

Role of Performance Measurement Systems in Enhancing Organizational Resilience: Evidence from a Mediated Moderating Model

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Abstract: In today's rapidly changing, digital world, it is becoming essential for organizations to be resilient. While it is widely acknowledged that Performance Measurement Systems (PMS) are vital management tools to closely monitor and spur improvement in organizational performance, limited research has looked into how PMS can contribute to building organizational resilience through strategic organizational capabilities and digital transformation. This study aims to examine the mediating role of strategic agility and the moderating effect of digital capability between the relationship of Performance Measurement Systems and Organizational Resilience in Malaysian firms. The study is based on Dynamic Capabilities Theory and Organizational Information Processing Theory with a quantitative research design using survey data from 210 managerial respondents from manufacturing and service organizations in Malaysia. This proposed research model is analysed through a hybrid approach of Partial Least Squares Structural Equation Modelling (PLS-SEM) and Artificial Neural Network (ANN) to explain and predict the results. The results prove that Performance Measurement Systems have a significant effect on Organizational Resilience both directly and indirectly via Strategic Agility. The results also show a positive moderating effect of Digital Capability on the link between Performance Measurement Systems and Organizational Resilience; that is, the more digitally capable companies are, the more resilient they are when they employ PMS. Based on sensitivity analysis in ANN, the most dominant influence factor of Organizational Resilience is Strategic Agility followed by Performance Measurement Systems and Digital Capability. The research extends the literature in the field of performance management and organizational resilience by introducing the two concepts of strategic agility and digital capability in a single framework and by showing the added value of the combination of PLS-SEM and ANN methodology. The findings also have implications for managers who want to enhance organizational resilience by means of strategic performance management and digital transformation efforts.

Keywords: Performance Measurement Systems; Organizational Resilience; Strategic Agility; Digital Capability

1. Introduction

The world is experiencing a VUCA (volatile, uncertain, complex and ambiguous) environment of fast changing technologies, economic disruptions, geopolitical instability, and changing customer expectations, all of which are affecting organizations around the globe. The growing need for organizational resilience (OR) the capacity of an organization to predict, withstand, adjust to, and bounce back from shocks and stresses while continuing to perform – has created a greater need for preparedness. The COVID-19 pandemic also highlighted that resilient organizations are more likely to weather the storm and benefit from new opportunities, turning resilience into a strategic imperative for scholars and practitioners. Therefore, the organizational capacities which support resilience have become a topic of research in management, accounting and organisational studies (Madani & Parast, 2023; Ignatowicz et al., 2023; Lo et al., 2026). Of these features, the one that has gained growing

attention is performance management, as organizations need to be responsive to uncertainty in their environment and need to have timely and accurate information that is relevant to them.

Performance Measurement Systems (PMS) have come a long way from their roots as traditional financial control systems to become full fledged systems of strategic management, encompassing both financial and non-financial measures to aid in organizational planning, monitoring, and decision making. Today PMS enable strategic alignment, organizational learning, performance evaluation, and continuous improvement, and give managers real-time information to make evidence-based decisions. Modern performance measurement systems, however, are used not just to evaluate what has already happened, but to help organizations predict what will happen, find opportunities and make decisions about allocating resources in dynamic situations. Some of the research has shown that strategic performance systems, quality management systems and management control systems play a crucial role in the process of organizational resilience in terms of organizational coordination, adaptability and strategic responsiveness (Bracci & Tallaki, 2021; Werner et al., 2021; Al Balushi, 2025; Almeida Marques, 2026). However, the processes and pathways by which Performance Measurement Systems result in increased organisational resilience is still poorly understood.

A possible linkage between Performance Measurement Systems and Organizational Resilience is Strategic Agility. Strategic Agility is about the organization's capability to quickly perceive what's going on in the environment, reconfigure resources, and respond with strategic actions to new opportunities and threats as soon as they arise. Performance information can increase managerial awareness, facilitate proactive decision making and help to enhance the flexibility of an organization; this means organizations with effective performance measurement systems are likely to be strategically agile. Strategic agility has been identified as one of the most important dynamic capabilities that help companies remain competitive in dynamic business environments. Islam et al. (2026), for instance, indicated that strategic agility has a significant influence on improving organizational performance, allowing companies to be more agile in adapting to market shifts after the pandemic. Keskin et al. (2026) revealed that organizational intelligence positively impacts resilience capacity by fostering adaptive organizational capabilities. However, the empirical studies that have explored the Strategic Agility as a mediator between Performance Measurement Systems and Organizational Resilience are still quite limited.

Performance information is also being collected, analysed and used differently, as a result of the speed of the digitalization of business processes. Digital technologies like AI, cloud computing, business analytics, and enterprise systems enable organizations to process information more efficiently and make faster decisions to uncertainty in the environment. As a result, Digital Capability has become a key organisational asset that can bolster the impact of Performance Measurement Systems on building resilience. The more digital an organisation can be and the more it has analytical skills, the more likely it is to turn performance data into action and so increase the adaptability and resilience of the organisation. The use of digitalized performance systems has been demonstrated recently to significantly enhance organizational resilience through strategic coordination, predictive analytics, and adaptive decision-making processes (Almeida Marques, 2026; Cavadi & Cosenz, 2025). Likewise, Pham and Vu (2025) highlighted the significance of effective digital governance and information-processing capabilities in enhancing the effectiveness of management accounting control systems. But there is still limited empirical evidence on the moderating role of Digital Capability in the link between Performance Measurement Systems and Organizational Resilience especially in emerging economies.

The relationships are relevant to Malaysia as the country moves to speed up its digital transformation programs and organisations work towards building their resilience and competitiveness as part of the Industry 4.0 agenda. As Malaysian businesses grapple with the challenges of economic uncertainty, investments in strategic performance management systems, digital technologies, and organizational capabilities have become more

commonplace. Evidence as to how these organisational resources combine to resilience is, however, still scarce. In addition, most of the existing studies have concentrated on public sector organizations, healthcare institutions or developed economies, with relatively little empirical research being conducted in Malaysian private sector companies. The present study strives to fill these gaps by building an integrated research framework based on Dynamic Capabilities Theory and Organizational Information Processing Theory. This paper examines the direct relationship of Performance Measurement Systems to Organizational Resilience, as well as the mediation of Strategic Agility, and the moderation of Digital Capability, using a hybrid PLS-SEM and ANN approach, and data gathered from 210 managerial respondents. The study combines explanatory and predictive analytical approaches, thereby enriching the literature of performance management, strategic management, and organizational resilience and providing valuable practical insights for managers aiming to create more resilient organizations in a digital transformation world.

2. Literature Review

Performance Measurement Systems (PMS) have matured significantly beyond conventional financial control systems, to become strategic management systems that enable organisations to learn, align, decide and continuously improve. Modern PMS combine financial measures with non-financial ones, giving managers all the information they need to keep track of their organizational goals and react to changing business conditions. However, PMS is not just for evaluation; they are tools for proactive decision-making that can help organizations identify potential risks, allocate resources effectively, and improve their adaptability. Almeida Marques (2026) found that digitally enabled strategic performance systems, in particular digitalized balanced scorecards, are of high strategic value to help enhance organizational resilience, strategic coordination and organizational responsiveness. Likewise, Bracci and Tallaki (2021) suggested that the management control systems represent capacities of the organization which contribute to resilience through organizational learning, coordination, and adaptive action in crises. Al Balushi (2025) further stated from the quality management point of view, organizations with strong quality management systems have greater resilience capacities as it facilitates systematic performance monitoring, which can identify vulnerabilities and constantly enhance operations.

The importance of organizational resilience has grown as a key organizational ability to respond to, and continue to function in, disruptions, both to be ready for future events and to recover from them, and to remain competitive and functioning over time. With the ever-expanding environmental uncertainty, digital transformation, geopolitical complexity, or global crises, scholars have been more interested in resilience as a strategic organizational outcome. Ilseven and Puranam (2021) defined organizational resilience as a performance outcome that can be measured as the ability of an organization to survive and continue to add value in the face of disruption. Similarly, Ignatowicz et al. (2023) studied empirical approaches to measuring resilience to reach an understanding that resilience is a multi-faceted process consisting of the dimensions of anticipation, adaptation, recovery and organizational learning. More recently, Lo et al. (2026) synthesized organizational resilience measurement instruments and highlighted the increasing significance of multidimensional resilience indicators in assessing organizational resilience to future disruptions. Werner et al. (2021) also noted the need to assess resilience capabilities through key performance indicators, which enables organisations to have a much better understanding of where their operations are weak and how to enhance adaptive capacity.

In recent years, one of the main thrusts in research on performance measurement systems is the role of these systems in providing strategic capabilities to organizations so as to enhance organizational resilience, not just for the purposes of direct improvements in the system's operations. Strategic agility has been a subject of much attention because it is one of the key organisational skills to respond swiftly to changes in the environment, to mobilise resources and to make appropriate strategic response in time. With a good PMS, you can get accurate and timely information about the performance of an

organization, which allows managers to take strategic decisions in uncertain times. Thus, it is expected that performance measurement systems will enhance strategic agility, thereby enhancing organizational resilience. While there are many studies on resilience, most of them have been concentrated on management control systems, quality management and organizational intelligence, there is still a limited number of empirical studies that focus on the issue of strategic agility as the underlying mechanism. Islam et al. (2026) showed that strategic agility has a meaningful impact on enhancing organizational performance by being responsive to environmental changes that occurred after the pandemic and Keskin et al. (2026) found that organizational intelligence boosts resilience capacity and financial performance based on its strategic adaptability.

Digital capability has also become a key organizational asset to enhance companies' capacities to adapt and build resilience in response to the information about their performance. Once organizations have a fully digital infrastructure, analytics capabilities and technological integration, they are able to process information more efficiently, identify changes more quickly and make timely strategic decisions. Thus, the use of digital capability can enhance the effectiveness of performance measurement systems through better information quality, faster decision-making and greater responsiveness of the organisation. Almeida Marques (2026) showed that digitalized performance systems have a significant impact on organizational resilience by increasing strategic information processing, and Cavadi and Cosenz (2025) indicated that AI-based performance management systems can enhance the resilience of healthcare organizations by optimizing their monitoring, predictive analytics, and adaptive decision-making processes. Similarly, Pham and Vu (2025) demonstrated that the use of management accounting control systems, along with effective risk governance, plays a significant part in improving organizational resilience within public sector organizations.

Although the literature on performance management and organizational resilience is increasing, there are several gaps in research. Previous studies have mostly focused on the direct relationship between management systems and resilience (Bracci & Tallaki, 2021; Al Balushi, 2025; Almeida Marques, 2026), the measurement of organizational resilience (Ignatowicz et al., 2023; Lo et al., 2026), or how resilience is a mediator between organizational capabilities and performance outcomes (Beuren et al., 2022; Zabłocka-Kluczka & Sałamacha, 2023). Few empirical studies have examined how strategic agility can become a capability in performance measurement systems that helps build organisational resilience, and also explored the role of digital capability as a moderator. Moreover, the majority of previous research has been conducted in the healthcare sector, public sector organizations and the quality management field and little research has been conducted from the perspective of private sector organizations in countries like Malaysia, which is among the emerging economies. The interrelatedness of the—PMS, Strategic Agility, Digital Capability, and Organizational Resilience—in an explanatory framework has thus remained under-researched. The current study identifies and fills these gaps by introducing and empirically examining an integrated research model based on data from Malaysian companies and adopts a hybrid PLS-SEM and Artificial Neural Network (ANN) model to gain both explanatory and predictive insights into the role of performance measurement systems in supporting organizational resilience in the era of digital transformation.

H1: Performance Measurement Systems have a positive and significant effect on Organizational Resilience.

H2: Performance Measurement Systems have a positive and significant effect on Strategic Agility.

H3: Strategic Agility has a positive and significant effect on Organizational Resilience.

H4: Strategic Agility mediates the relationship between Performance Measurement Systems and Organizational Resilience.

H5: Digital Capability positively moderates the relationship between Performance Measurement Systems and Organizational Resilience, such that the positive effect of Performance Measurement Systems on Organizational Resilience is stronger when Digital Capability is high.

The conceptual framework in the study to investigate the effects of Performance Measurement Systems (PMS) on Organizational Resilience (OR) through Strategic Agility (SA) as the mediator and Digital Capability (DC) as the moderator is shown in Figure 1. The framework is inspired by Dynamic Capabilities Theory (Teece et al., 1997), which suggests that organizations may gain a sustainable competitive advantage by being able to continuously sense their environment, seize new opportunities and reconfigure organizational resources accordingly to adapt to the dynamic environment of the market. From this viewpoint, Performance Measurement Systems can offer useful and timely information for managers to track and see how the organization is doing, what are its operational problems, and how it can make better decisions, thus increasing strategic agility, which in turn helps to build organizational resilience. Galbraith (1974) has also presented Organizational Information Processing Theory, which suggests that organizations that function in uncertain environments must have effective information processing capabilities to lessen uncertainty and to improve decision quality. Performance Measurement Systems can therefore be regarded as critical information-processing mechanisms, and Digital Capability can help increase the capacity of the organization to gather, analyse and use performance information to make quick decisions regarding the strategy to be adopted. Therefore, it is assumed that organizations with high digital competencies are able to make better use of Performance Measurement Systems, thus strengthening their organization. The proposed framework has explained the direct and indirect mechanisms by which Performance Measurement Systems helps in the organizational resilience and has shown that the presence of digital capability has played a contingent role in strengthening the relationship.

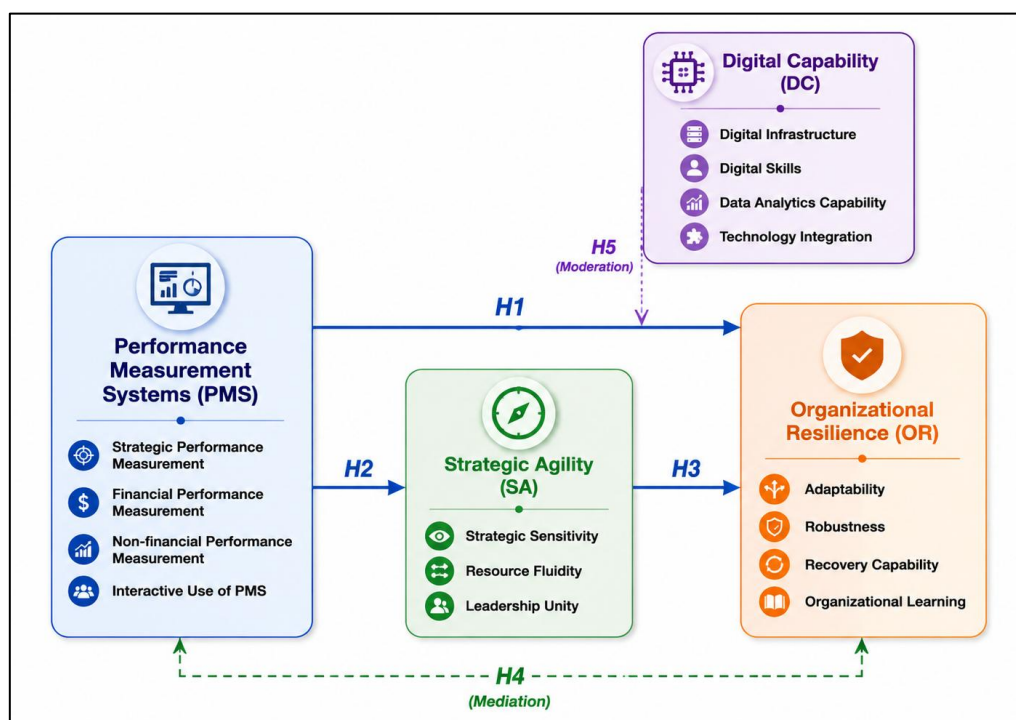


Figure 1. Conceptual model

3. Methodology

3.1 Research Design and Sample

The present study utilized quantitative cross sectional research design to investigate the contribution of Performance Measurement Systems in improving Organization Resilience of the Malaysian companies. As the majority of the data collection was to be obtained from a relatively large number of organizational respondents, and the study aims to

collect standardized data, a questionnaire survey was used as the main data collection method, which is another most commonly used method in management and accounting research. (Manufacturing and service organizations) managers from an organization that is using strategic performance management practices and digital technologies to enhance resilience in a dynamic business environment were the focus of the target population. The respondents were chief executive officers (CEOs), finance managers, operations managers, strategy managers, accounting managers, human resource managers and senior executives who had a good level of knowledge about the performance management practices and the strategic decision-making processes in their organizations. A purposeful sampling of respondents was used to ensure that they had sufficient managerial experience and were directly involved with organisational planning, performance evaluation or strategic management. 250 questionnaires were sent out, both online and offline. A total of 210 valid questionnaires were obtained for analysis, with a return of 84.0%. This amount of sample points is greater than the minimum sample size suggested for Partial Least Squares Structural Equation Modelling (PLS-SEM) that provides adequate sample size that is needed to estimate the proposed research model.

3.2 Measurement of Variables

Well-established scales, modified from previous studies, were used to measure all the constructs included in the study to ensure content validity and measurement reliability. Some minor modifications of wording were made in order to make the items clearer and more relevant to Malaysian organizations without altering the original conceptual meaning of each item. Performance Measurement Systems (PMS) measures were obtained from items adapted from Henri (2006), Bisbe and Malagueño (2012) and Franco-Santos et al. (2012) and included items related to the strategic use of financial performance measures, non-financial performance measures, interactive control, and performance monitoring practices. SA was evaluated with measurement items that were adapted from Doz and Kosonen (2010) and Clauss et al. (2021) which demonstrated strategic sensitivity, resource fluidity, and leadership unity. Validated scales developed by Kantur and Iseri-Say (2015), Ambulkar et al. (2015), and Duchek (2020) were used to measure Organizational Resilience (OR) that consists of adaptability, robustness, recovery capability and organizational learning. Digital Capability (DC) was comprised of items adapted from Bharadwaj (2000) and Warner and Wäger (2019) that assess digital infrastructure, analytics capability, technology integration and employees' digital competencies. Each item in the questionnaire was rated on a five-point Likert scale (1 = strongly disagree; 5 = strongly agree) to give the respondents the chance to mark to what extent they agreed or disagreed with the items.

3.3 Analytical Approach

Hybrid approach between PLS-SEM and Artificial Neurological Network (ANN) is used to analyse the proposed research model. PLS-SEM was chosen due to its appropriateness to examine complex research models with mediation and moderation relationships as well as to measure latent constructs with multiple indicators. Furthermore, PLS-SEM is suitable to be applied in predictive research and is not constrained from multivariate normality, but can be used with relatively moderate sample sizes like in the present study ($N = 210$ observations). The widely accepted two-stage procedure was used for analysis. First, the measurement model was assessed by examining indicator reliability (factor loadings), internal consistency (Cronbach's alpha and CR), convergent validity (AVE) and discriminant validity (HTMT). Variance Inflation Factors (VIF) were also used to check for collinearity diagnostics. The structural model was then assessed by estimating the path coefficients through bootstrapping with 5,000 resamples and by testing the significance of direct, mediating and moderating effects, as well as by considering the explanatory power (R^2), the effect sizes (f^2), the predictive relevance (Q^2) and the model fit (SRMR). Indirect effect estimates were used to assess mediation, and analysis of interaction terms was used to examine moderation.

Given the explanatory power of PLS-SEM, an Artificial Neural Network (ANN) model was used to capture possible non-linear relationships between the study variables, and to improve the prediction accuracy. In line with the previous hybrid SEM--ANN studies, statistically significant predictors that were obtained from previous PLS-SEM analysis were taken as the input neurons into the ANN model, with the Output neuron being Organizational Resilience. A multilayer perceptron with one hidden layer and a feed-forward backpropagation learning algorithm was implemented. The dataset was split into 90% training data and 10% testing data, and 10-fold cross validation procedure was performed to reduce overfitting, and increase the generalisability of a model. The performance of the ANN model was tested in terms of the Root Mean Square Error (RMSE) of the training and testing data sets. Finally, sensitivity analysis was performed to assess the proportion of each predictor that contributes to the explanation of Organizational Resilience and to gain additional insights concerning its predictors beyond the linear relations estimated by PLS-SEM.

4. Results

Table 1 shows the demographic information of 210 respondents who responded to the survey. Most respondents were male (60.0%) and the female respondents made up 40.0% showing reasonable gender representation in Malaysian firms. The age group of most of the respondents was 30-49 years (67.6%), indicating that the sample was made up of mostly matured professionals of managerial decision making. The manager's educational level was high; nearly half (49.0%) had a masters degree and 15.8% had doctoral level education. The majority of respondents were senior managers (33.8%), finance/accounting managers (21.9%) and operations managers (18.6%), thus obtaining the data from people with extensive experience of organizational performance management practices. Additionally, more than 86% of all respondents provided 5+ years of managerial experience, which suggests there was sufficient professional expertise to assess organizational resilience and strategic capabilities. The sample comprised of medium-sized organisations (43.3%) and large-sized organisations (33.3%) as well as small-size organisations (23.3%) and a diverse and representative sample of Malaysian organisations since the sample included both manufacturing (53.3%) and service (46.7%) organisations.

Table 1. Demographic Profile of Respondents (N = 210)

Characteristic	Category	Frequency (n)	Percentage (%)
Gender	Male	126	60.0
	Female	84	40.0
Age (Years)	Below 30	32	15.2
	30-39	78	37.1
	40-49	64	30.5
	50 and above	36	17.2
Highest Education	Bachelor's Degree	74	35.2
	Master's Degree	103	49.0
	Doctorate	33	15.8
Managerial Position	CEO/Director	24	11.4
	Senior Manager	71	33.8
	Finance/Accounting Manager	46	21.9
	Operations Manager	39	18.6
	HR/Strategy Manager	30	14.3
Working Experience	< 5 years	28	13.3
	5-10 years	76	36.2
	11-15 years	63	30.0
	> 15 years	43	20.5
Industry	Manufacturing	112	53.3

Firm Size	Services	98	46.7
	Small (<100 employees)	52	24.8
	Medium (100–249 employees)	91	43.3
	Large (≥250 employees)	67	31.9

Table 2 reports the results of the measurement model assessment. All indicator loadings were more than 0.7, the recommended threshold, and ranged between 0.831 and 0.896, indicating the sufficient reliability of indicators. Cronbach's alpha values ranged from 0.912 to 0.931 and Composite Reliability (CR) values ranged from 0.934 to 0.947, suggesting high internal consistency of all the constructs. Likewise, the rho_A exceeded the recommended cut-off value of 0.70, which is also evidence of construct reliability. The Average Variance Extracted (AVE) values were between 0.731 and 0.782, which is well above the threshold value of 0.50, thus confirming convergent validity. Overall, these results confirm the reliability of the measurement items in capturing the underlying constructs of Performance Measurement Systems, Strategic Agility, Digital Capability and Organizational Resilience. Thus, the reliability and validity of the measurement model are satisfactory, and the measurement model can be used for structural model analysis.

Table 2. Measurement Model Assessment

Construct	Item	Loading	Cronbach's α	rho_A	CR	AVE
Performance Measurement Systems (PMS)	PMS1	0.845	0.926	0.929	0.942	0.731
	PMS2	0.862				
	PMS3	0.876				
	PMS4	0.854				
	PMS5	0.831				
Strategic Agility (SA)	SA1	0.871	0.912	0.915	0.934	0.739
	SA2	0.852				
	SA3	0.875				
	SA4	0.844				
	SA5	0.856				
Digital Capability (DC)	DC1	0.861	0.919	0.922	0.939	0.756
	DC2	0.874				
	DC3	0.885				
	DC4	0.856				
	DC5	0.873				
Organizational Resilience (OR)	OR1	0.882	0.931	0.934	0.947	0.782
	OR2	0.896				
	OR3	0.873				
	OR4	0.889				
	OR5	0.875				

The results of structural models based on bootstrapping with 5,000 resamples are shown in Table 3. The results show that Performance Measurement Systems are positively and significantly related to Organizational Resilience ($\beta = 0.312$, $t = 4.826$, $p < 0.001$) and thus support H1. Similarly, Performance Measurement Systems are found to be a strong positive predictor of Strategic Agility ($\beta = 0.684$, $t = 16.972$, $p < 0.001$), thus supporting H2. Additionally, Strategic Agility has a positive and significant influence on Organizational Resilience ($\beta = 0.423$, $t = 6.351$, $p < 0.001$), which is congruent with H3. In terms of explanatory power, the variance accounted for by the model is 46.8% for Strategic Agility and 71.6% for Organizational Resilience, suggesting the model has considerable explanatory power. The predictive relevance of the endogenous constructs is confirmed by the positive Q^2 values; the value of the SRMR is 0.058, which is acceptable. In general, the structural model exhibits good empirical support for the proposed theoretical model and shows that

Performance Measurement Systems have a direct and indirect effect on Organizational Resilience.

Table 3. Structural Model Results and Hypothesis Testing

Hypothesis	Path	β	t-value	p-value	f ²	Decision
H1	PMS → OR	0.312	4.826	<0.001	0.149	Supported
H2	PMS → SA	0.684	16.972	<0.001	0.881	Supported
H3	SA → OR	0.423	6.351	<0.001	0.218	Supported
Endogenous Construct		R ²	Adjusted R ²	Q ²		
Strategic Agility		0.468	0.465	0.331		
Organizational Resilience		0.716	0.709	0.521		
Model Fit	Value					
SRMR	0.058					
NFI	0.924					

The mediation and moderation findings of the proposed research model are shown in Table 4. Results show that the indirect effect of Performance Measurement Systems on Organizational Resilience through Strategic Agility is positive and significant ($\beta = 0.289$, $t = 5.913$, $p < 0.001$), which supports H4. The significant direct and indirect impacts suggest that Strategic Agility acts as a partial mediator between Performance Measurement Systems and Organizational Resilience, meaning that performance measurement systems can directly enhance organizational resilience and indirectly through the impact of Strategic Agility. Moderation results also show a positive influence between the interaction of Performance Measurement Systems and Digital Capability on Organizational Resilience ($\beta = 0.168$, $t = 3.274$, $p = 0.001$), supporting H5. This discovery suggests that organisations with more developed digital capabilities are more likely to be able to use performance measurement systems to increase their resilience.

Table 4. Mediation and Moderation Analysis

Hypothesis	Relationship	β	t-value	p-value	95% BCa CI	Decision
H4	PMS → SA → OR (Indirect Effect)	0.289	5.913	<0.001	[0.197, 0.386]	Supported
H5	PMS × DC → OR	0.168	3.274	0.001	[0.071, 0.266]	Supported

Indirect Effect Summary

Effect	Direct	Indirect	Total Effect	Mediation Type
PMS → Organizational Resilience	0.312	0.289	0.601	Partial Mediation

Moderation Effect Summary

Moderator	Interaction Effect (β)	Effect Direction	Interpretation
Digital Capability	0.168 ($p < 0.01$)	Positive	Higher digital capability strengthens the positive effect of Performance Measurement Systems on Organizational Resilience.

Table 5 presents the results of Artificial Neural Network (ANN) modelling for the purpose of complementing the explanatory analysis of PLS-SEM with predictive modelling. Four ANN models were built based on the increasingly important predictors selected from the structural model. The final ANN model, which included Performance Measurement Systems as well as Strategic Agility, Digital Capability and their interaction, had the lowest prediction errors with a training RMSE of 0.219 and testing RMSE of 0.244, showing excellent predictive power and good generalisability of the model. The training and testing RMSE values are not significantly different, indicating that the model is unlikely to be overfitting and has a consistent level of prediction accuracy. In addition, the application of a MLP with one hidden layer, the feed-forward backpropagation algorithm and 10-fold cross validation further increases the robustness and reliability of the predictive

model. These results validate the hybrid PLS-SEM–ANN method as being able to capture both linear and non-linear relationships among the variables of the study.

Table 5. Artificial Neural Network (ANN) Architecture and Predictive Accuracy

ANN Model	Input Neurons	Hidden Neurons	Output Neuron	Activation Function	Training (90%) RMSE	Testing (10%) RMSE	Average RMSE
Model 1	PMS	3	OR	Sigmoid	0.284	0.311	0.298
Model 2	PMS, SA	4	OR	Sigmoid	0.261	0.286	0.274
Model 3	PMS, SA, DC	5	OR	Sigmoid	0.238	0.267	0.253
Model 4 (Final Model)	PMS, SA, DC, PMS × DC	6	OR	Sigmoid	0.219	0.244	0.232

ANN Model Configuration

Parameter	Specification
Neural Network Type	Multilayer Perceptron (MLP)
Learning Algorithm	Feed-forward Backpropagation
Hidden Layers	One
Training–Testing Split	90% : 10%
Cross-validation	10-fold
Number of Epochs	1,000
Stopping Criterion	Minimum RMSE
Software	SPSS Neural Network Module

The results of the sensitivity analysis for the final ANN model are shown in Table 6. The results show that the most influential predictor of Organizational Resilience is Strategic Agility with a Normalized importance score of 100%, followed by Performance Measurement Systems (88.0%), Digital Capability (73.9%) and the interaction between Performance Measurement Systems and Digital Capability (59.8%). This reveals that the impact of Performance Measurement Systems on resilience is amplified by Strategic Agility, underscoring the importance of organizational agility in adapting to the changing business landscape. Digital Capability also proves to be an important predictor, which demonstrates that digital technologies and information-processing capabilities increase the resilience of organizations. The results from the ANN are aligned with the results of the PLS-SEM and support the robustness of the conceptual framework proposed and also provide a further predictive evidence of the relative importance of each determinant of Organizational Resilience.

Table 6. Sensitivity Analysis and Normalized Importance of Predictors (ANN Results)

Predictor	Raw Importance	Normalized Importance (%)	Rank
Strategic Agility (SA)	0.326	100.0	1
Performance Measurement Systems (PMS)	0.287	88.0	2
Digital Capability (DC)	0.241	73.9	3
PMS × Digital Capability	0.195	59.8	4

Variable Importance Summary

Predictor	Relative Contribution	Interpretation
Strategic Agility	Very High	The most influential predictor of Organizational Resilience.
Performance Measurement Systems	High	Directly enhances organizational resilience and supports strategic agility.
Digital Capability	Moderate–High	Strengthens organizational adaptability and complements performance measurement practices.
Interaction (PMS × DC)	Moderate	Confirms that digital capability amplifies the effectiveness of Performance Measurement Systems in improving organizational resilience.

5. Discussion

This study aimed to assess the effect of Performance Measurement Systems (PMS) on Organizational Resilience (OR) in Malaysian companies, while taking into account the role of Strategic Agility (SA) as a mediator and Digital Capability (DC) as a moderator. The empirical findings by using hybrid PLS-SEM and Artificial Neural Network (ANN) approach give strong support for the conceptual framework proposed. Results show that there is a direct link between Performance Measurement Systems and Organizational Resilience, and that Strategic Agility is a key underlying mechanism. Furthermore, Digital Capability enhances the effectiveness of Performance Measurement Systems in promoting organizational resilience.

The study validates the positive influence of Performance Measurement Systems on Organizational Resilience, aligning with the concept that PMSs are not just tools for financial control but are strategic instruments that enhance the adaptability and sustainability of organizations. By having a complete performance measurement system, organizations can more effectively track changes in the environment, anticipate new risks, assess strategic performance, and take timely corrective actions to become more resilient to external disruptions. This aligns with Al Balushi (2025), who showed that quality management systems play a significant role in improving the resilience of organizations by effectively monitoring performance and making continuous improvements. Likewise, Almeida Marques (2026) found that digitalized strategic performance systems contribute to enhancing organizational resilience, enabling strategic coordination and adaptive decision-making. Bracci and Tallaki (2021) also suggested that management control systems constitute a basic and key mechanism in the process of organizational resilience, as they enhance organizational learning and adaptive capacities. Moreover, Werner et al. (2021) stressed the importance of the well-designed performance indicators because these help to predict operational disruptions and enhance the organization's resilience through informed decision-making.

The results also show that Performance Measurement Systems has a significant positive effect on Strategic Agility and Strategic Agility has a significant positive effect on Organizational Resilience. These findings suggest that organizations reap benefits from performance measurement not just from better monitoring, but because performance information allows managers to quickly detect shifts in the environment, re-direct organizational resources and respond strategically to the opportunities and threats that arise. This is fully in line with Dynamic Capabilities Theory which contends that the capabilities associated with sensing and seizing, along with the ability to reconfigure resources, help firms gain sustainable competitive advantage in an uncertain environment. The findings are also consistent with Islam et al. (2026), who reported that strategic agility is a key factor that positively influences the performance of an organization, allowing them to adjust to the changing market conditions. Similarly, Keskin et al. (2026) showed that organizational intelligence enhances the capacity for resilience by promoting adaptability and strategic responsiveness.

The mediation analysis is one of the most significant theoretical findings in the study. Findings reveal that Strategic Agility partially mediates the relationship between Performance Measurement Systems and Organizational Resilience, suggesting that performance measurement systems can affect organizational resilience both directly and indirectly by enhancing organizational agility. The implication of this discovery is that companies with a performance measurement system in place can be more flexible in their strategic choices, more efficient in allocating resources and be more responsive in their leadership, thus making them more resilient when facing uncertainty. While the literature on resilience has mostly focused on the direct relationships between management control systems and organizational outcomes (Bracci & Tallaki, 2021; Al Balushi, 2025), empirical evidence that explores the mediating role of Strategic Agility is still limited. Thus, the present findings make a valuable contribution to the literature of management accounting and strategic management, in that Strategic Agility is an important dynamic capability that connects

performance measurement to organizational resilience. It constitutes an empirical approach to Dynamic Capabilities Theory by depicting how organizational information created by performance measurement is translated into strategic behaviour to adapt and increase organizational resilience.

The other significant finding is the moderating effect of Digital Capability. The positive relationship between Performance Measurement Systems and Digital Capability, suggests that organisations with higher digital skills, technology integration, analytics capability and digital infrastructure are more likely to leverage performance data to enhance their resilience. This result supports the Organizational Information Processing Theory that postulates that the more uncertain an organization's environment, the more it needs to enhance its information-processing capacity to make better decisions and enhance its organizational effectiveness. Digital capability can improve the value of performance measurement systems through the capability to collect data in real time, perform more sophisticated analysis, communicate faster and inform decision making based on evidence. Almeida Marques (2026) showed that digitalized balanced scorecards can have a major impact on improving strategic information processing and, therefore, on their organizational resilience. Similarly, Cavadi and Cosenz (2025) discovered that AI systems designed for performance management significantly boost resilience by enhancing the organization's monitoring and predictive decision-making capabilities. In the same way, Pham and Vu (2025) stated that modern governance and information systems enhance the effectiveness of management accounting control systems.

The findings of the Artificial Neural Network analysis can be used to gain insights that cannot be explained with PLS-SEM, but can be used to make predictions. According to the sensitivity analysis, the most important predictor of Organizational Resilience is Strategic Agility, followed by Performance Measurement Systems and Digital Capability. This ranking indicates that effective performance measurement systems can give you the information you need to help you make strategic decisions, but the key to resilience is whether you can translate performance information to agile strategic actions. The comparatively high importance of Digital Capability further underlines the critical role of digital transformation in enhancing organizational adaptability and resilience. Further, the low values of the training and testing RMSE values show that the ANN model has good predictive accuracy and high generalisability. The high consistency between the results of the PLS-SEM and ANN results adds a layer of trust to the robustness of the proposed conceptual framework and shows the potential of combining explanatory and predictive analytical approaches in researching organizational resilience.

6. Conclusions

This study aimed to assess the effect of Performance Measurement Systems (PMS) on Organizational Resilience (OR) of Malaysian firms with Strategic Agility (SA) as the mediating mechanism and Digital Capability (DC) as the moderating factor. An integrated framework was proposed and tested empirically with 210 managerial respondents based on Dynamic Capabilities Theory and Organizational Information Processing Theory. The results show that PMS have a significant direct and indirect (via Strategic Agility) positive effect on Organizational Resilience. The findings also show that Digital Capability positively moderates the relationship between Performance Measurement Systems and Organizational Resilience, suggesting that organizations with a higher level of digital resources and information-processing capacity tend to gain more strategic value from PMSs. Furthermore, the ANN analysis revealed that Strategic Agility was the most effective and significant explanatory and predictive variable for Organizational Resilience, followed by Performance Measurement Systems and Digital Capability, proving the complementary explanatory and predictive power of the proposed model.

The study contributes in several important ways to the theory. First, it is an extension of the literature on organizational resilience, incorporating performance management, strategic management and digital transformation in a single concept. This study shows

how previous research has focused on the direct effect of management control systems on organizational effects and how the process of how Performance Measurement Systems can develop Strategic Agility and how this affects resilience. Second, the results confirm the assumptions of Dynamic Capabilities Theory and demonstrate that performance information is translated into resilient capabilities by strategic sensing, resource reconfiguration and adaptive decision-making. Third, the study contributes to the Organizational Information Processing Theory by using Digital Capability as a moderating variable, which provides a better understanding of how digital technologies enhance organizations' capacity in information processing and organizational response to uncertain environments. Lastly, the use of hybrid PLS-SEM-ANN methodology is methodologically novel as it incorporates both causal and predictive models, offering a richer insight than each model individually.

The results have a number of implications for managers and policy makers. Performance Measurement Systems should be thought of as management tools—not just financial reporting systems—by the organizational leaders. Firms need to invest in integrated performance measurement systems that integrate financial and non-financial measures, improve the ability of the organization to learn continually and provide real-time performance information for strategic decisions. Equally crucial, however, is the development of Strategic Agility, which involves facilitating quick decision-making, flexible resource allocation, and proactive strategic planning, thereby promoting organizational agility in uncertain times. In addition, organizations need to boost their Digital Capability by investing in digital infrastructure, analytics platforms, artificial intelligence and staff digital capabilities. The investments can help organizations to “maximize” the functionality of their performance measurement systems and become more resilient to economic, technological, and competitive shifts. As for policymakers, fostering digital transformation efforts and the adoption of advanced performance management practices can help create more resilient and competitive Malaysian businesses.

Yet, the study is limited in several ways which offer avenues for further research. The first drawback of the cross-sectional design is that the causal relationships during the time period cannot be determined. Future research might utilize longitudinal research models to explore the process of the transition of the performance measurement system and organizational resilience in response to shifts in the environment. Secondly, the study is limited to Malaysian companies only and further study is recommended to replicate this model with companies in another country and/or to compare the model from different countries so as to provide a more generalizability of the results. Third, the study is based on self-reported survey information and although procedural and statistical measures were used, the possibility of common method bias cannot be ruled out. Future research could be conducted that integrates survey data with objective data on organizational performance or archival data to increase robustness. Lastly, future studies may further develop the proposed framework by adding more organizational capabilities, like organizational learning, innovation capability, knowledge management, leadership style, or organizational culture, to understand the determinants of organizational resilience in more and more digital and uncertain business environment.

Declarations

Ethics and Guidelines: The study was conducted in accordance with the Declaration of Helsinki. The ethical approval specifically covers the research procedures and data collection activities conducted for this study.

Consent to participate: Written informed consent was obtained from all participants prior to data collection. Consent was obtained using a standardized written form, signed by each participant before participation in the survey.

Consent to publish: The authors have provided consent to publish.

Competing interests: The authors declare no competing interests.

Data availability statement: Data will be made available on reasonable request from the corresponding author.

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Declaration of using generative AI: During the preparation of this work the author(s) used ChatGPT in order to correct the grammatical errors. After using this tool/service, the author(s) reviewed and edited the content as needed and take full responsibility for the content of the published article.

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