

Data-driven dynamic capabilities in emerging markets: A grounded theory approach to digital transformation in african retail banking

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ABSTRACT

This study develops a process model of Data-Driven Dynamic Capabilities (DDDC) in African retail banking, addressing critical gaps in our understanding of how organizations develop and deploy data capabilities in data-rich, resource-constrained environments. Through a qualitative multiple case study of two major African banks, we uncover the specific practices through which banks develop capabilities despite resource constraints, deploy them to address contextual challenges, and generate competitive advantage. Our analysis reveals three interconnected processes: capability development practices (including data-driven culture cultivation, cross-functional integration, and adaptive infrastructure development); core capabilities that emerge through these practices (Data Integration and Synthesis, Real-time Insight Generation, and Agile Marketing Execution); and capability deployment practices (such as contextually adaptive customer engagement and regulatory navigation) that translate capabilities into competitive outcomes. The process model explains how contextual factors—including regulatory complexity, varying digital infrastructure, and skills constraints—shape both capability development and deployment practices. Theoretically, our study extends dynamic capabilities theory by reconceptualizing capability development as an ongoing process enacted through specific organizational practices rather than as a linear sequence of activities. It contributes to the literature on big data analytics by revealing how capabilities emerge through the interplay of organizational practices and contextual factors, challenging traditional assumptions about resource requirements for advanced analytics capabilities. By focusing on practices rather than just capabilities, our process model shows how organizations in resource-constrained environments develop innovative approaches to overcome limitations in specialized analytics talent and infrastructure. This research provides a roadmap for digital transformation in emerging markets, emphasizing the development of contextually appropriate practices rather than simply importing approaches from resource-rich environments. It sets the stage for future research on organizational adaptation in data-rich, resource-constrained environments, exploring the intersection of data analytics, dynamic capabilities, and contextual innovation.

1. Introduction

The retail banking sector is undergoing a profound transformation driven by the proliferation of big data and advanced analytics. This digital revolution is fundamentally reshaping how banks engage with customers, develop financial products, and compete in an increasingly digitized marketplace (Grewal et al., 2020; Kumar et al., 2019). Recent studies have documented how banks in developed markets are leveraging big data analytics for customer segmentation, risk assessment, and marketing optimization (Akter et al., 2020; Fosso Wamba et al., 2024). These studies reveal that while financial institutions report significant organizational impact from such initiatives (Deloitte, 2021),

many banks, particularly in emerging markets, struggle to fully leverage data capabilities to enhance customer centricity and gain competitive advantage (Mbama & Ezepue, 2018; Mikalef et al., 2020).

This struggle is particularly evident in African retail banking, where institutions must develop sophisticated data analytics capabilities within what we term "data-rich, resource-constrained environments." These environments are characterized by an abundance of diverse data streams—including mobile money transactions, alternative credit information, and rapidly evolving customer interactions—alongside significant constraints in specialized analytics talent, uneven technological infrastructure, and complex regulatory frameworks. African banks are pioneering innovative approaches to navigate these conditions,

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Table 1
Antecedents of DDDC.

Representative Quote	Antecedent	Emergent Concept	African Context
"We've had to fundamentally shift our mindset. It's not just about having data; it's about living and breathing data in every decision we make across our African operations." - Senior Executive, Bank A	Data-Driven Culture	Cultural Transformation	Addresses the need for organizational change to leverage data effectively in diverse African markets
"Our infrastructure needs to be as robust in rural areas as it is in major cities. We've developed a 'hybrid cloud' approach that allows us to maintain data integrity even in areas with unreliable connectivity." – Senior Exec, Bank B	Technical Infrastructure	Adaptive Technology Solutions	Responds to varied levels of digital infrastructure across African markets
"We've introduced 'data champions' in every department and country of operation. These individuals help translate data insights into actionable strategies for their teams." - Marketing Exec, Bank A	Cross-Functional Integration	Distributed Data Expertise	Facilitates data-driven decision making across diverse African operations
"Our CEO doesn't just talk about being data-driven; she actively participates in our data strategy sessions and champions our initiatives at the board level, considering implications for all our African markets." - Executive, Bank B	Leadership Support	Top-Down Data Commitment	Emphasizes the importance of leadership in driving data initiatives across diverse African contexts
"In the African context, data governance isn't just about compliance. It's about building trust with our customers and navigating the complex ethical landscape of data use in financially vulnerable populations across the continent." - Compliance Exec, Bank A	Data Governance Policies	Trust-Centric Data Governance	Addresses unique ethical and regulatory challenges in African markets

developing hybrid service models that can operate effectively across markets with vastly different levels of digital infrastructure and customer readiness (Lappeman et al., 2021; Fattah, 2024).

Current theoretical frameworks inadequately capture the dynamic processes through which organizations develop data capabilities in such environments. The dynamic capabilities literature, while providing valuable insights into organizational adaptation in rapidly changing environments (Teece, 2018), has not fully accounted for the specific practices through which capabilities emerge in data-intensive, resource-constrained settings. Rather than viewing these resource constraints primarily as “institutional voids” (Khanna & Palepu, 2010), recent scholarship suggests examining them as “generative constraints” that

Table 2
Data Integration and Synthesis Capability.

Representative Quote	DDDC Dimension	Emergent Concept	African Context
"We've implemented a unified data lake that integrates customer data from all touchpoints across our African operations. This holistic view has transformed our ability to understand customer journeys in diverse markets." – Senior Exec, Bank A	Data Integration	Pan-African Customer View	Addresses challenge of fragmented customer data across diverse African markets
"Our data synthesis algorithms now combine traditional banking data with alternative data sources like mobile money transactions. This gives us a much richer picture of customer behavior and creditworthiness, especially in underbanked areas." - Data Scientist, Bank B	Data Synthesis	Alternative Data Integration	Leverages unique data sources in African context, addressing lack of traditional credit data
"We've embedded data scientists directly into our marketing teams that oversee multiple African markets. It's no longer about marketing making requests to IT or analytics - we're all working together to turn data into actionable insights across diverse contexts." - Marketing Exec, Bank B	Cross-functional Collaboration	Integrated Insights Generation	Facilitates rapid, context-aware decision making across diverse African markets
"Our biggest challenge wasn't the technology, it was getting our teams across different African markets to work together. We've had to create cross-functional 'data squads' that bring together IT, marketing, and analytics people to solve specific business problems across our operations." – Data Exec, Bank A	Organizational Structure	Pan-African Data Collaboration	Addresses challenge of developing solutions that work across diverse African markets

can stimulate distinctive organizational responses (Nason & Bothello, 2023; George et al., 2016). For example, the limited availability of specialized analytics talent in African markets has prompted banks to develop innovative knowledge-sharing practices and cross-functional integration mechanisms that actually enhance contextual understanding of data (Anning-Dorson, 2018; Bag et al., 2021).

The African retail banking sector provides a particularly rich context for exploring these issues. This sector spans diverse markets with varying levels of digital infrastructure and regulatory frameworks, yet shares common challenges in leveraging big data for competitive advantage. Recent empirical studies have documented specific challenges faced by African banks, including managing data quality in markets with

fragmented information infrastructure (Fosso Wamba et al., 2024), developing analytics capabilities despite shortages of specialized talent (Fast et al., 2023), and ensuring responsible data use in communities with varying levels of digital literacy (Fattah, 2024). At the same time, African banks are creating innovative data practices, such as alternative data analytics for credit scoring and hybrid digital-physical customer engagement models, making them what Burgess and Steenkamp (2006) term "natural laboratories" for theory development.

This complex landscape presents several theoretical tensions that current literature has not adequately addressed. First, while studies have examined big data analytics capabilities in resource-rich contexts (Wamba et al., 2017; Morimura & Sakagawa, 2023), their findings may not capture the distinctive practices through which capabilities are developed in resource-constrained settings. Second, although research has explored digital transformation in emerging markets (Kumar et al., 2023; Wang et al., 2024), it has not fully theorized the specific organizational practices through which data-driven capabilities are developed and deployed within resource constraints. Third, while the importance of context in capability development is acknowledged (Mishra & Anning-Dorson, 2022), we lack process models that explain how environmental factors shape both the development and deployment of data-driven capabilities.

Given these gaps and the lack of comprehensive process models to understand them, we adopt a grounded theory approach (Charmaz, 2014) to explore the practices through which African retail banks develop and deploy data-driven capabilities. This approach allows us to develop theory inductively, grounded in the rich, contextual data of the African banking landscape, while paying particular attention to the processes and practices through which capabilities emerge and are deployed.

Our study addresses three interconnected research questions:

1. Through what specific practices do African retail banks develop data-driven capabilities despite resource constraints in their operating environment?
2. How do banks deploy these capabilities through distinct organizational practices to address the contextual challenges of African retail banking?
3. How do these capability development and deployment practices collectively contribute to competitive advantage in this context?

Through in-depth case studies of two major African banks operating across multiple countries, our study develops a process model of Data-Driven Dynamic Capabilities (DDDC) in data-rich, resource-constrained environments. Our analysis reveals how specific development practices—such as cross-functional integration, adaptive infrastructure development, and contextual data governance—enable the emergence of data-driven capabilities that are then deployed through distinct organizational practices to achieve competitive advantage, all within the unique context of African retail banking.

Our study makes several important contributions to information systems and strategic management research. First, it extends dynamic capabilities theory by providing a process model of how organizations develop and deploy data-driven capabilities through specific practices in resource-constrained environments. Second, it contributes to the literature on big data analytics by revealing how capabilities emerge through the interplay of organizational practices and contextual factors in emerging markets. Third, it provides practical insights for organizations seeking to develop data-driven capabilities in environments characterized by both data abundance and significant resource constraints.

The remainder of this paper is organized as follows: We first provide a focused review of relevant literature to contextualize our study. We then detail our research methodology and present our findings. Finally, we discuss the theoretical and practical implications of our work and outline directions for future research in this rapidly evolving field.

Table 3
Real-time Insight Generation Capability.

Representative Quote	DDDC Dimension	Emergent Concept	African Context
"We've developed AI models that can predict customer churn with 85 % accuracy across our diverse African markets, allowing us to intervene proactively with at-risk customers." – Senior Exec, Bank A	AI/ML Implementation	Predictive Customer Retention	Addresses challenge of customer retention in diverse and often volatile African markets
"We can now adjust our customer segments in real-time based on behavior across our African operations. For example, if we see a customer suddenly increasing their savings rate, we can immediately start targeting them with investment product offers tailored to their specific market." – Marketing Exec, Bank B	Real-time Customer Segmentation	Dynamic Pan-African Segmentation	Enables responsive marketing strategies that account for diverse economic conditions across African markets
"Our predictive models now factor in macroeconomic indicators and social media sentiment from across our African markets to forecast demand for different financial products." - Data Analyst, Bank A	Predictive Analytics	Contextual Demand Forecasting	Incorporates diverse economic and social factors affecting demand across African markets
"We've had to get creative in building our AI/ML teams to serve our pan-African operations. We're partnering with universities across the continent, running hackathons, and sponsoring coding bootcamps to develop the talent pool we need." – Emerging Tech Exec, Bank B	Talent Development	Pan-African AI Talent Pipeline	Addresses the challenge of developing local AI/ML expertise across diverse African markets

Table 4
Agile Marketing Execution Capability.

Representative Quote	DDDC Dimension	Emergent Concept	African Context
"We're running hundreds of A/B tests every month across our digital channels in various African markets. We can now go from idea to live test in days rather than weeks or months. It's dramatically accelerated our learning and improvement cycle across diverse contexts." - Digital Marketing Exec Bank B	Rapid Experimentation	Pan-African Agile Testing	Enables rapid learning and adaptation across diverse African markets
"Our AI-driven personalization engine can now tailor product recommendations, interest rates, and even UI elements based on individual customer profiles and real-time behavior, accounting for diverse market conditions across our African operations." - Personalization Lead, Bank A	Personalized Marketing	Contextual Personalization	Addresses the need for market-specific personalization across diverse African contexts
"We've developed a single customer view across all channels - branch, mobile, web, call center - for all our African operations. This allows us to provide a consistent experience and pick up conversations where they left off, regardless of channel or market." - Omnichannel Exec, Bank B	Omnichannel Integration	Pan-African Customer Consistency	Enables seamless customer experiences across diverse channels and markets in Africa
"We've restructured our entire marketing department around agile principles to serve our pan-African operations. We now work in two-week sprints, with daily stand-ups and regular retrospectives. It's allowed us to be much more responsive to market changes and customer needs across	Agile Organization	Responsive Pan-African Marketing	Facilitates rapid adaptation to diverse and changing market conditions across Africa

Table 4 (continued)

Representative Quote	DDDC Dimension	Emergent Concept	African Context
diverse African contexts." – Marketing Exec, Bank A			

Table 5
Contextual Factors Shaping DDDC.

Representative Quote	Contextual Factor	Emergent Concept	African Context
"The lack of comprehensive credit bureaus across many of our markets has forced us to be innovative. We're now using alternative data sources like mobile money transactions and psychometric tests to assess creditworthiness for the unbanked population across our African operations." - Retail Banking Exec, Bank A	Institutional Voids	Innovative Credit Assessment	Addresses the challenge of limited formal credit information in many African markets
"Data protection regulations vary significantly across our African markets. We've had to develop sophisticated consent management systems that are flexible enough to comply with diverse regulatory requirements while still enabling us to leverage customer data effectively." – Compliance Exec, Bank B	Regulatory Environment	Adaptive Compliance Framework	Responds to the diverse and evolving regulatory landscape across African markets
"We can't just focus on digital channels. We've had to develop hybrid approaches that combine digital marketing with more traditional, high-touch methods to reach and serve all our customer segments effectively across our diverse African markets." – Inclusivity Exec, Bank A	Digital Divide	Hybrid Engagement Strategies	Addresses varying levels of digital adoption and access across African markets
"Our models are getting more sophisticated, but we still need people who understand the nuances of each market we operate in. A spike in transactions might mean something different in one country versus another." - Data Scientist, Bank A	Cultural Context	Contextual Insight Interpretation	Emphasizes the importance of local knowledge in interpreting data across diverse African markets

Table 6
Ethical Considerations in DDDC.

Representative Quote	Ethical Aspect	Emergent Concept	African Context
"We're constantly grappling with ethical questions that vary across our African markets. How do we balance personalization with privacy? How do we ensure our AI models aren't perpetuating societal biases? These aren't just compliance issues - they're fundamental to maintaining customer trust across diverse cultural contexts." – Senior Exec, Bank A	Data Privacy and Algorithmic Bias	Ethical AI Deployment	Addresses the challenge of maintaining ethical standards across diverse cultural and regulatory environments in Africa
"We've implemented a 'privacy by design' approach in all our data initiatives across our African operations. Every new data use case is evaluated not just for business value, but also for its impact on customer privacy in each market we operate in." - Data Governance Lead, Bank B	Privacy by Design	Proactive Privacy Protection	Responds to varying levels of data protection awareness and regulations across African markets
"We're not just complying with regulations, we're trying to set new standards for ethical data use in banking across Africa. We've established an external ethics advisory board with members from various African countries to guide our data practices." – Senior Exec, Bank B	Ethical Leadership	Pan-African Ethical Standards	Demonstrates proactive approach to establishing ethical norms in data use across diverse African contexts
"We're working on making our AI models more explainable, considering the diverse customer base we serve across Africa. When a loan application is rejected, we want to be able to provide clear, understandable reasons why, in a way that makes sense in each local context." - AI Executive, Bank A	AI Transparency	Contextual AI Explainability	Addresses the need for clear communication about AI decisions across diverse cultural and educational contexts in Africa

2. Literature review

Our investigation of DDDC in African retail banking builds upon and extends three primary streams of literature: dynamic capabilities theory, digital transformation in banking, and emerging market strategy. While these streams have developed largely independently, their integration provides crucial theoretical foundations for understanding how organizations develop and deploy data-driven capabilities in resource-constrained environments.

2.1. Dynamic capabilities and digital transformation

The dynamic capabilities framework, originally developed by Teece et al. (1997) and further refined by Teece (2007), (2018), explains how organizations sense and seize opportunities while reconfiguring their resources to maintain competitiveness. Recent theoretical developments have emphasized the process nature of dynamic capabilities—viewing them not as static resources but as enacted through specific organizational practices (Feldman & Pentland, 2003; Langley et al., 2013; Langley & Tsoukas, 2016). This process perspective focuses on how capabilities emerge through recurring patterns of action and how they are continuously reconfigured through specific managerial practices.

In the context of digital transformation, Warner and Wäger (2019) identify specific practices that underpin dynamic capabilities, including digital scouting, rapid prototyping, and balancing digital portfolios. These practices extend Teece's framework by showing how organizations sense digital opportunities, seize them through capability development, and transform their resource base accordingly. Similarly, Ellström et al. (2022) demonstrate that successful digital transformation requires specific practices within the sensing-seizing-reconfiguring framework, including cross-industrial digital sensing and inside-out digital infrastructure assessment.

This process of developing dynamic capabilities for digital transformation involves what Mayer and Rich (2015) term “capability gap identification and bridging”—systematic assessment of disparities between current and required capabilities followed by concrete practices to address these gaps. This perspective is particularly valuable for understanding how African banks identify and bridge significant gaps in their data analytics capabilities while operating under resource constraints. Rather than viewing these constraints as insurmountable barriers, recent research suggests they can become “generative constraints” (Nason & Bothello, 2023) that stimulate distinctive organizational responses and novel capability development practices.

2.2. The role of learning and alignment in capability development

A critical aspect of developing data-driven capabilities is the role of organizational learning practices. Zollo and Winter (2002) identify three key learning mechanisms—experience accumulation, knowledge articulation, and knowledge codification—that contribute to the evolution of dynamic capabilities. These mechanisms are particularly relevant for understanding how African banks develop data capabilities despite constraints in specialized analytics talent. Recent research has shown how these learning processes are shaped by organizational culture, leadership support, and deliberate knowledge-sharing practices (Wang et al., 2024; Fattah, 2024). The alignment between capability development practices and organizational strategy emerges as another crucial consideration. Yeow et al. (2018) demonstrate that successful digital transformation requires continuous alignment practices between emergent strategies and existing resources. This perspective is enhanced by Regné's (2008) emphasis on the micro-level activities that constitute dynamic capabilities, highlighting how strategy emerges through day-to-day actions rather than through formal planning alone. In the African context, this alignment process is complicated by resource constraints, requiring organizations to develop unique approaches to capability development.

2.3. Big data analytics practices in banking

The banking sector has been at the forefront of big data adoption, leveraging vast amounts of customer and transaction data to drive decision-making and enhance services. Recent empirical studies highlight specific practices banks employ to develop sophisticated analytics capabilities for customer segmentation, risk assessment, and marketing optimization (Mikalef et al., 2020; Morimura & Sakagawa, 2023). However, as Vial (2019) notes, the effective utilization of big data remains challenging, particularly in terms of data integration, real-time analytics, and translating insights into action—challenges that are amplified in resource-constrained environments. Building on Eisenhardt and Martin's (2007) observation that dynamic capabilities exhibit common features while generating unique resource configurations, we observe that African banks are developing distinctive practices for data analytics. For instance, banks are creating hybrid capabilities that combine sophisticated analytics with traditional banking practices, as documented in recent studies (Bag et al., 2021; Fast et al., 2023). These practices are not merely adaptations to resource constraints but represent innovative approaches to capability development that leverage local knowledge and alternative data sources.

2.4. Resource Constraints as Generative Contexts

The resource-constrained environments of African retail banking present both challenges and opportunities for developing data-driven capabilities. Rather than viewing these environments through the lens of "institutional voids" (Khanna & Palepu, 2010)—focusing on what is missing—recent scholarship suggests examining the alternative institutional arrangements and distinctive resources that shape capability development (Nason & Bothello, 2023). This perspective acknowledges the limitations in specialized analytics talent, technological infrastructure, and regulatory frameworks while also recognizing unique resources such as innovative payment ecosystems, alternative data sources, and contextual knowledge. These resource-constrained yet data-rich environments require organizations to develop what Burgess and Steenkamp (2006) term "contextually appropriate capabilities"—capabilities that are adapted to specific institutional conditions through distinctive organizational practices. Schilke et al.'s (2017) comprehensive review of dynamic capabilities research emphasizes the importance of such contextual adaptation, highlighting how capabilities emerge through the interplay of organizational practices and environmental factors.

A particularly significant constraint in African banking is the limited availability of specialized data analytics talent (Lappeman et al., 2021; Fast et al., 2023). This constraint shapes how banks approach capability development, often leading to innovative organizational practices such as cross-functional integration, knowledge sharing, and collaborative learning (Anning-Dorson, 2018; Fattah, 2024). Rather than viewing these talent constraints as purely limiting factors, recent research suggests they can stimulate distinctive approaches to capability development that leverage contextual knowledge and alternative learning mechanisms (George et al., 2016; Nason & Bothello, 2023). The African banking sector exemplifies these dynamics, demonstrating how organizations can develop contextually appropriate data capabilities through innovative practices. Recent studies document how African banks are pioneering distinctive approaches to credit scoring, customer analytics, and omni-channel engagement (Mbama & Ezepe, 2018; Kumar et al., 2023). These innovations demonstrate how organizations in resource-constrained environments can develop distinctive capabilities that address local needs while leveraging global technological advances.

2.5. Process models of capability development

Recent theoretical developments have emphasized the importance of understanding dynamic capabilities from a process perspective (Langley

et al., 2013; Langley & Tsoukas, 2016). This approach focuses not just on what capabilities are, but on how they develop and are deployed through specific organizational practices over time. Process models attend to the dynamic interplay between organizational practices, emergent capabilities, and contextual factors, capturing the "becoming" rather than just the "being" of organizational capabilities (Langley & Tsoukas, 2016). In the context of data-driven capabilities, this process perspective is particularly valuable. Mikalef et al. (2020) demonstrate that big data analytics capabilities are developed through specific organizational practices involving cross-functional collaboration, experimental learning, and knowledge integration. Similarly, Warner and Wäger (2019) show how digital capabilities emerge through iterative processes of sensing, seizing, and reconfiguring that are enacted through concrete organizational practices. This process perspective is especially relevant for understanding capability development in resource-constrained environments, where organizations must develop innovative practices to overcome limitations in specialized skills, technological infrastructure, or financial resources (George et al., 2016). By focusing on the specific practices through which African banks develop and deploy data-driven capabilities, we gain insight into how these organizations navigate resource constraints while leveraging their unique contextual knowledge.

Research Gap and Theoretical Opportunity: The above literature reveals several important gaps in understanding data-driven capability development in resource-constrained environments. First, while dynamic capabilities theory provides valuable frameworks for understanding organizational adaptation (Teece, 2018), it has not fully accounted for the specific practices through which capabilities emerge and are deployed in data-intensive, resource-constrained environments. Second, although research has examined big data analytics capabilities in resource-rich contexts (Wamba et al., 2017), these findings may not capture the distinctive development and deployment practices in emerging market settings. Third, while studies have explored digital transformation in emerging markets (Elias, 2022; Wang et al., 2024), they have not provided process models that explain how organizations develop and deploy data-driven capabilities within resource constraints. These gaps present an opportunity to extend theory by examining the processes through which organizations in resource-constrained environments develop and deploy data-driven capabilities. The African retail banking sector, with its unique combination of data richness and resource constraints, provides an ideal context for such theoretical development. By examining the specific practices through which banks in this setting develop and deploy DDDC, we can enhance our understanding of capability development processes in data-rich, resource-constrained environments while contributing to broader discussions about organizational adaptation in the digital age.

3. Research design

Our investigation into Data-Driven Dynamic Capabilities (DDDC) in African retail banking adopts an interpretive research stance, acknowledging that capabilities emerge through complex social processes and are imbued with meanings constructed by organizational actors (Charmaz, 2014; Grodal et al., 2021). This approach aligns with recent calls in strategic management research for more contextualized understanding of capability development in emerging markets (Sheth, 2011; Mishra & Anning-Dorson, 2022).

3.1. Empirical context

The African retail banking sector provides a particularly rich empirical setting for exploring DDDC development in data-rich, resource-constrained environments. This context features both abundant data sources (including mobile money transactions, alternative credit information, and diverse customer interactions) alongside specific resource constraints in specialized analytics talent, varying levels of

digital infrastructure, and complex regulatory frameworks. The sector spans diverse markets with varying levels of digital infrastructure and regulatory frameworks, yet shares common challenges in leveraging big data for competitive advantage (Lappeman et al., 2021; Fosso Wamba et al., 2024). This variety within unity provides an ideal laboratory for theory building about capability development in data-rich, resource-constrained environments. The selection of African retail banking was purposive, responding to calls for more research on digital transformation in emerging markets (Kumar et al., 2023; Wang et al., 2024). The sector's unique combination of advanced financial infrastructure and significant socio-economic disparities (Fattah, 2024) creates a distinctive context for examining how organizations develop and deploy data-driven capabilities under complex institutional conditions.

3.2. Research Stance

Our study adopts an interpretive stance, acknowledging that organizational capabilities are socially constructed phenomena that emerge through the shared understanding and actions of organizational members (Grodal et al., 2021). This philosophical position aligns with our research questions, which seek to understand how banks develop and deploy DDDC within their specific cultural and institutional contexts. The interpretive approach enables us to explore the nuanced ways in which organizational actors make sense of and implement data-driven initiatives, recognizing that capability development is not merely a technical process but one deeply embedded in social and organizational contexts (Symon et al., 2018). This stance informed our choice of grounded theory methodology, specifically following Charmaz's (2014) constructivist approach, which acknowledges the researcher's role in co-creating understanding while maintaining systematic analytical procedures. This approach aligns with recent methodological developments in information systems research that emphasize the importance of context-sensitive theory building (Vial, 2019; Fast et al., 2023). This interpretive stance enables us to explore not just what capabilities banks possess, but the specific practices through which these capabilities emerge and are deployed within their unique contexts (Langley et al., 2013).

3.3. Study design

We employed a multiple-case study design focusing on two major African retail banks, each operating in at least ten African countries. This design choice enables rich, contextual understanding while allowing for theoretical comparison across cases (Eisenhardt & Graebner, 2007; Yin, 2018). The selection of cases followed theoretical sampling principles (Glaser & Strauss, 1999), choosing banks that represent exemplars of advanced digital capabilities and significant big data initiatives in marketing across multiple African markets. Our case selection criteria were informed by recent research on digital transformation in banking (Morimura & Sakagawa, 2023) and emerging market strategies (Elias, 2022). The selected banks needed to demonstrate:

1. Significant investments in big data analytics capabilities
2. Operations across multiple African markets
3. Active digital transformation initiatives
4. Willingness to provide access to senior executives and relevant documentation

The two banks were selected not only for meeting these criteria but also for their distinctive geographic footprints and strategic approaches, providing valuable comparative insights. Bank A has a stronger presence in West African markets with greater infrastructure variability and less formalized banking systems, while Bank B has more established operations in East and Southern African markets including South Africa with its more developed regulatory environment. These differences allowed us to examine how contextual factors shape capability development

across diverse African banking environments while maintaining sufficient similarity for meaningful comparison. Both banks were recognized industry leaders in digital transformation initiatives within their respective regions, having received industry awards for their data and analytics projects over the past three years.

3.4. Data collection process

Our data collection spanned three months and involved 20 in-depth, semi-structured interviews with senior executives and big data experts at the banks' retail headquarters in Africa. Following Doz's (2011) recommendations for international business research, we selected participants based on their direct involvement in cross-border big data and digital marketing initiatives. Interviews lasted 60–90 minutes each and were conducted via video conferencing, recorded with permission, and transcribed verbatim. The interview protocol was designed following Charmaz's (2014) guidelines for intensive interviewing in grounded theory studies, allowing for rich narrative development while maintaining theoretical sensitivity. Document analysis complemented these interviews, examining annual reports, press releases, and regulatory filings from various African markets where the banks operate. Additionally, we conducted structured observations of each bank's digital banking platforms and marketing communications across multiple African countries, following Bowen's (2009) approach to document analysis in qualitative research.

4. Data analysis process

Our analytical approach followed the systematic procedures of grounded theory while maintaining interpretive sensitivity to meaning and context. Following Grodal et al.'s (2021) recommendations for achieving rigor in qualitative analysis through active categorization, our analysis proceeded through three main phases, each supported by NVivo 12 software. The first phase involved open coding, where we inductively generated initial codes from the data. This process focused on understanding participants' meanings and experiences rather than fitting data into predetermined categories. Following Charmaz's (2014) guidelines, we paid particular attention to in-vivo codes that captured participants' own language and meaning-making. We coded data from each bank separately during this phase to maintain sensitivity to the distinctive contexts and approaches of each organization.

The second phase employed focused coding, where we synthesized the most significant codes into higher-level concepts. This process involved constant comparison between emerging categories and raw data, ensuring our theoretical constructs remained grounded in participants' experiences. We maintained detailed coding memos documenting our decision-making process, following Grodal et al.'s (2021) recommendations for transparency in qualitative analysis. During this phase, we began systematic comparison between the two banks, identifying both similarities in capability development processes and differences in specific practices shaped by their distinct operating contexts. The final phase involved theoretical coding, where we identified relationships between categories and integrated them into a coherent theoretical framework. This process was guided by recent developments in dynamic capabilities theory (Teece, 2018; Kumar et al., 2023) while remaining open to novel theoretical insights emerging from our data. We developed a process model that captured both the common patterns of capability development across the banks and the distinctive ways in which contextual factors shaped specific practices in each organization.

Throughout the analytical process, we employed several techniques to ensure theoretical sensitivity to differences between the cases:

1. Cross-case analysis matrices that systematically compared emerging concepts between Bank A and Bank B
2. Temporal bracketing to identify sequential patterns in capability development within each bank

3. Visual mapping of relationships between contextual factors and specific capability development practices in each organization
4. Systematic identification of confirming and disconfirming evidence for emerging theoretical insights across both banks

To ensure research quality, we employed several strategies aligned with interpretive research principles (Symon et al., 2018). *Authenticity*: We maintained rich descriptions of participants' experiences and organizational contexts, documenting both successful and challenging aspects of DDDC development across both banks. *Plausibility*: We systematically documented our analytical process through detailed memos and coding hierarchies, allowing for transparent evaluation of our theory-building process. *Criticality*: We engaged in reflexive examination of our assumptions and interpretations, regularly challenging our emerging theoretical insights through peer debriefing and member checks with key informants from both banks.

Our analytical process moved systematically from raw data to theoretical insights through several distinct yet interconnected stages. In the initial phase, we conducted line-by-line coding of interview transcripts, identifying key concepts related to how African banks develop and deploy data-driven capabilities. This process yielded 109 initial codes, ranging from specific practices like "alternative data integration" to broader organizational aspects such as "cross-functional collaboration." Following Grodal et al.'s (2021) recommendations for active categorization, we then engaged in focused coding, consolidating these initial codes into 26 conceptual categories. For example, various codes related to data collection and integration were synthesized into the broader category of "Data Integration and Synthesis Capability." Throughout this process, we maintained theoretical memos documenting our analytical decisions and emerging insights.

The transition from focused codes to theoretical concepts involved intensive comparative analysis across both cases and data sources. We systematically compared emerging patterns against raw data, seeking both confirming and disconfirming evidence. This process revealed three distinct yet interconnected capabilities that form the core of our DDDC framework. For instance, the identification of "Real-time Insight Generation" as a distinct capability emerged from observing consistent patterns across both banks in how they transformed raw data into actionable insights, despite operating in different market contexts. Similarly, the recognition of specific antecedents emerged from analyzing how different organizational elements consistently enabled or constrained capability development across cases.

Our analytical process was particularly attentive to the African context's influence on capability development. Rather than treating context as a background factor, we explicitly analyzed how specific features of the African banking environment shaped capability development differently in each bank. For example, our identification of "technical infrastructure" as a critical antecedent emerged from analyzing how banks adapted their data capabilities to operate across varying levels of digital infrastructure, with Bank A emphasizing offline functionality for West African markets and Bank B focusing on scalability across its more diverse East and Southern African operations.

Through constant comparison between emerging theoretical insights and raw data from both banks, we refined our understanding of how contextual factors both enable and constrain DDDC development in African retail banking. This systematic comparative process ensured that our resulting process model captures both the common patterns across the banks and the distinctive ways in which each organization's practices are shaped by its specific operating context.

5. Findings

Our analysis reveals the processes through which African retail banks develop and deploy Data-Driven Dynamic Capabilities (DDDC) in data-rich, resource-constrained environments. Rather than viewing these capabilities as static resources, our findings illuminate the specific

practices through which banks develop capabilities despite resource constraints, deploy them to address contextual challenges, and ultimately generate competitive advantage. We organize our findings to show: (1) the practices through which banks develop data-driven capabilities; (2) the capabilities that emerge through these practices; (3) the deployment practices through which banks leverage these capabilities; and (4) how these development and deployment practices collectively generate competitive advantage.

5.1. Practices of capability development in resource-constrained environments

The banks in our study engage in five interconnected sets of practices that enable capability development despite significant resource constraints, particularly in specialized analytics talent and technological infrastructure. These practices demonstrate how banks transform potential constraints into sources of innovative capability development.

5.1.1. Data-driven culture cultivation practices

While both banks actively cultivate data-driven cultures, they employ different approaches reflecting their organizational histories and market positioning. Bank A, with its stronger presence in West African markets, focuses on embedding analytics in performance metrics and creating regular data learning forums. As one senior executive from Bank A explained: *"We've had to shift from seeing data as just a byproduct of operations to viewing it as a core strategic asset that drives every decision we make across our ten operating countries."* In contrast, Bank B, with its more established presence in East and Southern African markets, emphasizes the role of designated champions. A senior marketing executive from Bank B elaborated: *"We've introduced 'data champions' in every department and country of operation. These individuals help translate data insights into actionable strategies for their teams, ensuring that data-driven decision-making becomes part of our organizational DNA despite varying levels of digital sophistication across our markets."*

These different approaches address a critical challenge in the African banking context—bridging varying levels of data literacy among staff. Rather than relying solely on scarce specialized talent, both banks have developed practices that democratize data understanding, though with distinctive emphases. Bank A's approach centers on structured learning: *"We run weekly 'data clinics' where business units bring real problems and learn how to apply data thinking. This creates a collaborative learning environment that multiplies our analytics capacity despite limited specialist resources,"* explained a data scientist from Bank A. Bank B, meanwhile, has focused more on embedding expertise within business units to facilitate knowledge transfer across their operations.

5.1.2. Technical infrastructure adaptation practices

The development of technical infrastructure in resource-constrained environments has led to distinctive adaptation practices in each bank. Bank A, operating in markets with more pronounced infrastructure variability, has prioritized resilience and offline capabilities. A technology executive from Bank A described their approach: *"Our infrastructure needs to be as robust in rural areas as it is in major cities. We've developed a 'hybrid cloud' approach that allows us to maintain data integrity even in areas with unreliable connectivity, which is crucial given our significant presence in rural West African markets."* Bank B, with its stronger presence in markets with relatively more developed infrastructure, has focused on modularity and scalability. An IT manager from Bank B explained their distinctive approach: *"We've created what we call 'gracefully degrading systems'—analytics capabilities that automatically adjust their functionality based on available connectivity without losing core functionality. This approach emerged directly from our need to operate across markets with vastly different infrastructure levels, from South Africa's relatively advanced networks to more challenging environments in our other operating countries."*

5.1.3. Cross-functional integration practices

Both banks have developed integration practices to overcome traditional organizational silos and address the scarcity of specialized analytics talent, though with notable differences in implementation. Bank B has established formal structures: *"We've created 'data squads'—cross-functional teams that bring together IT, analytics, and business units. This integration allows us to rapidly prototype and deploy data-driven solutions that actually address real business needs across our diverse market footprint,"* described a data scientist from Bank B. Bank A, in contrast, has adopted a more fluid approach to integration, focusing on embedding analytics professionals within business teams. A marketing executive from Bank A explained: *"We can't hire enough data scientists to cover all our needs across ten countries, so we've created ways to multiply the impact of the specialists we have by embedding them within business teams and creating knowledge transfer mechanisms. This approach has been particularly effective in our West African operations where specialized talent is especially scarce."*

5.1.4. Leadership engagement practices

The banks display distinctive leadership engagement approaches that reflect their different organizational cultures. Bank A's approach is characterized by direct executive involvement in data initiatives. As an executive emphasized: *"Our CEO doesn't just talk about being data-driven; she actively participates in our data strategy sessions and champions our initiatives at the board level. This top-down commitment has been crucial in overcoming resistance to change and securing resources for our data initiatives across all our operating markets."* Bank B has developed a more structured approach to leadership engagement through formalized programs. A board member from Bank B explained: *"Our executive team has adopted a practice we call 'data shadowing,' where each leader spends time with analytics teams to understand their work firsthand. This creates genuine appreciation for data capabilities that translates into resource support despite budget constraints. This program has been particularly impactful in our Southern African operations where we've made our largest data infrastructure investments."*

5.1.5. Data governance development practices

In response to complex regulatory environments and varying customer digital literacy levels, the banks have developed distinctive governance practices. Bank B, operating in countries with more established data protection regulations, has focused on regulatory compliance as a strategic advantage. A compliance executive from Bank B explained: *"In the African context, data governance isn't just about compliance. It's about building trust with our customers and navigating the complex ethical landscape of data use in financially vulnerable populations. Our strong presence in South Africa has shaped our approach to data governance across all our markets."* Bank A has developed a more adaptable framework suited to the diverse regulatory environments across its operations. As a governance officer from Bank A noted: *"We've developed what we call 'contextual governance'—frameworks that adapt to specific market conditions while maintaining core principles. This approach emerged directly from operating across West African markets with significantly different regulatory environments and customer expectations."*

These five sets of practices interact synergistically to create an organizational environment conducive to capability development despite resource constraints. As a senior executive from Bank A observed: *"It's the interplay between different practices that really matters. Our success in developing data capabilities comes from having all these pieces work together in a coordinated way."* This integration enables the emergence of sophisticated data capabilities that might otherwise be unattainable in resource-constrained environments.

5.2. The emergent capabilities: characteristics and interactions

Through these development practices, three interconnected data-driven capabilities emerge: Data Integration and Synthesis, Real-time

Insight Generation, and Agile Marketing Execution. These capabilities represent not static resources but dynamic organizational abilities that continuously evolve through ongoing practices.

5.2.1. Data integration and synthesis capability

This capability enables banks to combine diverse data sources in ways that generate meaningful insights despite infrastructure limitations, with each bank developing distinctive approaches based on their market contexts. Bank A, with its stronger presence in markets with limited formal credit infrastructure, has focused on alternative data sources. A data architect from Bank A described: *"We're not just looking at traditional banking data. We're integrating alternative data sources like mobile money transactions, social media activity, and even psychometric assessments to get a holistic view of our customers in markets where traditional credit data might be limited. This approach has been particularly valuable in our West African operations."* Bank B, operating in more diverse market contexts including more developed financial systems, has emphasized integration across varying data ecosystems. As a data scientist from Bank B explained: *"Our integration capability didn't appear overnight. It developed through repeated cycles of identifying valuable data sources, creating technical bridges between systems, and refining our synthesis algorithms based on business feedback across our diverse operating markets. This has allowed us to create a unified view across markets at very different stages of financial formalization."*

5.2.2. Real-time insight generation capability

This capability enables banks to transform integrated data into actionable insights through automated analytics processes, with each bank emphasizing different aspects based on their market priorities. Bank B has focused on customer behavior prediction in competitive markets: *"We've developed AI models that can predict customer churn or identify cross-selling opportunities in real-time, but these models are designed to work even when data streams are interrupted or when we're dealing with partial information. This flexibility emerged from our learning about conditions across our East and Southern African operations,"* explained a marketing analytics lead from Bank B. Bank A has developed capabilities focused on context-aware analytics suited to markets with greater data quality challenges. An analytics manager from Bank A noted: *"We've built what we call 'robust algorithms' that can generate insights even with imperfect data—a direct response to the data quality challenges we face in our West African markets. This approach developed through iterative testing across different market conditions and has been crucial to our expansion in financially underserved regions."*

5.2.3. Agile marketing execution capability

The capability to rapidly deploy and iterate on data-driven marketing initiatives shows distinct emphases across the two banks. Bank A has developed capabilities that bridge the digital divide within its markets: *"We've adopted agile methodologies in our marketing teams, but with a twist. Our two-week sprints include contingencies for varying levels of digital readiness across different markets. We might be testing sophisticated digital campaigns in urban areas while simultaneously developing USSD-based services for rural customers, an approach that's been particularly effective in our West African operations,"* described a digital marketing manager from Bank A. Bank B has emphasized rapid experimentation and scale-up capabilities across its more diverse market portfolio. A campaign manager from Bank B explained: *"Our agility comes from systematic practices—running multiple small experiments simultaneously, quickly assessing results, and scaling what works while learning from what doesn't. This approach emerged directly from the need to operate in markets with vastly different customer preferences and digital readiness, from South Africa to our other East and Southern African operations."*

These three capabilities interact continuously through specific organizational practices in both banks, though with distinctive patterns reflecting their different market portfolios. As a senior executive from Bank A observed: *"These capabilities strengthen each other through daily*

interaction. Better data integration enables more sophisticated insights, which allow more effective marketing execution, which in turn generates new data for integration. It's a virtuous cycle that continuously enhances our capabilities across our West African footprint."

5.3. Practices of capability deployment in the african context

The banks deploy their data-driven capabilities through specific organizational practices that respond to the unique challenges and opportunities of the African banking context. These deployment practices translate capabilities into market actions that address contextual factors such as regulatory complexity, varying digital infrastructure, and the digital divide among customers.

5.3.1. Contextually adaptive customer engagement practices

Both banks deploy their capabilities through customer engagement practices that adapt to varying levels of digital readiness, though with emphases reflecting their different market portfolios. Bank B, with its presence in markets with greater digital adoption disparities, has developed multi-modal approaches: "We deploy our data capabilities through what we call 'multi-modal engagement'—using the same customer insights to drive both sophisticated mobile app experiences for digitally savvy customers and USSD-based interactions for those with basic phones. This isn't just about having different channels; it's about consistently applying analytics across vastly different technological interfaces within and across our operating countries," explained a customer experience lead from Bank B. Bank A has developed more market-specific engagement models suited to its West African footprint. A digital banking lead from Bank A elaborated: "We've developed practices for 'insight activation' that work across the digital divide—applying the same customer understanding through different engagement mechanisms depending on local context. This approach emerged directly from the need to serve customers at very different points on the digital journey, particularly in our rural West African operations."

5.3.2. Regulatory navigation practices

The banks deploy their data capabilities through specific practices designed to navigate complex and evolving regulatory environments, with distinctive approaches based on their different operating contexts. Bank B, with significant operations in South Africa's more regulated environment, has focused on turning compliance into competitive advantage: "Regulations like POPIA in South Africa have forced us to be innovative in how we handle customer data. We've turned compliance into an advantage by developing granular data management capabilities that actually enhance our ability to serve customers while maintaining their privacy. These capabilities have given us an edge in other markets where regulations are still evolving," noted a compliance executive from Bank B. Bank A has developed more flexible compliance frameworks suited to its operations across West African markets with more diverse regulatory approaches. A legal officer from Bank A explained: "We've developed what we call 'compliance by design'—embedding regulatory requirements directly into our data workflows rather than treating them as afterthoughts. This approach emerged from operating across multiple regulatory environments in West Africa and has actually enhanced our ability to use data effectively despite the complex regulatory landscape."

5.3.3. Rapid experimentation and scaling practices

Both banks deploy their capabilities through practices that enable rapid market experimentation followed by selective scaling of successful initiatives, though with distinctive approaches reflecting their organizational cultures. Bank A emphasizes context-specific experimentation: "We've developed a practice we call 'test and learn cycles'—running small, controlled experiments across different market contexts before committing significant resources. This allows us to rapidly identify what works in specific contexts while minimizing risk in our resource-constrained West African operations," described a digital innovation lead from Bank A. Bank B has developed more formalized scaling frameworks suited to its diverse

market portfolio. An innovation manager from Bank B explained: "Our deployment approach involves systematically testing concepts in microcosms of different market conditions, extracting contextual learning, and then scaling with appropriate adaptations. This practice emerged directly from the diversity of markets we operate in, from South Africa to our East African operations, and the need to be efficient with limited resources across this broad footprint."

5.3.4. Cross-channel orchestration practices

The banks deploy their capabilities through practices that orchestrate consistent customer experiences across varying channels and touchpoints, with emphasis reflecting their different channel strategies. Bank A, with its greater reliance on physical infrastructure in some markets, focuses on bridging physical and digital experiences: "We've developed what we call 'omni-channel orchestration'—practices that ensure customers receive consistent, personalized experiences whether they're using our mobile app, visiting a branch, or interacting with an agent. This orchestration is powered by our data capabilities but requires specific processes to execute effectively across our diverse channel landscape in West Africa," explained a channel manager from Bank A. Bank B has developed more digitally-centered orchestration suited to its operations in markets with higher digital adoption. A digital experience director from Bank B noted: "Our deployment practices are designed to bridge the physical and digital worlds that co-exist in our markets, with particular emphasis on digital channels in our more developed markets like South Africa while ensuring appropriate physical touchpoints in other regions. We've developed specific mechanisms to ensure that insights generated through our data capabilities translate appropriately across vastly different customer touchpoints across our East and Southern African operations."

Through these deployment practices, the banks transform their data-driven capabilities into market actions that address the specific challenges and opportunities of African retail banking. As a strategy executive from Bank B observed: "Having capabilities is only half the equation. Our competitive advantage comes from systematically deploying these capabilities through practices that respond directly to our unique market contexts across East and Southern Africa. These deployment practices have developed through years of learning what works in our specific environments"

5.4. From development to deployment: how practices generate competitive advantage

The banks' capability development and deployment practices collectively generate three distinct yet interconnected competitive advantages. Our analysis reveals the mechanisms through which these practices translate into tangible business outcomes in the African retail banking context.

5.4.1. Enhanced customer centricity through contextual understanding

The first competitive advantage emerges through practices that generate deeper understanding of customer needs across diverse market segments and translate this understanding into contextually relevant offerings. Bank A has leveraged this advantage particularly in markets with limited formal banking history: "Our data-driven approach has allowed us to move beyond simple segmentation to true individualization, even in markets where traditional customer data is limited. We can now anticipate customer needs before they even express them, which has been transformative in our West African markets where formal banking relationships are still developing," explained a customer insights manager from Bank A. Bank B has focused this advantage on creating consistent experiences across diverse markets: "Our competitive edge in customer centricity comes from connecting practices across our organization—from how we collect and analyze data to how we design and deliver experiences. This connected approach allows us to create what we call 'contextually relevant banking experiences' that genuinely resonate with diverse customer segments across our East and Southern African operations," noted a customer experience director from Bank B.

5.4.2. Improved marketing ROI through resource optimization

The second competitive advantage manifests through practices that optimize marketing resources in resource-constrained environments, with each bank emphasizing different aspects based on their marketing priorities. Bank B has focused on sophisticated targeting in competitive markets: *"Our AI-driven campaign optimization has increased our marketing ROI by 40 % in the past year alone. We're not just spending less; we're reaching the right customers with the right offers at the right time—a critical advantage in our Southern African markets where competition for banking customers is intense,"* explained a marketing executive from Bank B. Bank A has developed capabilities for efficient marketing in more cost-sensitive markets. A campaign director from Bank A elaborated: *"Our marketing efficiency isn't just about having good targeting algorithms; it comes from a connected set of practices that allow us to continuously learn and adapt across our West African operations. We've developed systematic approaches to testing, measurement, and optimization that allow us to extract maximum value from limited resources in markets where marketing budgets must stretch further."*

5.4.3. Accelerated time-to-market through adaptive innovation

The third competitive advantage appears in the banks' ability to rapidly develop and deploy new products and services that respond to evolving market needs. Bank A has leveraged this advantage to address rapidly evolving customer needs in its markets: *"Using our 'digital twin' capabilities, we can now test and refine new product concepts in virtual environments before launch, significantly reducing our time-to-market. What used to take months now takes weeks—a critical advantage in our rapidly evolving West African markets where customer needs and competitive offerings change quickly,"* explained an innovation lead from Bank A. Bank B has focused this advantage on efficient innovation across diverse market contexts. A product development director from Bank B noted: *"Our speed advantage comes from systematic practices that reduce uncertainty in innovation. We've developed specific approaches to using data throughout the product development process—from initial concept testing to staged rollout—that allow us to move quickly yet safely across our diverse East and Southern African operations with their varying regulatory environments and customer preferences."*

These competitive advantages reinforce each other, creating what one senior executive described as a *"virtuous cycle of data-driven value creation."* Enhanced customer centricity leads to more effective marketing, which in turn enables faster product development and deployment. As a strategy executive from Bank B observed: *"These advantages work together to create a distinctive competitive position across our diverse market portfolio. Our ability to understand customers deeply, market to them effectively, and rapidly develop products that meet their needs has fundamentally changed how we compete in East and Southern African markets."* The achievement of these competitive advantages demonstrates how African retail banks are not simply adopting global best practices in data analytics but are developing distinctive capability development and deployment practices that reflect and respond to their unique market conditions. Our analysis reveals that in data-rich, resource-constrained environments, competitive advantage emerges not just from possessing capabilities but from the specific practices through which organizations develop and deploy these capabilities in response to contextual challenges and opportunities.

6. Discussion: a process model of data-driven dynamic capabilities in resource-constrained environments

Our grounded theory analysis revealed patterns in how African banks develop and deploy data-driven capabilities that both confirm and extend existing theoretical perspectives on dynamic capabilities. Through systematic analysis of our empirical data, moving from specific practices through conceptual categories to theoretical constructs, we developed a comprehensive process model that explains how organizations in data-rich, resource-constrained environments develop and

deploy sophisticated data capabilities despite significant constraints.

6.1. The data-driven dynamic capabilities (DDDC) process model

The DDDC process model that emerged from our analysis is presented in Fig. 1. This model illustrates the interrelated processes through which banks develop capabilities through specific practices, the core capabilities that emerge, how these capabilities are deployed through distinct organizational practices, and the resulting competitive outcomes—all within the context of African retail banking. Following Langley et al. (2013) and Langley and Tsoukas (2016), this process model captures how capabilities emerge and evolve through specific organizational practices rather than existing as static resources.

Our process model consists of four interconnected components: capability development practices, core capabilities, capability deployment practices, and competitive outcomes. Unlike traditional capability frameworks that focus primarily on the capabilities themselves, our model emphasizes the practices through which capabilities are developed and deployed—responding to recent calls for more process-oriented perspectives on capability development (Feldman & Pentland, 2003; Langley et al., 2013).

At the left of the model, five sets of capability development practices—data-driven culture cultivation, technical infrastructure adaptation, cross-functional integration, leadership engagement, and data governance development—create the foundation from which data-driven capabilities emerge. These practices represent recurring patterns of organizational action that enable banks to overcome resource constraints, particularly in specialized analytics talent and technological infrastructure. As our findings revealed, these practices are not merely adaptations to constraints but innovative responses that transform potential limitations into sources of distinctive capability development.

At the center of our model are three interconnected capabilities that emerge through these development practices: Data Integration and Synthesis Capability, Real-time Insight Generation Capability, and Agile Marketing Execution Capability. These capabilities exist not as static resources but as dynamic organizational abilities that continuously evolve through ongoing practices. The model illustrates how these capabilities interact through bidirectional arrows, creating what one executive termed a "capability ecosystem" that strengthens through continuous interaction.

The right side of our model shows how these capabilities are deployed through specific organizational practices—contextually adaptive customer engagement, regulatory navigation, rapid experimentation and scaling, and cross-channel orchestration. These deployment practices translate capabilities into market actions that address the specific challenges and opportunities of African retail banking. Our process model emphasizes that competitive advantage emerges not directly from capabilities themselves but through the specific practices through which organizations deploy these capabilities in response to market contexts.

These deployment practices lead to three competitive outcomes: enhanced customer centricity through contextual understanding, improved marketing ROI through resource optimization, and accelerated time-to-market through adaptive innovation. The model illustrates how these outcomes emerge through the connected chain of development practices, capabilities, and deployment practices rather than from any single element alone.

Crucially, our process model explicitly acknowledges how contextual factors—regulatory complexity, digital infrastructure variability, digital divide among customers, and skills and talent constraints—shape both capability development and deployment practices. Rather than viewing these contextual factors as merely moderating the relationship between capabilities and outcomes (as in traditional capability frameworks), our process model shows how they permeate and influence multiple stages of capability development and deployment.

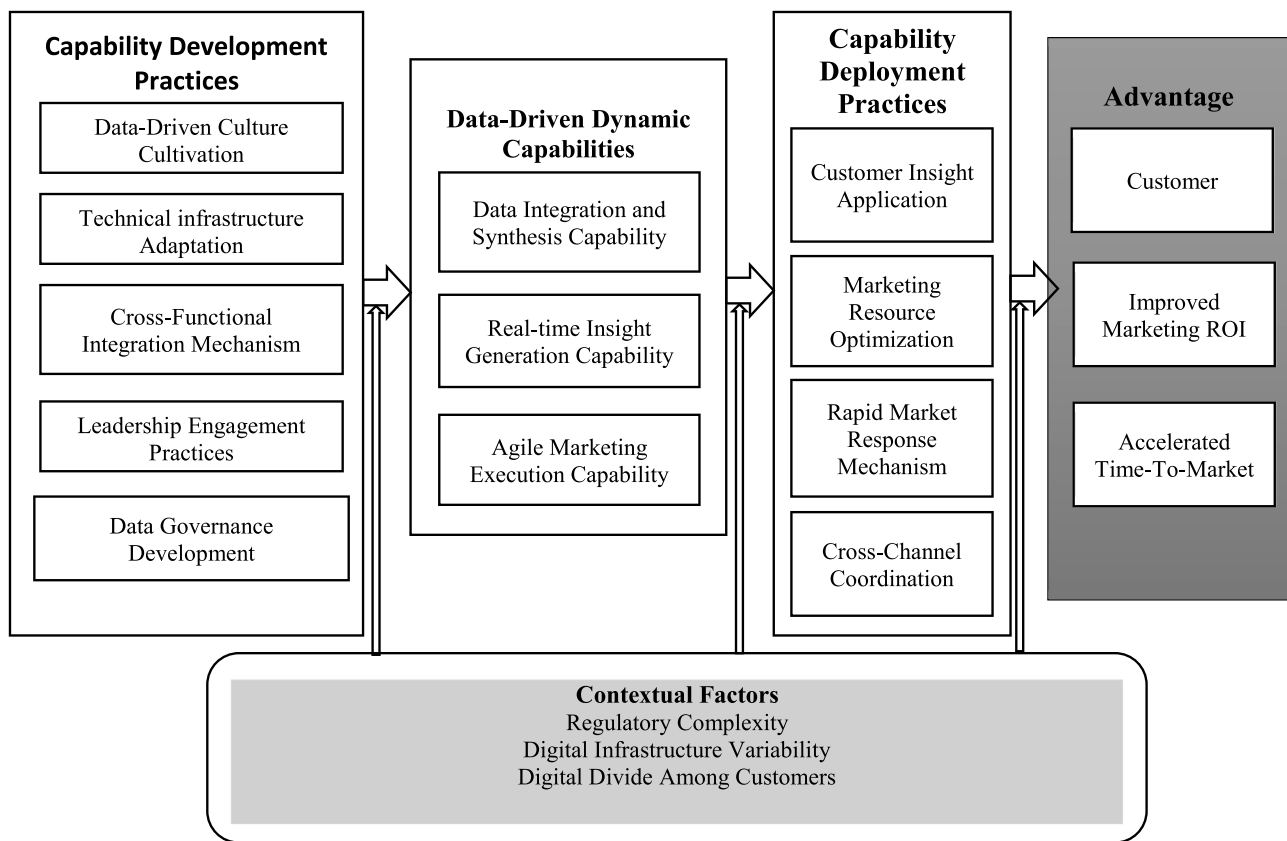


Fig. 1. Data-Driven Dynamic Capabilities (DDDC) as a Process Model in African Retail Banking.

7. Implications

7.1. Theoretical implications: advancing dynamic capabilities theory

Our DDDC process model extends dynamic capabilities theory in several important ways. First, it reconceptualizes capability development for data-intensive, resource-constrained environments, challenging traditional assumptions about the linearity and episodic nature of dynamic capabilities. While Teece's (2007), (2018) sensing-seizing-reconfiguring framework provides valuable insights into capability development, our findings suggest that in data-rich environments, these processes occur simultaneously and continuously rather than sequentially. The real-time nature of data analytics enables organizations to sense, seize, and reconfigure almost simultaneously, creating what we term "compressed capability cycles" that accelerate organizational adaptation.

Second, our process model highlights how specific organizational practices enable capability development despite significant resource constraints. This advances Warner and Wäger's (2019) work on digital capability development by showing how organizations in resource-constrained environments develop distinctive practices that leverage local knowledge and alternative resources rather than simply adapting global best practices. For example, the cross-functional integration practices we identified represent innovative responses to specialized talent constraints, creating what one executive called "capability multipliers" that extend the impact of limited analytics expertise across the organization.

Third, our process model reveals how contextual factors shape capability development and deployment processes rather than merely moderating their outcomes. This extends Schilke et al.'s (2017) emphasis on the contextual embeddedness of dynamic capabilities by showing the specific mechanisms through which context influences capability development. For example, our findings revealed how the

digital divide among customers shapes not just the deployment of capabilities but their very development, leading to what we term "contextually adaptive capabilities" that function effectively across varying levels of digital infrastructure and customer readiness.

Fourth, our process model contributes to the emerging literature on big data analytics capabilities (Mikalef et al., 2020; Wamba et al., 2017) by revealing the specific practices through which these capabilities emerge in resource-constrained environments. While previous research has identified components of data analytics capabilities, our process approach shows how these capabilities develop through recurring patterns of organizational action rather than through one-time investments or initiatives. This perspective addresses recent calls for more process-oriented approaches to understanding organizational capabilities (Langley et al., 2013; Feldman & Pentland, 2003).

Finally, our findings advance theoretical understanding of capability development in emerging markets by moving beyond the traditional "institutional voids" perspective (Khanna & Palepu, 2010) to examine how specific contextual elements can become sources of distinctive capability development. Following Nason and Bothello (2023), our process model shows how what might be viewed as constraints can become "generative conditions" that stimulate innovative organizational practices. For instance, the limited availability of comprehensive credit bureaus in many African markets has led banks to develop sophisticated alternative data integration practices that provide potentially richer customer insights than traditional credit scoring.

7.2. Practical implications: a roadmap for data-driven transformation

Our process model offers several practical insights for organizations seeking to develop data-driven capabilities in resource-constrained environments. First, it provides a roadmap for digital transformation that emphasizes practices rather than just investments. For banking executives and strategists in emerging markets, our model suggests focusing

on developing specific organizational practices—such as cross-functional integration mechanisms and contextual data governance frameworks—rather than simply acquiring technology or hiring scarce analytics talent.

Second, our findings highlight the importance of developing contextually appropriate capability development practices rather than importing approaches from resource-rich environments. Organizations operating in resource-constrained settings should focus on identifying and leveraging their distinctive contextual knowledge while developing innovative practices to overcome specific constraints. For instance, the adaptive technical infrastructure practices we identified offer a template for developing resilient data systems that can operate effectively across varying levels of digital infrastructure.

Third, our process model emphasizes the critical connection between capability development and deployment practices. Organizations should develop systematic approaches for translating capabilities into market actions through specific deployment practices tailored to their operating contexts. The regulatory navigation practices we identified, for example, demonstrate how organizations can transform potential constraints into sources of competitive advantage through innovative deployment approaches.

Fourth, our findings underscore the importance of developing what we term "hybrid capabilities" that can operate effectively across varying levels of digital readiness. Organizations in emerging markets should focus on capabilities that bridge rather than amplify the digital divide, developing approaches that can serve both digitally advanced and more traditional customer segments. The contextually adaptive customer engagement practices we identified provide a template for such hybrid approaches.

Finally, our process model suggests that organizations in resource-constrained environments should view contextual factors not as immutable limitations but as potential sources of distinctive capability development. By developing practices that respond creatively to specific contextual challenges, organizations can transform potential constraints into sources of competitive advantage. The talent development practices we identified, for example, show how organizations can address specialized skill shortages through innovative cross-functional learning approaches that may actually enhance contextual understanding of data.

8. Conclusion, limitations and future research direction

Our study highlights the dynamic processes through which African retail banks develop and deploy data-driven capabilities in resource-constrained environments. By examining the specific practices that enable banks to overcome resource limitations while leveraging data for competitive advantage, we have developed a process model that extends both theoretical understanding and practical approaches to capability development in emerging markets.

The DDDC process model we propose demonstrates that in data-rich, resource-constrained environments, competitive advantage emerges not from static resources but through the interplay of specific organizational practices that develop and deploy capabilities in response to contextual challenges. By reconceptualizing capability development as an ongoing process enacted through organizational practices rather than as a linear sequence of activities, our model provides a more nuanced understanding of how organizations adapt in the digital age. This process perspective reveals how African banks transform potential constraints into sources of distinctive capability innovation, developing what one executive termed "capability multipliers" that extend the impact of limited analytics expertise across the organization.

Our findings highlight that successful digital transformation in resource-constrained environments requires not simply adopting global best practices, but developing contextually appropriate approaches that leverage local knowledge and alternative resources. The capability development and deployment practices we identified—from cross-functional integration mechanisms to contextual data governance

frameworks—offer a roadmap for organizations navigating digital transformation with limited specialized analytics talent and uneven technological infrastructure.

While offering valuable insights, our study has several limitations that provide avenues for future research. The focus on two major African retail banks, while providing depth, limits the generalizability of our findings. Future research could expand to a broader range of financial institutions across multiple African countries or other emerging market contexts. Such comparative studies could further refine our process model, potentially uncovering regional variations in capability development and deployment practices.

Additionally, the cross-sectional nature of our study captures capability development processes at a specific point in time. Longitudinal research tracking how these practices evolve over time, particularly in response to major market or technological disruptions, would provide valuable insights into the temporal dynamics of capability development in data-rich environments.

Furthermore, while our qualitative approach yielded rich, contextual insights into capability development processes, it lacks quantitative validation of the relationships between practices, capabilities, and competitive outcomes. Future research could develop and validate measures for the key constructs in our process model, examining their relationships through mixed-method approaches to enhance the model's applicability across different organizational and market contexts.

Our study opens several promising avenues for future research. First, researchers could explore how data-driven capability development practices vary across different resource-constrained contexts, potentially developing a typology of contextually specific practices. Second, studies could examine the role of organizational learning mechanisms in enabling capability development despite resource constraints, particularly how organizations develop alternative learning approaches when traditional knowledge acquisition methods are limited.

A particularly promising direction for future research lies in examining how organizations develop responsible data-driven capabilities in contexts with varying levels of digital literacy and data protection frameworks. Our findings on contextual data governance practices suggest that organizations in emerging markets are developing distinctive approaches to responsible data use that may offer valuable insights for global practice. Future research could explore how these approaches balance innovation with ethical considerations in data-rich, resource-constrained environments.

As the global banking sector continues its digital evolution, the ability to develop and deploy data-driven capabilities through contextually appropriate practices will likely become a key differentiator between market leaders and laggards. Our process-oriented understanding of these capabilities offers valuable insights for scholars, practitioners, and policymakers navigating the complex intersection of big data, dynamic capabilities, and emerging market dynamics in an increasingly data-driven world.

CRediT authorship contribution statement

Anning-Dorson Thomas: Writing – review & editing, Writing – original draft, Supervision, Methodology, Formal analysis, Data curation, Conceptualization. **Zulu Melissa:** Writing – review & editing, Conceptualization. **Baba Faeza:** Investigation, Formal analysis, Data curation.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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