills, 2020). The individuals are required to carry out job duties and responsibilities in personal and professional lives. They assign priorities to the job

duties and responsibilities.

The ones, which are more important are carried out first, whereas, the ones, which are less important are implemented after the completion of more important ones. Procrastination is avoided. One of the important benefits of implementing these skills is, individuals will be able to complete their job duties and responsibilities within the stipulated period of time. Furthermore, they will be able to take out sufficient time for all types of job duties and responsibilities in both personal lives, educational institutions and employment settings. Therefore, it is well-understood; acknowledging and implementing time-management skills is essential in leading to progression of individuals in personal and professional lives.

Within personal lives, within the course of pursuance of educational programs in educational institutions of all levels and in all types of employment settings, the individuals are required to carry out number of job duties and responsibilities. These are implemented in less amount of time or can be more time-consuming. Hence, individuals need to take out sufficient time for all types of job duties and responsibilities. For this purpose, they need to be well-informed in terms of various types of methodologies and procedures. These are referred to the techniques of carrying out different types of job duties and responsibilities in a satisfactory manner (Time Management Skills: Definition and Examples, 2020).

The individuals need to acquire an efficient understanding of the concepts. Furthermore, they need to hone confidence levels and overcome the feelings of apprehensiveness and vulnerability. As a consequence, individuals will be able to make use of all types of methodologies and procedures in a well-ordered manner. Furthermore, they will be able to complete all types of job duties and responsibilities within the required time-frame. Therefore, possession of adequate information in terms of various types of methodologies and procedures will be facilitating in putting into operation time-management skills in a satisfactory manner.

Understanding the Meaning and Significance of Implementing Time-Management Skills

From the stage of early childhood, throughout the lives of the individuals, they need to lead to up-gradation of communication skills. These skills are put into operation with individuals within personal and professional lives. These are the skills, which are facilitating in augmenting information in terms of various subjects and concepts; exchanging different types of ideas and viewpoints; obtaining answers to various types of questions that are overwhelming and clarifying doubts in terms of various factors. Furthermore, individuals need to be well-informed in terms of communication ethics, i.e. making use of polite language and decent words; treating others with respect and courtesy; making provision of factual information; depicting the traits of helpfulness and co-operation and possessing an approachable nature and an amiable attitude. The communication processes takes place in a verbal and written form. Verbal communication takes place face to face, video-calling or phones, whereas, written communication takes place through exchanging messages, emails, letters and notices.

Through implementing communication skills with family members, educators and employers, individuals will generate information in terms of various types of job duties and responsibilities. Furthermore, individuals will augment information in terms of ways of putting these into operation within the required time-frame. Within professional settings, i.e. educational institutions of all levels and in all types of employment settings, these need to be completed within the target date. As a consequence, they will be able

to put into operation time-management skills in an adequate manner. Hence, it is understood on a comprehensive basis that communicating with individuals will enable them to lead to up-gradation of time-management skills. Therefore, individuals are able to acquire an efficient understanding of the meaning and significance of implementing time-management skills, when they are putting into operation communication processes in an effective manner with family and community members.

Within personal lives, within the course of pursuance of educational programs in educational institutions of all levels and in all types of employment settings, individuals are required to carry out number of job duties and responsibilities. Some of these are implemented on an individual basis or through working in collaboration and integration with other individuals, including family members, educators, supervisors, employers, classmates and colleagues. Hence, it is of utmost significance for individuals to form cordial and amiable terms and relationships with all these individuals. As a consequence, the mind-sets of the individuals will be stimulated and they will lead to up-gradation of motivation and concentration levels towards works. One of the major benefits is, individuals will obtain help and support in providing solutions to various types of dilemmas and challenging situations, particularly which cannot be solved on one's own. The individuals need to ensure, they communicate with each other in a polite and respectful manner in order to generate desired outcomes.

The individuals are able to acquire importance of time-management skills, when they are putting into operation various types of job duties and responsibilities in collaboration and integration with others. The individuals direct and lead each other towards the right path, so they are successful in their works. As a consequence, they will understand the importance of time-management skills. It is apparently understood that discussions take place in terms of different subjects and factors among individuals. In other words, all the individuals put in their best efforts in carrying out all types of job duties and responsibilities in a successful manner. They have the major goal of meeting the expectations of family members, educators and employers. Therefore, one is able to acquire an understanding of the meaning and significance of implementing time-management skills, when they are working in collaboration and integration with each other.

Within the course of putting into operation various types of job duties and responsibilities in personal and professional lives, it is apparent that individuals will be overwhelmed by psychological problems of anger, stress, anxiety, frustration and depression. The influence of these psychological problems is experienced in a major or minor form. The individuals need to provide solutions to these in an appropriate manner. Furthermore, these are prevented from giving rise to impediments within the course of doing well in all types of job duties and responsibilities, achieving desired goals and objectives and meeting the expectations of family members, educators and employers. Throughout the lives of individuals, they need to augment information in terms of strategies of managing psychological problems in an adequate manner. Furthermore, these are prevented from giving rise to impediments within the course of putting into operation various types of job duties and responsibilities in a well-ordered and disciplined manner.

The individuals are able to acquire importance of time-management skills, when they are coping with different types of psychological problems in a satisfactory manner. As a consequence, individuals will promote calm and composed mind-sets. Furthermore, they will lead to up-gradation of various types of skills

and abilities in an effective manner. Apart from these, inculcation of traits of efficiency, honesty and truthfulness is essential in generating desired outcomes and reinforcing time-management skills. In addition, these are to be utilized in an adequate manner in putting into operation time-management skills. Hence, it is well-understood, when individuals will cope with different types of psychological problems, they will render an important contribution in putting into operation time-management skills in their personal and professional lives. Therefore, an understanding of the meaning and significance of implementing time-management skills is acquired, when individuals are managing psychological problems of anger, stress, anxiety, frustration and depression in a satisfactory manner.

Measures to put into practice in implementing Time-Management Skills

An aimless life is a meaningless life. Hence, individuals, belonging to all occupations, communities and socio-economic backgrounds have goals and objectives to achieve. The different factors in terms of which these are formulated are education, careers, employment opportunities, family, relationships, settlement, travelling, resources, assets, property, health, well-being, personality traits and overall standards of living. In achieving all types of goals and objectives, individuals need to be well-prepared. Furthermore, they need to lead to up-gradation of competencies and abilities. These are required to be put into operation in a well-ordered and regimented manner in generating desired outcomes (The Significance of Responsibility, 2020).

The honing of time-management skills is regarded to be of utmost significance in achieving desired goals and objectives. Throughout the lives of the individuals, they need to augment information in terms of measures to be implemented in leading to up-gradation of time-management skills. All types of measures are required to be put into operation in a well-ordered and satisfactory manner. Furthermore, positivity needs to be reinforced in all types of measures. One of the important aspects that needs to be taken into account is all measures need to be facilitating in promoting well-being of individuals and organizations. The various factors that are facilitating in augmenting information in terms of various measures are, implementing effective communication processes with family members, educators and employers, being well-informed in terms of job duties and methodologies, conducting research through various sources and work experience. Therefore, measures to put into practice in implementing time-management skills are stated as follows:

Being well-informed in terms of Job Duties and Responsibilities

Within personal lives, within the course of pursuance of educational programs in educational institutions of all levels and in all types of employment settings, individuals, belonging to all job positions are required to carry out number of job duties and responsibilities. These are implemented in less amount of time or can be more time-consuming. Hence, individuals need to take out sufficient time for all types of job duties and responsibilities. For this purpose, they need to be well-informed in terms of time-management skills. These are the skills, which are facilitating in generating information in terms of various types of techniques. These are essential in carrying out different types of job duties and responsibilities in a satisfactory manner. Furthermore, they need to lead to up-gradation of competencies and abilities. These are required to be put into operation in a well-ordered manner in implementing various types of job duties and responsibilities.

The various factors that are facilitating in augmenting information in terms of various types of job duties and responsibilities are, implementing effective communication processes with family members, educators and employers, conducting research through various sources and work experience. The individuals need to ensure, they are well-equipped in terms of different types of job duties and responsibilities in personal and professional lives. As a consequence, individuals will lead to up-gradation of determination levels to achieve desired goals and objectives. Therefore, being well-informed in terms of job duties and responsibilities is regarded as one of the indispensable measures to put into practice in implementing time-management skills.

Being well-aware in terms of Methodologies and Procedures

Within personal lives, within the course of pursuance of educational programs in educational institutions of all levels and in all types of employment settings, individuals are required to be well-informed in terms of various types of methodologies and procedures in carrying out different types of job duties and responsibilities. These are implemented in less amount of time or can be more time-consuming. Hence, individuals need to take out sufficient time for putting into operation all types of methodologies and procedures. These are required to be put into operation in a well-ordered and regimented manner in putting into operation different types of job duties and responsibilities. The implementation of time-management skills is the key in putting into practice various types of methodologies and procedures within the stipulated period of time.

The individuals need to acquire an efficient understanding of the concepts. Furthermore, they need to hone confidence levels and overcome the feelings of apprehensiveness and vulnerability. As a consequence, individuals will be able to make use of all types of methodologies and procedures in a satisfactory manner. Furthermore, they will be able to complete all types of job duties and responsibilities within the required time-frame. Hence, possession of adequate information in terms of various types of methodologies and procedures will be facilitating in putting into operation time-management skills in an appropriate manner. Therefore, being well-aware in terms of methodologies and procedures is one of the significant measures to put into practice in implementing time-management skills.

Utilizing Pioneering Methods and Materials

With advancements taking place and with the advent of modernization and globalization, individuals in personal and professional lives are utilizing pioneering methods and materials. These are utilization of different types of tools, devices, apparatus, machinery, equipment and technologies. These are implemented in less amount of time or can be more time-consuming. Hence, individuals need to take out sufficient time for putting into operation all types of pioneering methods and materials. These are required to be put into operation in a well-organized manner in putting into operation different types of job duties and responsibilities. The implementation of time-management skills is the key in putting into practice various types of pioneering methods and materials within the required time-frame.

The individuals need to acquire an efficient understanding of the concepts. Furthermore, they need to hone confidence levels and overcome the feelings of apprehensiveness and vulnerability. This is considered vital in making use of these within the stipulated period of time. As a consequence, individuals will be able to

make use of all types of pioneering methods and materials in an appropriate manner. Furthermore, they will be able to complete all types of job duties and responsibilities within the required time-frame. Hence, possession of adequate information in terms of various types of pioneering methods and materials will be facilitating in putting into operation time-management skills. Therefore, utilizing pioneering methods and materials is an eminent measure to put into practice in implementing time-management skills.

Implementing Effective Communication Processes

Throughout the lives of the individuals, they need to implement effective communication processes. This is implemented with individuals within personal and professional lives. The important benefits are augmenting information in terms of various subjects and concepts; exchanging different types of ideas and viewpoints; obtaining answers to various types of questions that are overwhelming and clarifying doubts in terms of various factors. Furthermore, individuals need to be well-informed in terms of communication ethics, i.e. making use of polite language and decent words; treating others with respect and courtesy; making provision of factual information; building trust and understanding; reinforcing the traits of adeptness and proficiency; depicting the traits of helpfulness and co-operation and possessing an approachable nature and an amiable attitude. The communication processes takes place in a verbal and written form. Verbal communication takes place face to face, video-calling or phones, whereas, written communication takes place through exchanging messages and emails and writing letters and notices.

Through implementing communication skills with family members, educators and employers, individuals will generate information in terms of various types of job duties and responsibilities. Furthermore, individuals will generate information regarding strategies of putting these into operation within the required time-frame. Within professional settings, i.e. educational institutions of all levels and in all types of employment settings, these need to be completed within the target date. As a consequence, they will be able to put into operation time-management skills in an appropriate manner. Hence, it is understood on a comprehensive basis that communicating with individuals will enable them to lead to up-gradation of time-management skills. Therefore, implementing effective communication processes is an expedient measure to put into practice in implementing time-management skills.

Coping with Psychological Problems in an Adequate Manner

Within the course of putting into operation various types of job duties and responsibilities in personal and professional lives, it is apparent that individuals will be overwhelmed by various types of psychological problems. The individuals need to provide solutions to these in an appropriate manner. Furthermore, these are prevented from giving rise to impediments within the course of doing well in all types of job duties and responsibilities, achieving desired goals and objectives and meeting the expectations of family members, educators and employers. Throughout the lives of individuals, they need to augment information regarding techniques of managing psychological problems in a satisfactory manner. Furthermore, these are prevented from giving rise to impediments within the course of putting into operation various types of job duties and responsibilities in a well-organized manner.

The individuals are able to acquire importance of time-management skills, when they are coping with

different types of psychological problems in a satisfactory manner. As a consequence, individuals will promote calm and composed mind-sets. Furthermore, they will lead to up-gradation of various types of competencies and abilities in an appropriate manner. Apart from these, inculcation of traits of reliability and effectiveness is essential in generating desired outcomes and reinforcing time-management skills. In addition, these are to be utilized in an adequate manner in putting into operation time-management skills. Hence, it is well-understood, when individuals will cope with different types of psychological problems, they will render an important contribution in putting into operation time-management skills in their personal and professional lives. Therefore, coping with psychological problems in an adequate manner is a renowned measure to put into practice in implementing time-management skills.

Promoting Normal Mind-sets

In implementing various types of job duties and responsibilities in personal lives, educational institutions and employment settings, individuals experience anger and stress. The individuals need to provide solutions to these in an adequate manner. Furthermore, these are prevented from giving rise to impediments within the course of doing well in all types of job duties and responsibilities. Throughout the lives of individuals, they need to augment information regarding techniques of managing anger and stress in a satisfactory manner. Furthermore, these are prevented from giving rise to impediments within the course of putting into operation various types of job duties and responsibilities in a successful manner. As a consequence, individuals will augment information and understanding in an appropriate manner. Furthermore, they will complete their job duties and responsibilities within the required time-frame.

The individuals are able to acquire importance of time-management skills, when they are coping with anger and stress in a satisfactory manner. As a consequence, individuals will promote normal mind-sets. Furthermore, they will lead to up-gradation of various types of competencies and abilities in a satisfactory manner. Apart from these, inculcation of traits of morality, ethics, diligence and conscientiousness is essential in generating desired outcomes and reinforcing time-management skills. Hence, it is well-understood, when individuals will promote normal mind-sets, they will render an important contribution in putting into operation time-management skills in their personal and professional lives. Therefore, promoting normal mind-sets is a decisive measure to put into practice in implementing time-management skills.

Assigning Priorities to Job Duties and Responsibilities

The individuals are required to carry out job duties and responsibilities in personal and professional lives. They assign priorities to the job duties and responsibilities. The ones, which are more important are carried out first, whereas, the ones, which are less important are implemented after the completion of more important ones. Procrastination is avoided. Some of the job duties and responsibilities in both personal and professional lives are considered to be more important as compared to others. Hence, when the individuals are well-aware in terms of the ones, which are more important, they will acknowledge and implement time-management skills in appropriate manner. As a consequence, individuals will render an important contribution in honing time-management skills.

One of the important benefits of implementing time-management skills is, individuals will be able to complete their job duties and responsibilities within the stipulated period of time. Furthermore, they will be able to take out sufficient time for all types of job duties and responsibilities in personal lives, educational institutions and employment settings. Hence, it is well-understood; acknowledging and implementing time-management skills is essential in leading to progression of individuals in personal and professional lives. As a consequence, within homes, within the course of pursuance of educational programs in educational institutions of all levels and in all types of employment settings, individuals will be successful in their job duties and responsibilities. Therefore, assigning priorities to job duties and responsibilities is an imperative measure to put into practice in implementing time-management skills.

Leading to Up-gradation of Motivation and Concentration Levels

The individuals are required to carry out job duties and responsibilities in personal and professional lives. These are implemented in less amount of time or can be more time-consuming. Hence, individuals need to take out sufficient time for all types of job duties and responsibilities. For this purpose, they need to be well-informed in terms of time-management skills. These are the skills, which are facilitating in generating information in terms of various types of techniques. These are essential in carrying out different types of job duties and responsibilities in a satisfactory manner. Furthermore, they need to lead to up-gradation of competencies and abilities. These are required to be put into operation in a well-ordered manner in implementing various types of job duties and responsibilities.

As a consequence of possession of awareness, individuals will render an important contribution in leading to up-gradation of motivation and concentration levels. In this manner, the mind-sets of the individuals will be stimulated and they will put in their best efforts in carrying out all types of job duties and responsibilities in a satisfactory manner. Furthermore, individuals will make wise and productive decisions in terms of various factors. In addition, different types of dilemmas and challenging situations will be coped with in an appropriate manner. As a consequence, individuals will take out sufficient amount of time for all types of job duties and responsibilities in personal and professional lives. Therefore, leading to up-gradation of motivation and concentration levels is a notable measure to put into practice in implementing time-management skills.

Implementing Leadership Functions in an Well-ordered Manner

In all types of organizations, i.e. educational institutions of all levels, training centers, production and manufacturing organizations, services organizations, financial institutions, agencies, non-government organizations and so forth, there are individuals in leadership positions. They are required to carry out various types of job duties and responsibilities. These are related to human resources, infrastructure, amenities, facilities, technologies, machines, training and development programs, recruitment and selection methods, organizational culture and overall functioning of the organizations. In doing well in all types of job duties and responsibilities, leaders need to implement different types of techniques in a satisfactory manner. This is facilitated, when they determine that all types of job duties and responsibilities will be completed within the stipulated period of time.

For this purpose, they need to be well-informed in terms of time-management skills. These are the skills, which are facilitating in generating information in terms of various types of techniques. These are essential in carrying out different types of job duties and responsibilities in a satisfactory manner. Furthermore, they need to lead to up-gradation of competencies and abilities. In addition, the leaders need to put in their best efforts in overcoming all types of setbacks. Furthermore, these are prevented from giving rise to impediments within the course of generating desired outcomes. As a consequence of possession of awareness, individuals will render an important contribution in leading to up-gradation of time-management skills. Therefore, implementing leadership functions in a well-ordered manner is a noteworthy measure to put into practice in implementing time-management skills.

Implementing the Traits of Honesty and Righteousness

The individuals, belonging to all occupations, communities and socio-economic backgrounds need to implement the traits of honesty and righteousness. The family members are the first and foremost individuals, who are imparting information in terms of these traits. Furthermore, educators in educational institutions of all levels also impart information in terms of these. These are the traits, which are facilitating in carrying out different types of job duties and responsibilities in personal lives, educational institutions of all levels and in all types of employment settings in a well-ordered and satisfactory manner. As a consequence, the individuals will depict the traits of goodness, decency, truthfulness and accuracy. Furthermore, they will achieve desired goals and objectives in an adequate manner. In this manner, they will contribute in meeting the expectations of individuals in leadership positions, i.e. educators and employers. Furthermore, family members will also be pleased. Hence, in order to be successful in their works, throughout the lives of the individuals, they need to acknowledge and implement these traits (The Management Principle of Honesty, n.d.).

For implementing these traits in an adequate manner, individuals need to be well-informed in terms of time-management skills. These are the skills, which are facilitating in generating information in terms of the factor that in living effectual lives, all types of job duties and responsibilities need to be completed within the stipulated period of time. These are essential in carrying out different types of job duties and responsibilities in a satisfactory manner. Furthermore, they need to lead to up-gradation of various types of competencies and abilities. As a consequence of possession of awareness, individuals will render an important contribution in inculcating these traits and honing time-management skills. Therefore, implementing the traits of honesty and righteousness is a useful measure to put into practice in implementing time-management skills.

Advantages of implementing Time-Management Skills

The individuals, belonging to all occupations, communities and socio-economic backgrounds have one of the major goals of sustaining their living conditions. As a consequence of being wholeheartedly committed towards achievement of this goal, the individuals are required to carry out job duties and responsibilities in personal and professional lives. For this purpose, they need to be well-equipped in terms of time-management skills. The individuals are rendering an important contribution in being successful in their

works, when they are putting into operation these skills (The Six Types of Courage, n.d.). One of the important aspects that needs to be taken into account is, the job duties and responsibilities need to be completed within the required time-frame. The implementation of these skills is considered to be advantageous on a comprehensive basis. Therefore, advantages of implementing time-management skills are, promoting enhancement of career prospects; meeting the expectations of leaders; incurring the feelings of pleasure and contentment and leading to up-gradation of overall standards of living. These are stated as follows:

Promoting enhancement of Career Prospects

Promoting enhancement of career prospects is regarded as one of the major goals of individuals, belonging to all occupations, communities and socio-economic backgrounds. In achieving this goal, the possession of information in terms of various types of job duties and responsibilities is regarded to be of utmost significance. Furthermore, generating information in terms of various types of techniques is crucial. These are facilitating in carrying out different types of job duties and responsibilities in a satisfactory manner. Furthermore, individuals need to lead to up-gradation of competencies and abilities. In addition, inculcation of traits of truthfulness and efficiency is vital. These are required to be put into operation in a satisfactory manner in implementing various types of job duties and responsibilities. All this is facilitated, when individuals will put into operation time-management skills. Therefore, promoting enhancement of career prospects is regarded as one of the indispensable advantages of implementing time-management skills.

Meeting the Expectations of Leaders

As a consequence of putting into operation time-management skills, the individuals will contribute in meeting the expectations of leaders. In educational institutions of all levels, within the course of pursuance of educational programs and in all types of employment settings in implementing job duties and responsibilities, individuals need to meet the expectations of leaders. Hence, when they will implement these skills, all types of job duties and responsibilities will be completed within the stipulated period of time. These skills are essential in carrying out all types of job duties and responsibilities in all types of professional settings in accordance to the expectations of leaders. Therefore, meeting the expectations of leaders is one of the significant advantages of implementing time-management skills.

Incurring the feelings of Pleasure and Contentment

Through putting into practice time-management skills, individuals are generating information in terms of the factor that in living effectual lives, all types of job duties and responsibilities will be completed within the stipulated period of time. These are essential in carrying out different types of job duties and responsibilities in a satisfactory manner. Furthermore, individuals will lead to up-gradation of various types of competencies and abilities. As a consequence, they will contribute in achieving desired goals and objectives. Furthermore, they will meet the expectations of family members, educators and employers. In this manner, they will incur the feelings of pleasure and contentment. This is essential in leading to up-gradation of overall personality traits. Therefore, incurring the feelings of pleasure and contentment is an eminent advantage of implementing time-management skills.

Leading to Up-gradation of overall Standards of Living

Leading to up-gradation of overall standards of living is regarded as one of the major goals of individuals,

belonging to all occupations, communities and socio-economic backgrounds. In achieving this goal, the possession of information regarding different types of job duties and responsibilities is essential. Furthermore, generating information in terms of various types of techniques is crucial. These are facilitating in carrying out different types of job duties and responsibilities in a satisfactory manner. Furthermore, individuals need to lead to up-gradation of various types of skills and abilities. In addition, inculcation of traits of proficiency, adeptness and effectiveness is essential. These are required to be put into operation in an appropriate manner in implementing various types of job duties and responsibilities. All this is facilitated, when individuals will put into operation time-management skills. Therefore, leading to up-gradation of overall standards of living is an expedient advantage of implementing time-management skills.

Conclusion

The time-management skills are the skills, which enable the individuals to make use of the time in a productive and efficient manner. The individuals acknowledge and implement these skills in personal lives, educational institutions of all levels and in all types of employment settings. Furthermore, individuals need to be well-informed in terms of measures to put into practice in implementing time-management skills. In addition, individuals need to be well-informed in terms of advantages of implementing time-management skills. Finally, it can be stated, time-management skills are facilitating in leading to progression of individuals in personal and professional lives.

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