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Internal Control Effectiveness in Malaysian Cooperatives: Insights from Self-Organizing Maps and Artificial Neural Networks

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ABSTRACT

The study aims to evaluate and visualize the effectiveness of internal control in Malaysian cooperatives. Adapting the three categories of internal control objectives and the five internal control components in the internal control integrated framework designed by COSO, the effectiveness of internal control is measured based on assessments conducted by the cooperative's internal auditor or audit committee member, as Malaysian cooperatives are not required to provide material weakness statements in financial reporting. Survey data from 126 cooperatives generating Malaysian Ringgit (RM) 800,000.00 and above are clustered using the self-organizing map (SOM), a clustering technique based on artificial neural networks (ANNs). The analysis reveals four groups of internal control effectiveness in Malaysian cooperatives, visually demonstrating the association between internal control components and objectives. The results suggest an interrelated, albeit not straightforward, relationship between internal control components and objectives. The study emphasizes the importance of heightened attention to internal control within Malaysian cooperatives by responsible parties, including internal auditors, internal audit committees, cooperative management, cooperative boards, and the Malaysian Cooperative Society Commission (MCSC). This paper represents one of the first attempts to assess internal control components and objectives in Malaysian cooperatives based on internal audit and audit committee assessments rather than relying on material weakness statements.

Keywords: Internal Control Effectiveness, Clustering, Self-Organising Map, Cooperative, Malaysia

INTRODUCTION

Internal control systems are established to identify, manage, and reduce risks, serving as a vital part of corporate governance across all organizations. These systems are crucial for detecting and addressing risks from both internal and external sources, thus playing a key role in enhancing effective organizational governance (Goh & Li, 2013). In response to the 2008 financial crisis, which was characterized by numerous high-profile fraud cases that caused the fall of several well-known financial institutions (Pfister, 2009), the significance of effective internal control systems has grown substantially worldwide. This crisis has left a lasting impact on various entities, including public institutions, public administration, business enterprises, and nonprofit organizations (Minelli et al., 2009). Consequently, governing bodies around the world have adopted internal control measures as guiding principles and regulatory frameworks. Notable examples include the corporate governance standards issued by the Central Bank of Malaysia (Central Bank of Malaysia, 2016), the COBIT framework developed by the Information Systems Audit and Control Association (IT Governance Institute, 2004), Guideline 27 – Cooperative Governance (SKM, 2015), and the Malaysian Code on Corporate Governance by the Securities Commission of Malaysia (Security

Commission Malaysia, 2012). These measures are designed to protect all stakeholders from internal and external risks that could lead to organizational losses.

Effective internal control systems significantly safeguard shareholder investments and an organization's assets, making them essential for risk management and achieving organizational goals (ICAEW, 1999). These systems support the development of efficient operations, whether financial or non-financial, and ensure the accuracy of all organizational reporting for internal and external stakeholders while complying with all applicable laws and regulations (COSO, 2013; ICAEW, 1999).

The responsibility for establishing internal control systems lies with the board of directors, which often delegates this task to management or a committee. This includes developing policies and procedures to create a secure and productive environment, overseeing all organizational activities to align with the organization's objectives, carefully evaluating all risks, and applying appropriate mitigation measures. Moreover, it functions as a way to communicate with and train employees, fostering a proper work environment and maintaining continuous monitoring of all activities, with prompt corrective actions for any issues.

The Committee of Sponsoring Organizations (COSO) internal control integrated framework states that for an organization to have an effective internal control system, it must include all five internal control components working together to achieve three main objectives (Protiviti, 2013). These five components include the control environment, control activities, risk assessment, information and communication, and monitoring. The three primary objectives are efficient operations, reliable financial and non-financial reporting, and compliance with laws and regulations (Protiviti, 2013).

Organizations without effective internal controls face numerous problems that can seriously affect the organization and its stakeholders, including employees and customers. In larger organizations, these effects can also reach their operating countries. A key role of internal control is detecting fraud, which helps reduce opportunities and factors within the fraud triangle (Kranacher, 2010) that enable or hide fraud (Hillison et al., 1999). It lessens the chances of risks such as unintended errors (Benaroch et al., 2012) happening (ACFE, 2007). History shows that large organizations have often collapsed due to financial misconduct, as seen in cases like Enron, Parmalat, WorldCom, and Lehman Brothers (Brewer, List, & FBCs, 2004; Peltier-Rivest & Lanoue, 2012; Yadav, 2013). A major reason behind these collapses was the absence of internal controls, either within the organizations or set by authorities (Arwinge, 2009; Lakis & Giriūnas, 2012; Y. Li, 2010). Malaysian cooperatives faced similar issues, with scandals involving Multi-purpose Holding Berhad in 1980 (Singam, 2012), ANGKASA in 2008 (Mohamad et al., 2013), Telekom Malaysia (Mazwin, 2017), and Bank Rakyat in 2017 (Baga, 2018), where weak internal controls were a significant factor. These incidents drew attention from the Malaysian Prime Minister and the Chairman of MCSC (Utusan Malaysia, 2012a, 2012b).

In the United States, the Sarbanes-Oxley Act (SOX) mandates the disclosure of material weaknesses (MW) in an organization's internal control within annual financial reports (Coates, 2007). A material weakness arises when internal control over financial reporting is ineffective, increasing the likelihood of significant misstatements in financial statements. Globally, countries such as Canada, the UK, and Malaysia require Boards of Directors, Audit Committees, and external auditors to disclose the state of an organization's internal control in financial reports, aligning with various financial reporting standards and statutory requirements.

Nonetheless, recent research questions the accuracy of relying solely on MW assessments to gauge the effectiveness of internal control within an organization. Concerns arise from the potential bias in MW statements influenced by managerial and auditor incentives to detect and disclose internal control weaknesses (Dechow, Ge, & Schrand, 2010). Therefore, researchers are adopting a broader perspective to assess internal control effectiveness, involving top management, officers, or internal auditors in evaluating their organization's internal control (Ayagre et al., 2014; Drogalas et al., 2016; Hermanson et al., 2012; Jokipii et al., 2011; Karagiorgos et al., 2010; Lansiluoto et al., 2016). Notably, most of these studies have focused on firms and financial institutions, with limited attention to cooperatives. Consequently, this study investigates and assesses the effectiveness of internal control within Malaysian cooperatives, employing employee assessments based on the COSO Integrated Framework components and objectives. To achieve this objective, the researcher adapts the methodology proposed by Lansiluoto et al. (2016) to categorize each cooperative in the sample based on their internal control effectiveness level.

LITERATURE REVIEW

Malaysian Cooperatives

Malaysian cooperatives were introduced in 1907 within the Federated Malay States, which encompassed Negeri Sembilan, Perak, Pahang, and Selangor, under British colonial rule. This initiative faced initial rejection by Muslims due to the presence of usury (Riba) in the cooperative system. However, in 1922, the Cooperative Enactment was

passed, and Muslim officials and society began to embrace cooperative concepts (Fredericks, 1974). This enactment mirrored the Indian Cooperative Societies Act of 1912 and was later replaced by the Cooperative Societies Act of 1948. In 1993, the act was renewed to consolidate existing Malaysian cooperative regulations. Subsequent amendments were made, with the latest occurring in January 2008. In July 2007, the Malaysian Cooperative Societies Commission (MCSC) was established following the gazetting of the MCSC Act on 19 July 2007, to oversee Malaysian cooperatives.

Malaysian cooperatives have experienced significant growth in both capital and memberships, averaging 9.4 percent annually from 2005 to 2009. They accumulated total assets of RM65 billion and more than RM9 billion in capital. In 2016, Malaysian cooperatives generated a revenue of RM39.66 billion and held total assets of RM130.74 billion. On average, each cooperative earned RM2.95 million (MCSC, 2017). Currently, there are 13,428 cooperatives with over 7 million members. The government aims for cooperatives to contribute ten percent of the country's GDP by 2020. Therefore, effective internal control is crucial to ensure the efficiency of cooperatives and reduce the risks of fraud and mismanagement. However, by the end of 2016, only 258 (1.9 percent) of Malaysian cooperatives were classified as large, accounting for 94.7 percent of the total revenue of all cooperatives. Most are classified as small and micro cooperatives. Despite the MCSC issuing guidelines, including the Cooperative Governance Guideline in 2015, concerns remain about the effectiveness of internal control in Malaysian cooperatives. Prior research indicates that around 20 percent of cooperatives are unprepared to implement internal control, and over 56 percent do not comply with regulations and guidelines (Ariffin et al., 2016). A case study of a large Malaysian workers' cooperative showed significant discrepancies in membership and financial databases caused by a lack of internal control (Abd Rahim et al., 2017). Additionally, most Malaysian cooperatives are managed by staff with limited financial resources and expertise (Ariffin et al., 2016), increasing the risk of ineffective internal control. Therefore, this study aims to evaluate the effectiveness of Malaysian cooperatives.

Internal Control Effectiveness

The concept of internal control, initially introduced as "internal check" in auditing procedures (Dicksee, 1907), later evolved into the "General System of Internal Check." In 1936, the American Institute of Accountants (AIA) adopted Dicksee's definition and developed methods to safeguard assets and ensure the integrity of administrative bookkeeping (Arwinge, 2009). In 1949, AIA extended the definition to emphasize operational efficiency and adherence to management policies and standards (Heier, Dugan, and Sayers, 2005). COSO defined internal control in 1992 and updated it in 2013 as "a process, effected by an entity's board of directors, management, and other personnel, designed to provide reasonable assurance regarding the achievement of objectives relating to operations, reporting, and compliance." This definition gained global acceptance, including that of associations such as the Canadian Guidance on Control Board (COCO), the Institute of Chartered Accountants in England and Wales (ICAEW), and the Federation of European Accountants (FEE) (Pfister, 2009).

COSO's 1992 framework outlined three primary categories of internal control objectives: operational efficiency, financial reporting reliability, and compliance with laws and regulations. In 2013, COSO reinforced these objectives and emphasized that effective internal control requires all five components to coexist: control environment, risk assessment, control activities, information and communication, and monitoring (Protiviti, 2013). Research has shown that strong control in one component does not guarantee strength in all components (Jokipii et al., 2011). The control environment comprises standards, processes, and structures established by the board of directors and management to set the organization's internal control "tone at the top" (COSO, 2013). Risk assessment identifies risks hindering objective attainment (COSO, 2013). Control activities ensure that processes are risk-free, based on established policies and procedures (Rendon & Rendon, 2016). Information and communication capture significant events and provide reliable, relevant information (Chen et al., 2014). Monitoring involves continuous evaluation, informing the board and management of internal control weaknesses and non-compliance (COSO, 2013). For monitoring to be effective, employees must understand the organization's objectives, mission, risk tolerance, and responsibilities (Dinapoli, 2007). The results should then prompt appropriate action (Dinapoli, 2007).

COSO 2013 states that internal control is effective when all interconnected components work together to ensure efficient operations, protect assets, deliver timely reports, and adhere to laws and regulations.

Assessment of Internal Control Effectiveness

Previous research mainly evaluated internal control effectiveness through MW statements in organizations' financial reports (Donelson et al., 2014; Doyle et al., 2006; Klamm et al., 2012; Klamm & Watson, 2009; Li et al., 2010). However, recent studies use a variety of different approaches. For example, Jokipii (2006) assessed the effectiveness of internal control based on responses from Finnish CEOs, examining how COSO's internal control components mediate the relationship between organizational characteristics and effectiveness. Karagiorgos et al. (2010) measured Greek banks' internal control effectiveness by gathering employee feedback. Wittayapoom and

Limsuwan (2012) evaluated the internal control effectiveness of Thai-listed firms based on administrative and accounting controls. Hermanson, Smith, and Stephens (2012) studied internal control in North American organizations, focusing on control environment, risk assessment, and monitoring components. Ninlaphay and Ngamtampong (2013) investigated how internal control effectiveness influences stakeholders' credibility performance in Thai companies.

Ayagre, Appiah-Gyamerah, and Nartey (2014) assessed a Ghanaian bank's control environment and monitoring activities. Lansiluoto et al. (2016) used the Self-Organizing Map (SOM) technique to evaluate the internal control structures and effectiveness of Finnish companies. Chen, Dong, Han, and Zhou (2017) introduced an internal control index for Chinese public firms, illustrating the connection between better internal control and more reliable financial reporting.

This study aims to assess the effectiveness of internal control measures in Malaysian cooperatives. This research examines the relationship between internal control components and objectives by adopting a modified version of Lansiluoto et al. (2016) clustering approach tailored to the Malaysian cooperative context. The five internal control components (control environment, control activities, risk assessment, information and communication, and monitoring) are evaluated in conjunction with three internal control objectives (effectiveness and efficiency of operations, reliability of financial reporting, and compliance with applicable laws and regulations). Effective internal control is assumed when all components function and all objectives are achieved, yielding a comprehensive evaluation of Malaysian cooperative internal control effectiveness.

METHODOLOGY

Study Population

This study focuses on Malaysian cooperatives with revenues exceeding RM800,000.00. Based on unaudited financial data from the Malaysian Cooperative Societies Commission (MCSC), 570 cooperatives met this revenue threshold, excluding two cooperative banks. Due to limitations in audited financial information, these two cooperative banks were omitted from the study population to maintain homogeneity among the cooperatives under investigation. The cooperatives in this study span various economic sectors, as outlined in Table 1. The most prominent sector is credit, comprising 150 cooperatives (26.3%). Geographically, most of these cooperatives are registered in the Federal Territory, amounting to 56 (15.1% of the total), as depicted in Table 2.

Table 1: Population-Based on Economic Sector

Sector	No. of Cooperative	Percentage (%)
Credit	150	26.3
Construction	10	1.8
Transportation	123	21.6
Consumer	104	18.2
Banking	0	0.0
Industrial	3	0.5
Services	67	11.8
Agricultural	98	17.2
Property Development	15	2.6
Total	**570**	**100.0**

Table 2: Population-Based on Geographical Location

State	No. of Cooperative	Percentage (%)
Johor	81	14.2
Kedah	31	5.4
Kelantan	28	4.9
Melaka	8	1.4
Negeri Sembilan	21	3.7
Pahang	75	13.2
Perlis	7	1.2
Pulau Pinang	22	3.9
Sabah	39	6.8

Sarawak	26	4.6
Selangor	43	7.5
Terengganu	47	8.2
Federal Territory	86	15.1
Perak	56	9.8
Total	**570**	**100.0**

Sampling and Respondents

The analysis unit in this study is the individual cooperative, with one designated respondent per cooperative. To achieve a 95% statistical power, as determined by G-Power (Erdfelder et al., 2009), and employing simple random sampling, a sample size of 234 cooperatives was selected. The cooperative's internal auditor or audit committee member was chosen as the designated respondent, given their capacity to represent the cooperative's perspective on internal control effectiveness assessment. This choice aligns with the study's objective of evaluating the effectiveness of internal control in cooperatives.

Questionnaire Development and Distribution

The study questionnaire, an integral part of a broader research endeavor, was constructed following an extensive literature review. It incorporated questions on internal control effectiveness adapted from Lansiluoto et al. (2016), with suitable modifications tailored to the Malaysian cooperative context. Comprising 27 queries on internal control components and 13 questions based on the COSO internal control integrated framework's objectives, the questionnaire employed a seven-point Likert-type scale, ranging from 1 (totally disagree) to 7 (totally agree).

Expert reviews and focus group discussions assessed the questionnaire's content validity. Self-administered questionnaires were distributed via regular mail to reach the targeted cooperatives effectively. This method was chosen because over 37% of the cooperatives preferred written questionnaires upon address verification. Additionally, many cooperative internal auditors or audit committee members serve voluntarily, except for cooperative banks. Only a limited number of questionnaires were distributed via email. Each questionnaire mailing included two cover letters to maximize response rates and minimize non-response. The first, bearing the university's letterhead and addressed to the cooperative's top management, elucidated the survey's purpose and assured respondent anonymity. The second cover letter was a copy of the support and approval letter from MCSC, signed by the MCSC Director of Statistics, Research, and Publishing Division and addressed "To whom it may concern." These measures aimed to mitigate non-response risks. In addition, respondents were informed that participating cooperatives would receive a complimentary summary of the study results and have the opportunity to enter a lucky draw for a free three-day internal control effectiveness inspection.

Data Collection and Analysis

In total, 133 responses were collected. Seventy-nine were received before issuing reminders, and 54 after the deadline had elapsed. Excluding five responses due to duplication or incomplete answers (where more than 25% of total questions were unanswered), 126 responses remained, constituting a response rate of 53.8%. A post hoc power analysis demonstrated an 83% statistical power, deemed adequate for this study. Some responses exhibited missing data, accounting for less than 15% of total questions, and were assumed to be missing completely at random. The Expectation-Maximization algorithm was employed to impute missing data. Subsequent data analysis included reliability testing, normality assessment (including outlier detection), and construct validity testing through Principal Component Analysis (PCA) and factor analysis. Data transformation was then executed, consolidating validated internal control components and objectives into single elements for Kohonen's Self-Organizing Map (SOM) analysis.

Kohonen's SOM Analysis

As illustrated in Figure 1, Kohonen's SOM analysis was conducted to explore and visualize the relationship between internal control components (CE, CA, RA, IC, and M) and the objectives of effective internal control (EEF, RFR, and LAW). The analysis employed the Viscovery SOMine version 7 application. The SOM method, rooted in artificial neural networks (ANNs), is an automatic data analysis technique widely used for clustering and data exploration in various domains. It visualizes similarity relationships in datasets, utilizing competitive learning among output neurons to respond to input data and selecting winning neurons (Haykin, 2009).

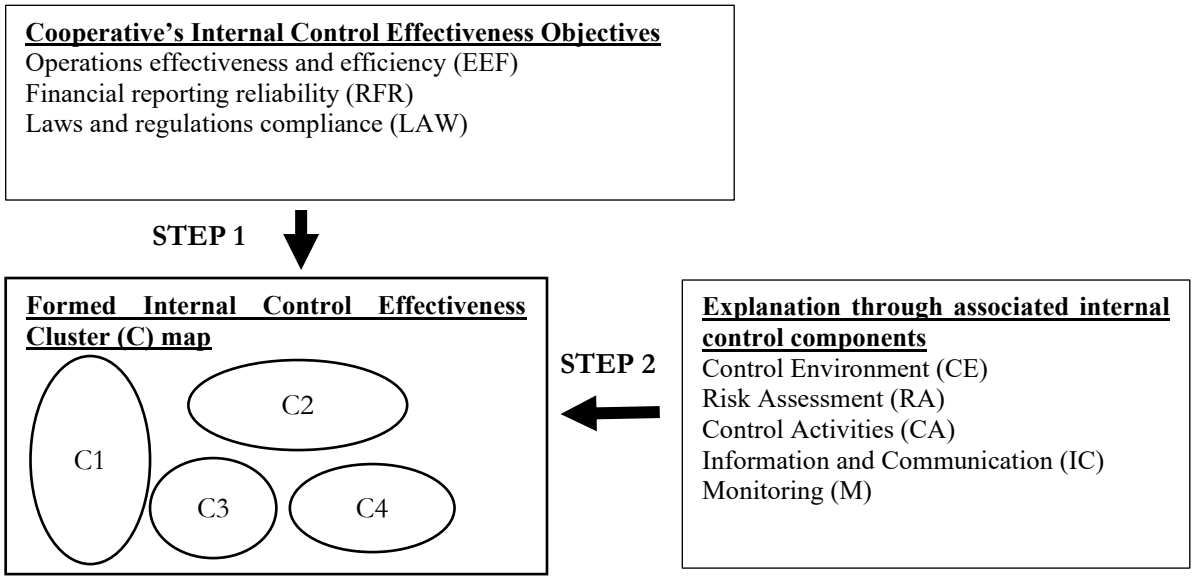

Figure 1: Kohonen's SOM Analysis Framework

Kohonen's SOM analysis involved two steps: first, training the clustered internal control effectiveness map using data related to cooperative internal control effectiveness objectives (EEF, RFR, and LAW); second, associating the five internal control components (CE, RA, CA, IC, and M) with the map. Kohonen's SOM is characterized by its ability to identify clusters in data based on similarities, making it a valuable exploratory tool for detecting variations in internal control effectiveness among Malaysian cooperatives.

Kohonen's SOM Approach

The SOM approach, grounded in artificial neural networks, is an automated data analysis method widely applied in solving clustering problems and data exploration across multiple disciplines. It visualizes similarity relations within datasets, utilizing competitive learning principles among output neurons (Haykin, 2009).

Kohonen introduced a new nonlinearity projecting mapping known as SOM in 1981, addressing limitations in earlier models (Malsburg, 1973; Amari, 1980). Kohonen's SOM offers improved practicality for data analysis, particularly for large networks and high-dimensional data. It differs from traditional self-organizing approaches and employs the Vector Quantization (VQ) method, initially used in signal processing for feature-sensitive filtering through competitive learning (Kohonen, 2013).

Kohonen's SOM does not require users to specify the number of clusters, making it ideal for exploratory data analysis. It exhibits robustness in handling noisy, erroneous, and missing data, as well as various data distributions, including linear and non-normally distributed data. Furthermore, it offers exceptional visualization capabilities, combining projection and clustering methods, which sets it apart from alternative multidimensional visualization techniques (Jokipii et al., 2011; Sarlin, 2015). In prior studies, Kohonen's SOM has been effectively applied in clustering and classifying firms' internal control effectiveness (Lansiluoto et al., 2016).

In conclusion, Kohonen's SOM analysis was chosen for this study due to its suitability for exploratory data analysis, tolerance for various data types, robustness in handling noisy and missing data, and capacity for visualizing multidimensional data relationships.

Descriptive Information

Initially, we received 78 usable questionnaires, with an additional 48 received after reminders. Levene's Test addressed potential non-response bias, indicating that over 74% of the data had a two-tailed value exceeding 0.05. Consequently, differences between early and late responders do not significantly impact our study.

Within our comprehensive sample, cooperative registration dates ranged from July 21, 1922, to April 15, 2011, with operational ages spanning from one to over 80 years. Notably, 48.4% of cooperatives operated for 21 to 40 years, demonstrating significant longevity within the sector. Geographically, our sample encompassed all Malaysian states, with Johor prominently represented by 27 cooperatives.

Membership sizes varied significantly, ranging from 38 to 273,421 individuals, with an average of 4,412 members per cooperative. Staffing levels ranged from none to up to 1,000 members, with an average of 21.3 staff

members per cooperative. Board memberships varied from 6 to 16 individuals, showcasing diversity in governance structures.

Financial metrics, denoted in Malaysian Ringgit, revealed substantial revenue and asset bases, with total revenue and assets reaching 1.6 billion and 4.6 billion Malaysian Ringgit, respectively. Profits and capital were equally impressive, totaling 1.6 billion and nearly 4.1 billion Malaysian Ringgit.

Our study examined various economic sectors, excluding banking, to highlight the diverse activities of the cooperative economy. Notably, cooperatives were involved in credit services (34.9%), consumer goods (23.8%), services (29.4%), agricultural projects (31.7%), industrial ventures (2.4%), real estate endeavors (5.6%), construction projects (10.3%), and transportation services (15.9%). This breadth of involvement underscores the resilience and versatility of cooperative enterprises across multiple sectors.

Empirical Results

During the validation process of the Internal Control Effectiveness Objectives (ICEO) elements, which comprised EEF1, EEF2, and EEF4 for EEF measurement, RFR1, RFR2, RFR3, and RFR5 for RFR measurement, and LAW1, LAW2, LAW3, and LAW4 for LAW measurement, we observed satisfactory corrected item-total correlations, all-surpassing 0.5. However, EEF3 exhibited a lower correlation of -0.328 and was consequently excluded. The removal of EEF3 notably improved the group's Cronbach's alpha, reaching a robust 0.836, indicating acceptable internal consistency.

The validation process expanded to encompass all Internal Control Components (ICC) elements: CE1, CE2, CE3, CE4, CE5, and CE6 for CE measurement; RA1, RA2, RA3, RA4, RA5, and RA6 for RA measurement; CA1, CA2, CA3, CA4, and CA5 for CA measurement; IC1, IC2, IC3, IC4, and IC5 for IC measurement; and M1, M2, M3, M4, and M5 for M measurement. While most elements exhibited satisfactory corrected item-total correlation values, CA4 and IC4 presented discrepancies and were subsequently excluded. Their removal resulted in an acceptable Cronbach's alpha of 0.886.

Consequently, the dimensions derived from these elements demonstrated strong internal consistency and explained variances, contributing to the study's robustness.

In assessing normality, most elements fell within the acceptable range of ±1.0, with only RFR1, RFR2, RFR3, and RFR5 slightly exceeding this range at ±2.0. Further examination of Z-scores ensured accuracy, confirming that these four elements did not display extreme outliers and were considered acceptable for normal distribution (significant at $p<0.001$).

To streamline our analysis, we transformed the validated elements into single-scale dimensions. These transformed dimensions, as delineated in Table 3, served as the foundation data for evaluating each cooperative's internal control effectiveness. This evaluation used the Viscovery Somine application, which employs Kohonen's Self-Organizing Maps (SOM) analysis.

Table 3: New Data Transformation for ICEO and ICC

Elements	**Transformed Variables Mean to New Elements**	**Variable name**
EEF1, EEF2 and EEF4	EEF	Effective and Efficient operations
RFR1, RFR2, RFR3 and RFR5	RFR	Reliable Financial Reporting
LAW1, LAW2, LAW3 and LAW4	LAW	Compliance with Law and Regulation
CE1, CE2, CE3, CE4, CE5 and CE6	CE	Control Environment
RA1, RA2, RA3, RA4, RA5 and RA6	RA	Risk Assessments
CA1, CA2, CA3 and CA5	CA	Control Activities
IC1, IC2, IC3 and IC5	IC	Information and Communication
M1, M2, M3, M4 and M5	M	Monitoring

n=126

The Result of Analysis

Our study employed Kohonen's SOM analysis, creating a map by recognizing patterns within the discovered foundation data. After rigorous training, the map successfully identified four distinct clusters: Cluster 1 (C1), Cluster 2 (C2), Cluster 3 (C3), and Cluster 4 (C4) (Figure 2). Each cluster illustrates varying levels of internal control

effectiveness, as shown in the Cluster Profile Comparisons graph (Figure 3). The quantization error of the trained map was 0.00, indicating a highly successful training process with reliable and accurate cluster formation.

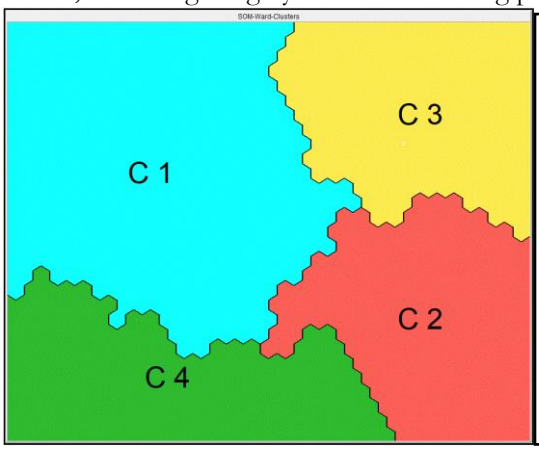

Figure 2: The Trained Map

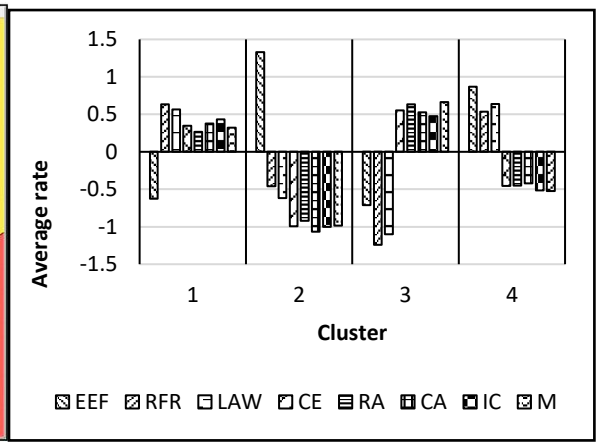

Figure 3: The Cluster Profile Comparisons

Internal Control Effectiveness Ranking for Cooperative

The study evaluated the cooperative's internal control effectiveness of cooperatives utilizing the Trained map (Figure 2) and Cluster profile comparisons (Figure 3). It ranked and labeled the internal control effectiveness achievement of the four clusters of cooperatives, as detailed in Table 4.

Table 4: Internal Control Effectiveness Ranking for Malaysian Cooperatives

Cluster	Description of cluster	N	%	Ranking*
4	Highest internal control effectiveness	27	21%	**1**
1	Low efficiency and effectiveness of activities	49	39%	**2**
2	Low reliability of financial information	21	17%	**3**
3	Lowest internal control effectiveness	29	23%	**4**

**1 is the best ranking, while 4 is the worst ranking. N=126.*

Cluster 4 secures the top rank, showcasing the highest internal control effectiveness, with ICEO variables consistently surpassing the overall average. All five ICC elements were operational, contributing to a robust internal control structure. Comprising 27 cooperatives (21% of the total surveyed), Cluster 4 exemplified strong internal control components, aligning with established theoretical frameworks. This assessment draws from Lansiluoto et al. (2016), Typology of Internal Control Effectiveness and Structure Practices (Figure 4).

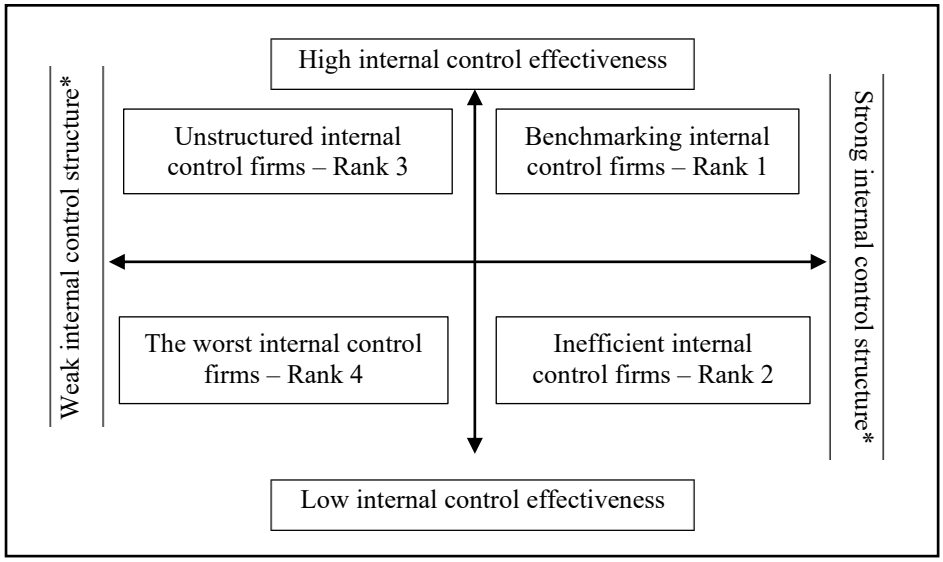

Figure 4: Typology of Internal Control Effectiveness and Structure Practices
* Internal control structure is called internal control components in this paper
Source: (Lansiluoto et al., 2016)

Cluster 1 is positioned at rank two due to demonstrating lower efficiency and effectiveness in activities. Although most ICEO and ICC components' dimensions were above average, the EEF dimension deviated by more than -0.5 from the overall average. Despite RFR and LAW scores exceeding the overall average by 0.5, indicating robust performance in these areas, Cluster 1 encountered challenges with internal control effectiveness and efficiency (EEF), marking the second lowest compared to other clusters. This could be attributed to rigid controls or excessive, ineffective procedures, posing risks of inefficiency (Loader, 2002). Cluster 1 comprised 49 cooperatives, representing 39 percent of the surveyed cooperatives.

Cluster 2 holds the third rank, with high EEF values but below-average LAW and very low RFR values. Additionally, ICC components dimensions received the lowest marks among all clusters, with CA scoring below average. Comprising 21 cooperatives (17 percent), Cluster 2 raises questions about management's trust in reported activities' effectiveness and efficiency, particularly with compliance and financial reporting reliability falling below average.

Cluster 3 is ranked fourth, exhibiting the lowest internal control effectiveness among all clusters. It performed poorly across all internal control effectiveness dimensions, with RFR scoring the lowest among all cooperative data. Although internal components were generally above average, Cluster 3 comprised the most ineffective cooperatives and demonstrated non-compliance with the law and questionable financial reporting reliability. With 29 cooperatives representing 23 percent of the cooperative's data, Cluster 3 occupies the lowest rank due to ineffectiveness.

Furthermore, the study revealed that cooperatives in Cluster 3 had internal control component values above average but ICEO objective values below average, consistent with the findings of Ali (2015) and Ariffin et al. (2016). This suggests that some Malaysian cooperatives struggle to produce reliable financial reports and comply with established standards and regulations.

Notably, the study identified 50 cooperatives (40 percent) in the sample as having ineffective internal control, ranking at numbers 3 and 4. These cooperatives were characterized by the lowest reliability of financial information and, consequently, the lowest level of internal control effectiveness. This finding aligns with the concerns raised by Ali (2015) regarding financial reliability reports and Ariffin et al. (2016) concerning internal control measurements, which all Malaysian credit cooperatives have not fully implemented. Given that this study sampled large cooperatives in Malaysia, it is plausible that similar internal control issues may exist among other unexamined cooperatives.

When assessing any organization's internal control effectiveness, evaluating the five internal control components alongside the internal control effectiveness objectives is imperative. These assessment results can serve as dependent variables in evaluating the relationship with internal audit effectiveness characteristics in future studies.

This study represents one of the earliest attempts to evaluate Malaysian cooperatives' internal control components and internal control effectiveness objectives, relying on internal audit and IAC (Internal Audit Committee) member assessments rather than material weakness statements. This study contributes to new knowledge by introducing a cooperative-specific internal control effectiveness ranking index. It utilizes the SOM clustering approach to measure cooperative internal control effectiveness based on cooperative internal auditor assessments. The findings reveal varying levels of internal control effectiveness among Malaysian cooperatives, each associated with distinct internal control structures. Additionally, this study suggests the application of Lansiluoto's typology to identify cooperative internal control rankings, aiding cooperatives in enhancing their internal control measures.

CONCLUSION

This study aimed to assess the effectiveness of internal control among Malaysian cooperatives and analyze the relationship between ICEO (Internal Control Effectiveness Objectives) dimensions and ICC (Internal Control Component) dimensions. This research drew upon the comprehensive framework provided by COSO, known as the Internal Control Integrated framework, which outlines three key objectives and five internal control components. Notably, COSO 2013 provided broad guidance on internal control concepts, enabling organizations to tailor the framework to their specific needs.

Previous research primarily relied on material weakness disclosure in financial statements to gauge internal control effectiveness, which posed challenges due to the lack of universal mandatory disclosure requirements across countries. Recent studies have attempted to address this issue by developing internal control indices based on the COSO framework and incorporating various guidelines and regulations relevant to their respective countries. However, limited attention has been given to evaluating the effectiveness of internal control within the context of Malaysian cooperatives.

This study was prompted by the prevalence of fraud and misappropriation cases within firms, publicly listed organizations, and cooperatives. Utilizing an exploratory data mining approach adapted from Lansiluoto et al. (2016), this research assessed the effectiveness of cooperatives' internal control based on the three ICEO objectives and their relationship with five of COSO's ICC components. The application of Kohonen's SOM clustering technique facilitated the analysis of survey data.

LIMITATIONS OF THE STUDY

The findings of this study must be interpreted within the context of several limitations. Firstly, these findings should not be generalized to encompass all Malaysian cooperatives but should be limited to those with turnovers exceeding RM800,000.00, excluding cooperative banks. Secondly, all survey questions were directed to the Cooperative's Chairman or Manager, who then forwarded the questionnaire to an internal auditor or audit committee member. Consequently, the researcher could not ensure the accuracy of the respondent's answers. Thirdly, this study relied on perceptions rather than assessments by internal control experts.

SUGGESTIONS FOR FUTURE RESEARCH

Based on Lansiluoto et al.'s (2016) method of assessing internal control effectiveness, this study has paved the way for future research avenues. Future studies may explore the relationship between internal control effectiveness and organizational performance. Additionally, a deeper examination of the differences within each cluster could provide valuable insights and guidelines for enhancing internal control effectiveness within the same economic group. Further research may also consider analyzing other types of cooperatives and comparing them with banking cooperatives or using the internal control effectiveness index as a performance variable in examining other independent variables. This alternative approach to assessing internal control effectiveness could be applied to other cooperatives, non-profit organizations, associations, or religious organizations that are not obligated to disclose material weakness statements, provided suitable respondents participate in the research.

STATEMENTS AND DECLARATIONS

Data Availability

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Ethical Approval

The authors did not perform any studies involving animals or human participants for this paper.

Competing Interests

The authors declare no competing interests.

Consent to Participate

The authors did not perform any studies involving animals or human participants for this paper.

Consent to Publish

Data used were publicly available.

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The authors have no relevant financial or non-financial interests to disclose.

Author Contributions

"All authors contributed to the study. Proposal preparation, data collection and analysis were performed by PhD student [Shamsul Anuar Abd Rahim], supervised by the main supervisor [Dr Intan Salwani Mohamed] and co-

supervised by [Dr Anuar Nawawi]. The first draft of the manuscript was written by [Shamsul Anuar Abd Rahim], edited and submitted by [Dr Intan Salwani Mohamed], and all authors commented on previous versions. All authors read and approved the final manuscript."

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