

## Neuroadaptive Workforce Management and Organisational Resilience in United Bank for Africa

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### ABSTRACT

The study examined the effect of Neuroadaptive Workforce Management (NAWM) on organisational resilience in Nigeria's banking sector. The specific objectives were to determine the influence of Brain-Computer Interfaces (BCIs), Neurofeedback Training (NFT), and Cognitive Load Management Systems (CLMS) on resilience among employees of United Bank for Africa (UBA). A cross-sectional survey research design was adopted, utilising primary data collected from 378 valid responses out of 393 questionnaires distributed to UBA employees across multiple branches nationwide. Data were analysed utilising descriptive statistics, Pearson correlation, and multiple regression analyses with the Statistical Package for Social Sciences (SPSS, version 27). The model specified organisational resilience as the dependent variable, while BCIs, NFTs, organisational factors, and CLMS served as independent variables. Results revealed that NAWM components have a significantly positive effect on organisational resilience at the 1% significance level ( $p \leq 0.01$ ). Among the components, Neurofeedback Training had the strongest influence ( $\beta = 0.482$ ,  $p < 0.01$ ), followed by perceptions of BCIs ( $\beta = 0.344$ ,  $p < 0.01$ ) and CLMS ( $\beta = 0.277$ ,  $p < 0.05$ ). This indicates that employee readiness and positive perceptions toward neuroadaptive technologies substantially enhance adaptability and sustained performance in UBA. NAWM significantly improves organisational resilience, with NFTs and BCIs as key drivers, while CLMS also plays a supportive role. Management should prioritise awareness, structured implementation, and supportive policies to optimise neuroadaptive technology adoption for a resilient workforce.

**Keywords:** Neuroadaptive Workforce Management, Organisational Resilience, Brain–Computer Interfaces, Neurofeedback Training, Cognitive Load Management Systems

## 1.0 INTRODUCTION

The modern business environment is increasingly characterized by volatility, uncertainty, complexity, and ambiguity (VUCA), requiring organisations to enhance adaptive capacity and resilience to maintain performance (Duchek, 2020; Hillmann & Guenther, 2021). Organisational resilience has evolved into a strategic capability, enabling institutions to anticipate disruptions, absorb shocks, adapt intelligently, and sustain operations (Williams et al., 2021). The financial sector faces compounded challenges, including economic instability, cybersecurity threats, digital transformation pressures, climate change uncertainties, and shifting customer expectations, which intensify employee stress, cognitive overload, and emotional fatigue (World Bank, 2020; Deloitte, 2022; Kiron et al., 2021; PwC, 2020; Aderibigbe & Mjoli, 2018).

In this context, Neuroadaptive Workforce Management (NAWM) has emerged as a promising strategy for strengthening organisational resilience by combining neuroscience, AI, and human–machine collaboration (Fairclough & Lotte, 2020; Ayaz & Dehais, 2019). NAWM employs technologies such as Brain–Computer Interfaces (BCIs) to link neural activity with digital systems (He et al., 2020), Neurofeedback Training (NFT) to support stress self-management and mental agility (Enriquez-Geppert et al., 2017), and Cognitive Load Management Systems (CLMS) to monitor and adjust cognitive demands, reducing fatigue and errors (Sweller et al., 2019).

Despite their potential, empirical studies on NAWM remain limited in Africa and other developing regions, with concerns over employee acceptance, trust, readiness, and ethical considerations (Ienca & Andorno, 2017; van Wynsberghe, 2013). The effectiveness of these innovations depends not only on technological sophistication but also on transparency, perceived organisational value, and willingness to adopt change (Venkatesh & Davis, 2000). In Nigeria’s banking sector, exemplified by the United Bank for Africa (UBA), understanding employee perceptions and preparedness for neuroadaptive technologies is critical for cultivating a resilient, future-ready workforce capable of sustaining performance amid digital disruption and operational pressures (Central Bank of Nigeria, 2020; PwC, 2020). The study therefore investigates the impact of BCIs, NFT, and CLMS on organisational resilience, addressing a notable empirical gap and offering evidence-based insights for human-centred technological integration in financial institutions.

### Objective of the Study

The following objective will guide this research:

- i. To determine the impact of neuroadaptive workforce management on organisational resilience in United Bank for Africa.

### **Research Hypothesis**

- i. Ho1: Neuroadaptive workforce management has no significant impact on organisational resilience in United Bank for Africa

## **2.0 LITERATURE REVIEW**

### **Neuroadaptive Workforce Management (NAWM)**

Neuroadaptive Workforce Management represents an innovative socio-technical framework that integrates neuroscience, artificial intelligence, and human factors engineering to enhance performance, safety, and resilience in dynamic work environments (Ayaz & Dehais, 2019; Fairclough & Lotte, 2020). This framework uses real-time neurophysiological and behavioural data, such as EEG, to monitor cognitive load and stress, enabling the system to respond in various ways (Aricò et al., 2018). BCIs, or brain-computer interfaces, are neurotechnological systems that facilitate direct communication between the brain and external digital devices. This capability allows for the real-time monitoring and modulation of cognitive states such as attention, fatigue, and stress (He et al., 2020; Nicolas-Alonso & Gomez-Gil, 2012). In the banking sector, BCIs can enhance performance in high-stakes situations by increasing alertness and enabling real-time adjustments (Aricò et al., 2018). However, challenges such as cost, infrastructure, and data privacy remain significant, particularly in developing countries (Ienca & Andorno, 2017).

### **Brain-Computer Interfaces (BCI)**

Brain-computer interfaces (BCIs) are an emerging neurotechnological innovation that enables direct communication between brain activity and external digital systems, bypassing traditional muscular pathways (He et al., 2020; Nakanishi, Luu, & Rutkowski, 2024). In organisational contexts, BCIs are being explored as tools for enhancing employee performance, cognitive awareness, and workplace safety through real-time monitoring of attention, fatigue, and mental workload (Aricò et al., 2020; Gu, Cao, & Jung, 2024). Their adoption is grounded in neuroergonomics, which focuses on aligning neural processes with work system design (Parasuraman & Rizzo, 2021; Ayaz & Soekadar, 2023). Using non-invasive technologies such as EEG and fNIRS, BCIs can detect employees' cognitive load and stress, enabling adaptive systems that adjust tasks, interfaces, or feedback to maintain performance and reduce fatigue or burnout (Roy et al., 2022; Wolff, Fairclough, & Lotte, 2025).

### **Neurofeedback Training (NFT)**

Neurofeedback Training is a self-regulation technique that provides individuals with real-time insights into their brain activity, assisting them in maintaining focus, managing their emotions, and enhancing their resilience when faced with challenging tasks (Enriquez-Geppert et al., 2017; Micoulaud-Franchi et al., 2021). NFT enhances resilience by improving focus, increasing stress management capabilities, and accelerating recovery (Gruzelier, 2014). In order for deployment to be effective, it is essential to establish ethical guidelines that safeguard data privacy and ensure informed consent (Ienca & Andorno, 2017).

### **Cognitive Load Management Systems (CLMS)**

Cognitive Load Management Systems monitor and regulate mental strain to prevent fatigue and maintain performance levels. They achieve such results by utilising tools such as EEG and eye-tracking to adjust task difficulty or work pace (Sweller et al., 2019). In financial settings, CLMS can reduce human errors and ensure operational stability during stressful periods (van der Kleij et al., 2013). The integration of BCIs, NFTs, and CLMS within NAWM establishes a comprehensive neuroadaptive ecosystem that enhances organisational resilience by enabling the proactive management of cognitive load, emotional regulation, and adaptive recovery (Duchek, 2020).

### **Organisational Resilience**

Organisational resilience refers to an organisation's ability to anticipate, prepare for, respond to, and adapt to disruptions while sustaining operations and long-term stability. It involves not only recovering from crises but also emerging stronger (Linnenluecke, 2017; Williams et al., 2021). Resilience spans strategic, operational, cultural, and technological dimensions. Strategically, it requires integrating risk management and scenario planning into decision-making. Operationally, it depends on adaptable processes, supply chains, and workforce structures that support continuity (Duchek, 2020; Lengnick-Hall et al., 2011). Culturally, resilience is strengthened through effective leadership, shared learning, and supportive environments that encourage adaptability. With advancing digital transformation, technological resilience has become increasingly vital, as tools such as AI, brain-computer interfaces, and cognitive load management systems enable organisations to detect stressors early, enhance employee well-being, and maintain performance under pressure (Hosseini et al., 2019; Ivanov, 2021).

### **Theoretical Review**

This study is grounded in Socio-Technical Systems (STS) Theory (Trist & Bamforth, 1951) and Adaptive Performance Theory (Pulakos et al., 2000). STS Theory posits that an organisation can

achieve optimal performance by effectively integrating its social and technological subsystems (Pasmore et al., 2019). In the context of NAWM, the effectiveness of technologies such as BCIs, NFTs, and CLMS depends not only on technological progress but also on the readiness and trust of employees (Venkatesh & Davis, 2000). Adaptive Performance Theory examines the ability of employees to manage fluctuating workloads and stress, with neuroadaptive technologies facilitating this process through feedback loops (Pulakos et al., 2000).

## **Empirical Review**

### **2.2 Empirical Review**

Nicolas-Alonso and Gomez-Gil (2012) performed a systematic review of BCI applications within the realms of healthcare, rehabilitation, and industrial sectors. Their research integrated both experimental and applied findings, demonstrating that BCIs enhance communication, monitor cognitive workload, and support adaptive interventions during stressful situations. Although the review utilised evidence from a variety of populations, including patients and industrial workers, it did not involve primary data collection. This absence of primary data restricts the generalisability of the findings to organisational settings, such as banking. Nevertheless, the synthesis underscored the potential of BCIs to enhance task performance and adaptability, which are crucial aspects of resilience. This study is particularly pertinent to the current research, as it offers foundational evidence that the adoption of BCIs can bolster resilience capacities, despite the ongoing need for cultural and sectoral validation.

Chanel and Mühl (2022) further contributed empirical evidence by investigating neuroadaptive systems through human–computer interaction experiments involving diverse participant samples. They found that BCIs can consistently identify lapses in attention and cognitive fatigue, allowing for adaptive modifications that enhance decision-making accuracy. The study employed quantitative assessments of neurophysiological data (EEG and physiological signals), thereby reinforcing its reliability. Nevertheless, the study mainly focused on short-term laboratory outcomes, with minimal investigation into long-term effects on organisations. This research highlights how the adoption of BCI could assist banks like UBA in supporting their employees in high-pressure situations, thus enhancing resilience.

Gruzelier (2021) evaluated clinical and workplace-related research on neurofeedback training, encompassing a range of participants from university students to professionals. The review integrated randomised controlled trials and applied field studies, concluding that neurofeedback improves self-regulation, emotional management, and adaptive functioning. These results are closely associated with resilience, as employees exhibiting higher self-regulation are more adept at managing disruptions. The strength of this review is its extensive coverage, although a

drawback is the insufficient representation of African workplace environments. Its significance to the current study is in illustrating how neurofeedback training could bolster employee preparedness in Nigerian banks.

### 3.0 METHODOLOGY

#### Research Design

This research utilised a quantitative cross-sectional survey design, which is fitting for analysing relationships among variables at a specific moment without altering any conditions. The design was appropriate, as the study aimed to explore how Neuroadaptive Workforce Management (NAWM) technologies, specifically Brain–Computer Interfaces (BCIs), Neurofeedback Training (NFT), and Cognitive Load Management Systems (CLMS), affect organisational resilience at the United Bank for Africa (UBA). This methodology allowed the researcher to collect standardised data from a broad employee population and empirically evaluate their perceptions, readiness, and experiences concerning neuroadaptive technologies as they naturally manifest within the organisational environment.

#### Nature and Sources of Data

The research was based on primary data gathered via a structured questionnaire that was distributed to employees of the United Bank for Africa (UBA) at selected branches throughout Nigeria. This questionnaire included closed-ended questions aimed at assessing the respondents' perceptions, preparedness, and evaluations of Neuroadaptive Workforce Management (NAWM) technologies, which encompass Brain–Computer Interfaces (BCIs), Neurofeedback Training (NFT), and Cognitive Load Management Systems (CLMS), in addition to their opinions on organisational resilience. A total of 393 questionnaires were issued, resulting in 378 valid responses that were subsequently analysed. All participants were guaranteed confidentiality and anonymity, and the data collection process was conducted in strict accordance with ethical research guidelines.

#### Model Specification

This study employed a multiple regression model to examine the relationship between Neuroadaptive Workforce Management (NAWM) components and organisational resilience within the United Bank for Africa (UBA). The model is expressed as:

$$OR = \beta_0 + \beta_1 BCI + \beta_2 NFT + \beta_3 CLMS + \mu$$

Where:

- *OR*= Organisational Resilience (dependent variable)

- *BCI*= Brain–Computer Interfaces (independent variable)
- *NFT*= Neurofeedback Training (independent variable)
- *CLMS*= Cognitive Load Management Systems (independent variable)
- $\beta_0$ = Constant term
- $\beta_1, \beta_2, \beta_3$ = Coefficients of the independent variables
- $\mu$ = Error term

This functional model captures how variations in the NAWM components, namely Brain–Computer Interfaces, Neurofeedback Training, and Cognitive Load Management Systems, both collectively and individually, influence organisational resilience among UBA employees.

### Methods of Data Analysis

The data gathered for this research were examined through a blend of descriptive and inferential statistical methods. Descriptive statistics, such as mean, median, standard deviation, frequency, and percentage distributions, were utilised to encapsulate the demographic characteristics of respondents and to demonstrate trends in perceptions and Neuroadaptive Workforce Management (NAWM) components among employees of the United Bank for Africa (UBA). Inferential statistics were employed to evaluate the hypotheses of the study and determine the strength and significance of the relationships between NAWM components, particularly brain-computer interfaces (BCIs), neurofeedback training (NFT), cognitive load management systems (CLMS), and organisational resilience. Multiple regression analysis was conducted to assess the predictive impact of the NAWM variables on resilience, while Pearson correlation analysis was used to quantify the degree and direction of association among the constructs. All statistical analyses were carried out using SPSS version 27, with the results displayed in tabular format to enhance clarity, interpretation, and ease of comparison.

## 4.0 DATA PRESENTATION AND ANALYSES

### Data Presentation

**Table 4.1** illustrates the descriptive statistics for four variables associated with Neuroadaptive Workforce Management (NAWM) technologies and organizational resilience outcomes: brain-computer interfaces (BCIs), neurofeedback training (NFT), cognitive load management systems (CLMs), and organisational resilience (OR). Data from 378 valid responses were analysed for each variable, with no missing values. The mean scores for these variables are closely grouped, ranging from 19.86 (BCIs) to 20.72 (OR). This indicates that, on average,

participants rated these aspects similarly. The median for all variables is 22, signifying that half of the responses for each variable exceed this value, while the other half fall below it. This consistency in the median further reinforces the similarity in participants' perceptions of each variable. The standard deviation values are also relatively similar, ranging from 5.077 (OR) to 5.568 (NFT), suggesting a comparable level of variability in responses across all four measures. The minimum values are slightly lower for BCIs (6) compared to the other variables (5), whereas the maximum value is 25 for all variables, indicating that at least one respondent assigned the highest possible rating for each. The data indicate a strong degree of consistency in both central tendency (mean and median) and variability (standard deviation) across the four variables. This suggests that participants' perceptions or experiences with these technologies and organisational resilience are quite uniform.

Descriptive Statistics					
		Brain-Computer Interfaces (BCIs)	Neurofeedback Training (NFT)	Cognitive Load Management Systems (CLMs)	Organisational Resilience (OR)
N	Valid	378	378	378	378
	Missing	0	0	0	0
Mean		19.86	20.3	19.9	20.72
Median		22	22	22	22
Std. Deviation		5.092	5.568	5.376	5.077
Minimum		6	5	5	5
Maximum		25	25	25	25

Source: Researcher’s Survey, 2025

Table 4.2 illustrates that all elements of neuroadaptive workforce management (NAWM), specifically brain-computer interfaces (BCIs), neurofeedback training (NFT), and cognitive load

management systems (CLMS), demonstrate strong positive and statistically significant correlations with organisational resilience ( $p < 0.01$ ). Among these components, BCIs and NFTs show the most robust correlations with organisational resilience ( $r = 0.873$ ), suggesting that these technologies significantly enhance resilience. CLMS also presents a strong correlation ( $r = 0.856$ ), albeit slightly less than that of BCIs and NFT. These findings indicate that the integration and favourable perception of neuroadaptive technologies are essential in bolstering organisational resilience, particularly at United Bank for Africa (UBA), where the readiness to adopt these technologies seems to be a crucial factor in promoting resilience.

<b>Correlations</b>					
		<b>Brain-Computer Interfaces (BCIs)</b>	<b>Neurofeedback Training</b>	<b>Cognitive Load Management Systems</b>	<b>Organisational Resilience</b>
<b>Brain-Computer Interfaces (BCIs)</b>	<b>Pearson Correlation</b>	1	.957**	.923**	.873**
	<b>Sig. (2-tailed)</b>		0	0	0
	<b>N</b>	378	378	378	378
<b>Neurofeedback Training</b>	<b>Pearson Correlation</b>	.957**	1	.906**	.873**
	<b>Sig. (2-tailed)</b>	0		0	0
	<b>N</b>	378	378	378	378
<b>Cognitive Load Management Systems</b>	<b>Pearson Correlation</b>	.923**	.906**	1	.856**
	<b>Sig. (2-tailed)</b>	0	0		0
	<b>N</b>	378	378	378	378

Organisational Resilience	Pearson Correlation	.873**	.873**	.856**	1
	Sig. (2-tailed)	0	0	0	
	N	378	378	378	378
**. Correlation is significant at the 0.01 level (2-tailed).					

Source: Researcher’s Survey, 2025

**Table 4.3** illustrates that all components of Neuroadaptive Workforce Management (NAWM), including brain–computer interfaces (BCIs), neurofeedback training (NFT), and cognitive load management systems (CLMS), have a beneficial impact on organisational resilience. The most significant effect is observed in the readiness to implement neurofeedback training ( $\beta = 0.491$ ,  $p < 0.01$ ), followed by the perceptions regarding the adoption of BCIs ( $\beta = 0.379$ ,  $p < 0.01$ ) and the effectiveness of cognitive load management systems ( $\beta = 0.265$ ,  $p < 0.05$ ). These results indicate that a greater willingness to adopt and integrate neurofeedback training, along with favourable perceptions of BCIs, plays a crucial role in enhancing organisational resilience. Although the effectiveness of cognitive load management systems is also important, its impact is relatively less pronounced compared to the other two factors. This underscores the necessity of promoting positive perceptions and preparing for the adoption of neuroadaptive technologies to bolster organisational resilience.

**Coefficients<sup>a</sup>**

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		
	B	Std. Error	Beta			Lower Bound	Upper Bound	
1	(Constant)	4.216	2.415		1.746	0.082	-0.533	8.965
	BCI	0.344	0.072	0.379	4.778	0	0.202	0.486
	NFT	0.482	0.069	0.491	6.986	0	0.346	0.618
	CLMS	0.277	0.064	0.265	4.328	0.019	0.051	0.503

Source: Researcher’s Survey, 2025

### **Test for Hypotheses**

The study examined 24,210 UBA employees across Nigeria, with 378 valid responses analysed. Using regression and Pearson correlation techniques, the research found that all three Neuroadaptive Workforce Management (NAWM) components Brain–Computer Interfaces (BCIs), Neurofeedback Training (NFT), and Cognitive Load Management Systems (CLMS) significantly improve organisational resilience. Neurofeedback training had the strongest influence, followed by BCIs and CLMS. All predictors showed positive, statistically significant effects on organisational resilience at the 1% and 5% levels, leading to the rejection of the null hypothesis. Overall, the findings provide strong empirical evidence that NAWM, especially neurofeedback training, plays a critical role in strengthening resilience and adaptability among UBA employees.

### **4.4 Discussion and Findings**

The findings indicate that Neuroadaptive Workforce Management (NAWM) greatly improves organisational resilience within UBA, with the readiness for Neurofeedback Training exerting the most substantial influence, succeeded by favourable views on Brain–Computer Interfaces and efficient Cognitive Load Management Systems. The willingness of employees to embrace neuroadaptive technologies enhances adaptability, stress management, and ongoing performance. This research underscores that the incorporation of these technologies bolsters resilience, while also stressing the necessity for heightened awareness and well-defined policies to guarantee successful implementation and enduring workforce robustness.

## **5.0 SUMMARY OF FINDINGS, CONCLUSION, AND RECOMMENDATIONS**

### **Summary of Findings**

The results indicate that neuroadaptive workforce management (NAWM) is crucial for enhancing organisational resilience at the United Bank for Africa (UBA). Of the various components, Neurofeedback Training is the most significant, followed by favourable views on Brain–Computer Interfaces and Cognitive Load Management Systems. Together, these technologies enhance employee adaptability, stress management, and overall workforce performance.

### **Conclusion**

The findings suggest that the implementation of neuroadaptive workplace technologies greatly improves organisational resilience within Nigeria's banking industry, especially when employees are ready and eager to accept these advancements. Notably, Neurofeedback Training has the

most significant effect, although all three components of NAWM play a vital role in enhancing resilience. Nevertheless, the research is constrained by its reliance on self-reported perceptions and its examination of only one financial institution; expanding the study to include more banks and objective performance metrics would yield a more thorough insight.

### Recommendations

It is recommended for UBA and similar organisations to emphasise awareness initiatives, organised integration, and supportive policies regarding neuroadaptive technologies. Enhancing employee training on neurofeedback, promoting favourable attitudes towards brain-computer interfaces, and guaranteeing effective cognitive load management systems will contribute to maintaining workforce resilience. Future studies should include a broader range of samples and investigate the long-term effects of NAWM implementation within the financial sector.

### Contribution to Knowledge

This study provides empirical evidence that Brain-Computer Interfaces, Neurofeedback Training, and Cognitive Load Management Systems substantially improve organisational resilience within Nigeria's banking industry, thereby contributing to the existing literature on workforce management. Additionally, it further develops socio-technical systems theory by illustrating how employee preparedness and favourable views of neuroadaptive technologies foster adaptability and sustained performance in ever-changing organisational settings.

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