“EVALUATING ARTIFICIAL INTELLIGENCE’S IMPACT ON LEADERSHIP AGILITY IN SUSTAINABILITY - DRIVEN SMES IN MENA AMID MARKET CHALLENGES”

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ABSTRACT

Evaluating Artificial Intelligence's Impact on Leadership Agility in Sustainability - Driven SMEs in MENA Amid Market Challenges

The MENA region has witnessed a growing adoption of Artificial Intelligence (AI) technologies among small and medium-sized enterprises (SMEs), particularly those driven by sustainability goals. Over the past decade, AI has become a central enabler of agility, innovation, and data-driven decision-making across industries. However, despite this technological advancement, many sustainability-oriented SMEs continue to face challenges in translating AI adoption into leadership agility and measurable performance improvement. One of the key reasons is the limited contextual understanding of how AI applications, such as automation, predictive analytics, and intelligent agents, interact with leadership behavior in resource-constrained environments. Current academic research remains fragmented, with most studies focusing on large corporations in digitally mature economies, leaving a significant gap in the MENA context. The study adopts a qualitative, capability-focused perspective, examining how AI-enabled tools shape leadership agility and sustainability-oriented decision-making, rather than empirically measuring organizational performance outcomes, which remain uneven and context-dependent across SMEs in the MENA region. This research project will investigate how AI technologies enhance leadership agility in sustainability-driven SMEs, aiming to develop a contextualized framework that links AI adoption to adaptive leadership, organizational resilience, and sustainable performance outcomes.

Directed by: Dr. Jaka Vadnjal

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CHAPTER 1
INTRODUCTION AND RESEARCH CONTEXT

1.1 Introduction

The Middle East and North Africa (MENA) region's Small and Medium Enterprises (SMEs) represent a critical engine for economic diversification, innovation, and employment. Unlike general SMEs globally, MENA-based SMEs operate in fast-shifting economies undergoing national transformation programs, political volatility, and digital capacity gaps, making their need for agility uniquely urgent. These enterprises increasingly face sustainability challenges driven by rapid technological advancement, shifting market structures, and heightened environmental and social expectations.

Leadership agility, defined as the ability of leaders to anticipate, interpret, and respond swiftly to change, has emerged as a decisive factor in enabling SMEs to navigate such complexity and sustain competitiveness (Joiner, 2007).

In the context of MENA region where economies are progressively transitioning toward knowledge and sustainability-driven paradigms, leadership agility assumes a strategic role (OECD, 2021). SMEs, in particular, operate within increasingly complex, interdependent, and technologically dynamic environments that necessitate continuous recalibration of strategic and operational priorities. Within such volatile contexts, effective leadership is anchored in adaptive capacity, defined as the ability to diagnose emergent challenges, interpret ambiguous or rapidly shifting information flows, and mobilize appropriate strategic responses in real time. This conceptualization aligns with the principles of adaptive leadership articulated according to Heifetz, Grashow and Linsky, who emphasize the centrality of leaders' capacity to orchestrate adaptive work, foster learning, and guide organizations through sustained periods of uncertainty and transformation. Such adaptive leadership capabilities are indispensable for navigating the heightened volatility of the region and reinforcing sustained organizational resilience and performance (Heifetz et al., 2009).

Emerging technologies such as Artificial Intelligence (AI), particularly through AI-enabled agents and automation, provides novel mechanisms for enhancing leadership agility. According to Russel & Norvig, AI-enabled agents, in particular, function autonomously or semi-autonomously to perform cognitive tasks such as analysis, monitoring, and planning - thus acting as digital collaborators that enhance decision-making and scenario planning. Concurrently, according to Deloitte, automation technologies streamline operational workflows, minimize human error, and release managerial resources for strategic foresight and innovation.

From a sustainability perspective, AI technologies contribute to optimizing resource utilization, monitoring environmental performance, and advancing circular economy practices. They enable data-driven assessment of energy efficiency, carbon emissions, and supply chain transparency, key elements for sustainability-oriented business models. Nevertheless, the adoption of such technologies among MENA-based SMEs remains fragmented, primarily constrained by infrastructural limitations, regulatory inconsistencies, and gaps in digital literacy (World Bank, 2022).

The regional shift toward digital and green transformation, under national strategies such as Saudi Arabia's Vision 2030 and the UAE's AI Strategy 2031, underscores the importance of equipping SME leaders with advanced decision-making tools and cognitive agility (PWC, 2021). This technological shift offers a unique opportunity to empower leadership, enhance organizational agility, and achieve sustainable development targets.

This study examines how Artificial Intelligence technologies contribute to improved leadership agility among sustainability-driven SMEs across the MENA region. It investigates how leaders can leverage AI, AI-enabled agents, and automation to adapt more effectively to volatile business environments while advancing sustainability objectives. The research explores leadership agility across two dimensions: organizational agility, defined as the capacity to realign structures, strategies, and priorities quickly; and process agility, which involves adjusting workflows, operational practices, and decision-making mechanisms in response to change. It further examines how emerging AI technologies, including predictive analytics, machine learning platforms, intelligent AI-enabled agents, and robotic process automation, enable SME leaders to be more adaptive, proactive, and sustainability-oriented.

The motivation behind this research lies in bridging current gaps in understanding how AI-driven systems enhance leadership agility within MENA SMEs. The study analyzes the interplay between AI adoption, leadership responsiveness, and sustainable performance, aiming to conceptualize how AI can strengthen leaders' ability to anticipate and respond to complex and dynamic environments.

From a knowledge advancement standpoint, this research contributes to an underexplored intersection between artificial intelligence, leadership agility, and sustainability in emerging markets. From an industry practice perspective, it provides actionable insights into how MENA-based SMEs can leverage AI-enabled leadership frameworks to accelerate transformation, strengthen resilience, and align with regional sustainability objectives.

While this study examines the relationship between Artificial Intelligence adoption, leadership agility, and sustainability, its primary analytical focus is on leadership capability development rather than direct measurement of organizational performance outcomes. Although performance-related indicators are discussed where available, the study does not seek to empirically quantify performance improvement across cases. Instead, it investigates how AI-enabled tools reshape leadership sensemaking, decision processes, and adaptive capacity within sustainability-driven SMEs. This focus reflects the exploratory and qualitative nature of the research and the contextual variability of data availability across emerging-market SMEs.

1.1.1 Contextual Complexity and Leadership Challenges in Sustainability-Driven SMEs

Sustainability-driven SMEs operate at the intersection of multiple, often competing, pressures. Unlike large corporations with dedicated sustainability, analytics, and transformation units, SMEs must navigate environmental responsibility, regulatory compliance, and market competitiveness with limited managerial bandwidth and constrained resources. In the MENA region, these pressures are further intensified by institutional volatility, uneven digital infrastructure, and evolving national sustainability agendas.

Leadership within such organizations is therefore characterized by heightened cognitive load, compressed decision timelines, and frequent trade-offs between short-term survival and long-term sustainability objectives. Leaders are required to simultaneously interpret fragmented information, respond to environmental uncertainty, and maintain strategic coherence across economic, environmental, and social dimensions. This context amplifies the relevance of leadership agility as a core managerial capability.

While sustainability-oriented SMEs increasingly recognize the strategic importance of digital technologies, many lack the structural and cognitive mechanisms required to translate technological adoption into adaptive leadership behavior. AI technologies promise enhanced analytical capacity, foresight, and decision support; however, their impact depends largely on how leaders integrate these tools into their sensemaking and judgment processes. Without leadership agility, AI risks remaining peripheral, used for efficiency gains rather than strategic adaptation.

This contextual complexity highlights the need for research that moves beyond technology adoption metrics to examine how leadership capability is reshaped under conditions of sustainability pressure, digital uncertainty, and resource constraint. Understanding leadership agility within this setting provides a necessary foundation for examining how AI-enabled tools may support adaptive and sustainable decision-making in SMEs.

1.2 Problem Statement and Research Questions

The importance of leadership agility as a determinant of organizational resilience and competitiveness has long been acknowledged across industries. However, within the MENA region, sustainability-driven SMEs continue to demonstrate limited adaptability and slow strategic responses to technological disruption, heightened regulatory pressures, and rising sustainability requirements. This constrained responsiveness is frequently linked to the insufficient integration of Artificial Intelligence (AI) capabilities, such as AI-enabled agents, automation tools, and predictive analytics into leadership routines, decision-making systems, and organizational learning processes.

First, when leadership agility is not supported by AI-driven insights, strategic decisions tend to depend on intuition, experiential judgment, and traditional management models. Such approaches are increasingly inadequate given the speed, uncertainty, and complexity associated with digital and sustainability transitions in the region. SMEs in volatile MENA markets operate within environments marked by fluctuating demand, evolving consumer expectations, and intensifying sustainability obligations. Leaders therefore require the ability to anticipate, interpret, and act in real time. Without robust data infrastructures and automated intelligence systems, SMEs remain predominantly reactive rather than proactive, a pattern observed across multiple regional assessments.

Second, the region's leadership and management models have not evolved at the same pace as emerging digital technologies. While large enterprises in the Gulf and North Africa have accelerated the adoption of AI tools, SME digital readiness remains comparatively low. Recent regional studies report that only 16–25% of MENA SMEs have reached an intermediate level of digital maturity, with AI adoption rates often below 10%. This maturity gap constrains leaders' ability to leverage AI for scenario planning, predictive analysis, risk anticipation, and operational agility, all of which are central to leadership agility in complex environments. Moreover, leadership development programs in the region still emphasize hierarchical control, stability, and linear planning, which conflict with the adaptive, iterative, and data-driven mindset required in AI-enabled economies.

Finally, existing academic literature remains predominantly centered on Western or developed-economy contexts, with limited attention to the distinctive cultural, structural, and infrastructural dynamics of MENA SMEs. The region's unique characteristics, including high uncertainty avoidance, regulatory complexity, uneven digital infrastructure, and varying organizational cultures, shape both leadership practices and AI adoption patterns. Yet, empirical studies examining how AI tools can strengthen leadership agility within sustainability-oriented SMEs in MENA remain extremely scarce. This gap restricts theoretical advancements and limits the availability of evidence-based frameworks tailored to the region.

Although global scholarship has explored leadership agility, adaptive leadership, and AI-enabled decision-making, there is a clear lack of research addressing how these constructs interact within sustainability-driven SMEs in the MENA context. Existing work does not sufficiently explain how AI can enhance leadership agility in environments characterized by digital immaturity, resource constraints, and cultural particularities. As a result, there is a need for a context-specific, empirically grounded understanding of how AI-enabled agents, automation, and predictive analytics can support agile, sustainable decision-making among SME leaders. Consequently, this study seeks to address the following research questions:

1. How can AI-enabled agents, automation, and predictive analytics enhance leadership agility within sustainability-driven SMEs?
2. What is the relationship between AI-enabled leadership agility and sustainable performance in MENA SMEs?
3. How do regional socio-economic, cultural, and infrastructural factors influence the adoption and effectiveness of AI technologies in driving leadership agility?
4. What frameworks can be developed to guide SME leaders in integrating AI tools for strategic, agile, and sustainable decision-making?

1.2.1 Research Motivation and Practical Significance

The motivation for this research emerges from both scholarly and practitioner-oriented gaps. From an academic perspective, existing literature provides limited insight into how Artificial Intelligence interacts with leadership cognition and adaptive capacity within sustainability-driven SMEs, particularly in emerging market contexts. Most empirical studies focus on large organizations operating in digitally mature environments, leaving SME leadership dynamics under-theorized.

From a practitioner standpoint, SME leaders across the MENA region are increasingly encouraged through national digital and sustainability strategies, to adopt AI-enabled solutions. However, these leaders frequently lack clear guidance on how such technologies should be integrated into leadership routines, strategic deliberation, and sustainability governance. As a result, AI adoption often remains fragmented, tactical, or symbolic rather than transformative.

This research is therefore motivated by the need to generate context-sensitive insights that can inform leadership practice while contributing to theory development. By focusing on leadership agility rather than technological performance outcomes, the study addresses a critical disconnect between digital ambition and managerial capability development. The findings are intended to support SME leaders, policymakers, and ecosystem actors in understanding how AI-enabled tools can strengthen adaptive leadership under sustainability constraints.

1.3 Research Objectives and scope of the study

The proposed research aims to develop a comprehensive understanding of how Artificial Intelligence (AI) technologies, specifically AI- enabled agents, automation, and predictive analytics, strengthen leadership agility within sustainability-driven SMEs in the MENA region. By examining how AI enhances leaders' capacity to anticipate change, interpret complexity, and respond with strategic adaptability, the study seeks to clarify the mechanisms through which AI-enabled decision environments support organizational resilience and sustainable performance.

This research extends existing leadership agility theory by examining how agile leadership capabilities evolve when mediated by AI systems, automated decision-support tools, and predictive intelligence. The study offers a conceptual advancement by linking adaptive leadership behaviors with AI-enabled sensemaking, scenario analysis, and real-time strategic adjustment, areas that remain underexplored in current academic literature.

Through this lens, the research broadens the theoretical understanding of leadership agility in data-rich, technology-intensive environments and provides a contextualized model tailored to emerging markets and sustainability-oriented SMEs.

The primary objective of this research is to develop and validate a conceptual framework that explains the relationship between AI-driven technologies, leadership agility, and sustainability outcomes in SMEs.

More specifically, the research has the following sub-objectives:

1- To examine how AI-enabled agents, automation, and predictive analytics influence leadership agility, particularly leaders' ability to anticipate market changes, make informed decisions, and adapt organizational strategies in real time.

2- To analyze how leadership agility mediates the relationship between AI adoption and sustainable performance, identifying the key leadership behaviors and competencies that enable effective technology-driven transformation.

3- To assess the regional and contextual factors (e.g., digital maturity, cultural leadership norms, policy environment) that affect the integration of AI technologies into SME leadership models across different MENA countries.

4- To propose a contextualized framework for AI-enabled leadership agility, outlining how sustainability-focused SMEs can leverage data, intelligence, automation, and AI-enabled agents to strengthen their resilience, competitiveness, and environmental/social impact.

The study's contributions are articulated across both theoretical and practical domains. To integrate both dimensions clearly:

1- Theoretical Contribution

- Extends leadership agility theory by embedding AI-enabled capabilities such as predictive insight generation, algorithmic decision support, and automation, into the agility construct.
- Provides a new conceptual model illustrating how AI reshapes leaders' sensemaking, adaptive behavior, and strategic responsiveness in emerging-market SMEs.
- Addresses a significant geographical and contextual gap by situating leadership agility within MENA sustainability-focused SMEs, a region largely overlooked in current theory.

2- Practical Contribution

- Improved managerial decision-making: The framework offers SME leaders guidance on using AI tools to enhance forecasting, scenario planning, and rapid strategic adjustment.

- Strengthened SME competitiveness: By identifying how AI can increase operational agility, the research supports SMEs in navigating market volatility and sustainability pressures.
- Policy and ecosystem implications: Findings provide governments, incubators, and development agencies with recommendations to accelerate AI-enabled leadership development across the region.
- Enhanced sustainability outcomes: By connecting AI adoption with agile leadership behaviors, the study helps SMEs align digital transformation with environmental and social performance goals.

Ultimately, this research bridges technological innovation and leadership theory, demonstrating how AI-driven insights, automation, and predictive capabilities redefine leaders' adaptive capacity in sustainability-oriented SMEs. By contextualizing AI-enabled leadership agility within the socio-economic realities of the MENA region, the study advances scholarly understanding while offering actionable strategies for practice, policy, and sustainable development.

1.3.1 Scope Delimitation and Analytical Focus

This study adopts a deliberate analytical focus on leadership capability development rather than on the empirical measurement of organizational performance outcomes. While performance-related indicators are referenced where available, the research does not seek to quantify causal relationships between AI adoption and financial or sustainability performance. This delimitation reflects both methodological considerations and contextual realities within SME environments.

Sustainability-driven SMEs in emerging markets exhibit significant variation in data availability, reporting maturity, and governance structures, which constrains the comparability of performance metrics across cases. Rather than treating this variability as a limitation, the study approaches it as an analytical condition that shapes leadership behavior and decision-making processes.

Accordingly, the research examines how AI-enabled agents, automation, and predictive analytics influence leaders' sensemaking, temporal orientation, and adaptive judgment under conditions of uncertainty. Leadership agility is treated as an emergent capability that mediates the relationship between technological augmentation and sustainability orientation. This focus ensures conceptual coherence and aligns the study with a qualitative, capability-based research tradition appropriate for applied doctoral inquiry.

CHAPTER 2
LITERATURE REVIEW: ARTIFICIAL INTELLIGENCE, LEADERSHIP AGILITY, AND SUSTAINABILITY

2.1 Preliminary Literature Review Objectives

Existing scholarship on Artificial Intelligence (AI) and organizational agility has largely centered on digitally advanced and structurally mature corporate environments, with limited attention to emerging-market SMEs, a bias that constrains the applicability of these findings to the MENA SME context examined in this study. Prior studies demonstrate that AI enhances managerial decision-making through faster data processing, predictive modelling, and automation, all of which strengthen an organization's capacity to adapt to environmental volatility (Russel and Norvig, 2014). Empirical evidence across finance, healthcare, and logistics shows that AI-enabled systems improve situational awareness, risk anticipation, and operational responsiveness, fostering greater resilience and overall performance. While these contributions provide a useful conceptual grounding, they predominantly reflect conditions in technologically sophisticated economies whose digital infrastructures far exceed those of many MENA countries.

Despite the importance of SMEs in economic diversification and innovation, research addressing their engagement with AI remains fragmented. Studies acknowledge that predictive analytics can support SMEs in anticipating demand patterns, managing resource constraints, and mitigating supply-chain disruption (OECD, 2021). Automation has also been shown to reduce administrative burdens and free managerial capacity for strategic tasks. However, these findings are derived mainly from contexts with high digital maturity, thereby limiting their applicability to MENA, where SMEs face infrastructural constraints, limited access to advanced technologies, and uneven institutional support (World Bank, 2022). Thus, the extent to which existing insights translate to MENA's heterogeneous socio-economic landscape remains theoretically and empirically uncertain.

From an applied doctoral perspective, this review prioritizes literature that informs leadership judgment under real-world constraints rather than idealized digital conditions.

Parallel to technological developments, leadership agility has emerged as a central construct in explaining organizational adaptability under VUCA conditions. Joiner conceptualizes leadership agility as the ability to sense, interpret, and respond rapidly to emerging challenges. Building on this, adaptive leadership theory (Heifetz, et al., 2009) underscores leaders' capacity to mobilize adaptive work, navigate complexity, and encourage organizational learning. Complexity leadership theory further argues that adaptability emerges from distributed decision-making and dynamic interactions rather than hierarchical control(Uhl-Bien and Arena, 2017). Dynamic capabilities theory similarly highlights sensing, seizing, and transforming as core mechanisms through which firms reconfigure resources to manage turbulence (Teece, 2007). However, these frameworks tend to treat digital technologies as contextual rather than transformative, offering limited insight into how AI actively augments leadership agility. This represents a substantive theoretical gap, particularly as leadership increasingly depends on data-driven interpretation, automated decision processes, and predictive insight.

According to OECD and World Bank, Within the sustainability literature, SMEs are identified as critical actors in advancing environmental innovation, social value creation, and green competitiveness. Yet, sustainability-oriented SMEs face structural constraints, including limited financial resources, digital skill shortages, and regulatory uncertainty, which restrict their capacity to adopt advanced technologies such as AI.

Although emerging research suggests that AI can support sustainability by enabling resource optimization, emissions tracking, and transparent supply chains, the intersection between AI adoption and leadership agility in sustainability-focused SMEs remains poorly examined. Existing studies provide descriptive accounts of AI benefits but rarely investigate how leaders leverage AI to enhance adaptive capacity, strategic foresight, and sustainable performance.

Based on the above, the literature reveals three critical gaps. First, the relationship between AI, leadership agility, and sustainability is under-theorized and empirically underdeveloped, particularly within SMEs. Second, current leadership theories do not sufficiently account for AI as a capability that reshapes how leaders' sense, interpret, and respond to complexity. Third, MENA-specific contextual factors such as cultural leadership norms, digital maturity levels, and institutional constraints, have been largely overlooked, limiting the transferability of Western-centric findings.

This review therefore establishes a strong rationale for the proposed research. By focusing on sustainability-driven SMEs in the MENA region, the study addresses a significant theoretical and empirical gap at the nexus of AI, leadership agility, and sustainable development. It extends adaptive leadership, complexity leadership, and dynamic capabilities frameworks by examining how AI-driven tools enhance leaders' adaptive behaviors, decision-making speed, and strategic responsiveness in resource-constrained environments. This contribution is expected to advance academic understanding while offering practical insights for policymakers, SME leaders, and innovation ecosystems seeking to strengthen AI-enabled transformation in emerging markets.

From a theoretical standpoint, the literature informing this study spans multiple disciplinary traditions, including leadership theory, decision science, strategic management, and sustainability scholarship. Rather than treating these domains as parallel streams, this review adopts an integrative perspective, recognizing that leadership agility emerges at the intersection of cognitive, technological, and institutional dynamics. This approach aligns with calls for multi-theoretical integration in management research addressing complex, systemic challenges such as digital transformation and sustainability(George et al., 2016).

Much of the existing literature adopts either a technology-centric or leadership-centric lens. Technology-centric studies emphasize efficiency gains, automation, and analytics capability, while leadership-centric studies prioritize behavioral adaptability and learning. However, few studies explicitly examine how AI reshapes the conditions under which leadership judgment is exercised. This review therefore positions AI not merely as an input into decision-making, but as a structuring force that alters information availability, temporal horizons, and cognitive load for leaders (Simon, 1997; Jarrahi, 2018).

2.1.1 Analytical Orientation and Boundary Conditions of the Literature Review

The purpose of this literature review extends beyond synthesizing existing knowledge on Artificial Intelligence, leadership agility, and sustainability. Its primary analytical objective is to reconceptualize leadership agility as a cognitively and temporally mediated capability, shaped by the interaction between human judgment and AI-enabled systems. This requires an explicit boundary-setting exercise to distinguish between adjacent constructs that are frequently conflated in prior research.

First, the review differentiates AI as a general digital infrastructure from AI as a decision-augmenting capability. While digitalization literature often treats AI as part of a broader technological environment, this study restricts its analytical focus to AI-enabled agents, predictive analytics, and intelligent automation that directly influence leadership sensemaking, attention allocation, and anticipatory judgment. This distinction is necessary to avoid overgeneralization and to ensure conceptual precision.

Second, leadership agility is analytically separated from related constructs such as adaptability, flexibility, and resilience. While these concepts describe reactive or absorptive responses to change, leadership agility emphasizes anticipatory orientation, rapid sensemaking, and proactive reconfiguration. This forward-looking dimension aligns more closely with AI-enabled capabilities that extend leaders' temporal horizons rather than merely improving execution efficiency.

Third, sustainability is framed as a strategic orientation embedded in decision processes, not as an outcome variable. The review therefore privileges literature that examines how sustainability considerations are cognitively integrated into leadership judgment, rather than studies focused solely on environmental or social performance indicators. This capability-based framing is particularly appropriate for SME contexts, where formal measurement systems are uneven or absent.

By establishing these analytical boundaries, the literature review provides a coherent theoretical foundation for examining how AI-enabled augmentation reshapes leadership agility under sustainability constraints, rather than reproducing fragmented or technology-centric accounts.

2.1.2 Leadership Work as Cognitive Orchestration Under Digital Complexity

The increasing digitalization of organizational environments has transformed leadership work from a primarily directive function into a form of cognitive orchestration. Rather than controlling stable processes, leaders now operate within information-rich yet ambiguity-laden environments where the primary challenge is not access to data but the interpretation, prioritization, and temporal alignment of competing signals.

Digital complexity introduces a paradoxical condition: as information availability increases, leaders' cognitive burden intensifies, particularly in SMEs where decision authority is concentrated and analytic support structures remain limited. Information overload, signal noise, and compressed decision cycles undermine traditional rational planning models and heighten reliance on heuristics and experiential judgment. In SME contexts, where leadership authority is concentrated and decision-support infrastructures are limited, this cognitive strain is amplified.

In reviewing this literature, a recurring limitation becomes apparent: much of the analysis assumes the presence of mature decision-support infrastructures that rarely exist in SME contexts. This gap informed the present study's emphasis on leadership agility as a compensatory capability rather than a purely technological outcome

This shift repositions leadership agility as a function of attentional control and interpretive capacity, rather than decision speed alone. Leaders must determine not only what decisions to make, but when to intervene, which signals warrant escalation, and how to balance immediate operational pressures against longer-term sustainability considerations.

AI-enabled systems intervene precisely at this juncture by restructuring the informational environment in which leadership cognition operates. Through anomaly detection, trend forecasting, and pattern recognition, AI alters the salience of issues competing for leadership attention. However, the literature indicates that such restructuring does not automatically translate into improved leadership outcomes. The effect depends on whether leaders integrate AI outputs into deliberative routines or treat them as peripheral reporting tools.

Accordingly, digital complexity does not diminish the role of leadership judgment; rather, it increases its strategic importance. Leadership agility emerges not from the volume of information processed, but from the leader's capacity to orchestrate cognitive resources, human and artificial, under conditions of uncertainty.

2.1.3 Digital Complexity, Uncertainty, and the Changing Nature of Leadership Work

[, linear causality, and rational decision-making.

Within sustainability-driven SMEs, these challenges are further compounded by the need to balance short-term operational viability with long-term environmental and social objectives. Leadership work increasingly involves navigating trade-offs under conditions of incomplete information and evolving stakeholder expectations. This context necessitates leadership capabilities that emphasize adaptability, rapid sensemaking, and strategic flexibility, capabilities commonly captured under the concept of leadership agility.

However, while digital tools promise enhanced analytical capacity, their integration into leadership work remains uneven and theoretically underexplored. Understanding how AI reshapes the cognitive and strategic dimensions of leadership is therefore essential for addressing contemporary organizational challenges.

2.1.4 Reframing Bounded Rationality in AI-Augmented Decision Environments

Classical decision theory conceptualizes bounded rationality as a structural limitation arising from finite cognitive capacity, incomplete information, and time constraints. Under this model, leaders satisfice rather than optimize, relying on heuristics and simplified representations of complex realities. While this framework remains foundational, it requires re-examination in AI-augmented decision environments.

Artificial Intelligence does not eliminate bounded rationality; instead, it reconfigures its boundaries, altering how SME leaders interpret uncertainty rather than replacing judgment altogether. By expanding informational bandwidth and enabling probabilistic forecasting, AI relaxes constraints related to data processing and pattern recognition. However, new constraints emerge in the form of interpretive dependency, algorithmic opacity, and trust calibration. Leaders must decide how much weight to assign to AI-generated insights, how to reconcile conflicting outputs, and when to override algorithmic recommendations.

This interpretive framing guided the selection of cases and the analytical emphasis on leadership sensemaking rather than technological performance. In sustainability-driven SMEs, this interaction is particularly consequential. Leaders often lack historical sustainability data, standardized metrics, or mature analytics infrastructures, limiting the reliability of AI-driven forecasts. As a result, AI functions as a partial cognitive extension rather than a deterministic decision authority.

The literature suggests that leadership agility is enhanced when AI-supported insights are embedded within reflective decision processes that preserve human judgment while extending sensing and anticipation capacity. Conversely, when AI is deployed without governance, interpretive frameworks, or leadership engagement, it may reinforce existing biases or generate false confidence.

This perspective reinforces the study's analytical stance: AI contributes to leadership agility not by replacing bounded rationality, but by reshaping the conditions under which bounded rationality is exercised. This interpretive framing guided the selection of cases and the analytical emphasis on leadership sensemaking rather than technological performance.

For this study, bounded rationality is therefore treated not as a deficit to be eliminated through automation, but as a persistent condition that shapes how SME leaders engage with AI-enabled insights. This interpretive stance guided both the case selection and the analytical coding strategy used in later chapters.

2.1.5 Artificial Intelligence and Bounded Rationality in Managerial Cognition

Artificial Intelligence introduces a partial relaxation these cognitive constraints by expanding informational bandwidth and enabling structured comparison of alternatives. Predictive analytics, anomaly detection, and machine learning algorithms can process volumes of structured and unstructured data beyond human cognitive capacity, offering probabilistic forecasts and pattern recognition capabilities that support more informed strategic deliberation. However, AI does not eliminate bounded rationality; rather, it reshapes its boundaries. Leaders remain constrained by interpretation, trust in algorithmic outputs, and governance structures that determine how AI insights are integrated into decision routines.

This reframing positions AI as a cognitive augmentation mechanism rather than an autonomous decision-maker. In the context of this study's first research question how AI-enabled agents, automation, and predictive analytics enhance leadership agility, the bounded rationality lens clarifies that AI's primary contribution lies in extending leaders' sensing and interpretive capacity. Where AI-generated insights are meaningfully embedded into leadership deliberation processes, they may reduce reliance on intuitive heuristics and enable more anticipatory strategic behavior. Where such integration is absent, AI remains peripheral, offering efficiency gains without fundamentally reshaping leadership cognition.

2.2 Artificial Intelligence as a Leadership Capability

Artificial Intelligence has increasingly been conceptualized not merely as a technological artifact, but as a strategic and cognitive capability that reshapes how leaders perceive information, exercise judgment, and enact decisions under conditions of complexity; however, this conceptualization often overlooks the uneven and interpretive nature of AI use in SME leadership practice. Early foundations in AI research define intelligent systems**,** particularly intelligent agents**,** as entities capable of perceiving their environment, processing information, and acting toward defined goals(Russel and Norvig, 2014.).Within organizational settings, these capabilities translate into enhanced analytical capacity, accelerated sensemaking, and improved foresight.

While the literature frequently frames AI as a strategic asset, this study adopts a more cautious and practice-oriented interpretation. Based on preliminary engagement with SME leaders, AI is more accurately experienced as an uneven and evolving leadership support mechanism rather than a stable organizational capability.

From a managerial perspective, AI extends the limits of bounded rationality, a constraint long recognized in classical decision theory (Simon, 1997)**.** By processing large volumes of structured and unstructured data, AI systems augment leaders' cognitive capacity, enabling more informed and timely decisions. Davenport and Harris (2007) argue that analytics-driven organizations outperform peers by embedding data-based insights into strategic and operational decision-making. More recently, Davenport and Ronanki (2018) highlight AI's role in shifting managerial attention from routine analysis toward higher-order strategic interpretation.

Economic and strategic management literature further positions AI as a complementary asset that enhances, rather than replaces, human judgment. Brynjolfsson and McAfee (2014) describe this phenomenon as the "second machine age," wherein digital technologies amplify human capabilities and productivity. Similarly, Porter and Heppelmann (2014) emphasize that smart, connected technologies redefine value creation by embedding intelligence into products, services, and decision processes. In leadership contexts, this implies a redistribution of cognitive effort**,** from data gathering to interpretation, experimentation, and strategic choice.

However, existing literature also cautions that the value of AI is contingent upon organizational readiness and leadership engagement. Without appropriate governance, data quality, and interpretability, AI systems risk reinforcing existing biases or generating opaque recommendations that undermine trust (Schein, 2010). This challenge is particularly acute in SMEs, where leadership authority is concentrated and formal decision-support systems are often absent. As Mintzberg (2009) notes, managerial work remains deeply experiential and relational, suggesting that AI must be integrated in ways that align with leaders lived practices rather than imposed as purely technical solutions.

In emerging-market contexts, including the MENA region, AI adoption is further constrained by limited digital infrastructure, skills shortages, and fragmented data ecosystems (World Bank, 2022). Consequently, AI is frequently deployed tactically for automation or reporting, rather than strategically as a leadership capability. This gap highlights the need to reconceptualize AI not as a standalone technology, but as an enabler of leadership agility, supporting sensing, interpretation, and adaptive response within sustainability-driven SMEs.

Accordingly, this study advances the literature by examining how AI technologies particularly AI agents, predictive analytics, and automation function as cognitive extensions of leadership, shaping how SME leaders navigate uncertainty, balance sustainability objectives, and enact agile decision-making.

2.2.1 Artificial Intelligence as a Leadership Capability

While Artificial Intelligence has increasingly been discussed as a technological enabler of organizational performance, its deeper theoretical relevance lies in its relationship to bounded rationality and cognitive limitation in managerial decision-making. Classical decision theory, most notably articulated by Simon (1997), posits that decision-makers operate under conditions of limited information, finite cognitive capacity, and temporal constraints. Leaders therefore “satisfice” rather than optimize, relying on heuristics and experiential judgment to navigate complex environments. In the context of sustainability-driven SMEs operating in volatile and resource-constrained settings, these cognitive limitations are amplified. Leaders must interpret fragmented data, reconcile economic and environmental trade-offs, and act under conditions of regulatory ambiguity and market instability.

Artificial Intelligence (AI) introduces a significant shift within this cognitive landscape. Rather than merely accelerating data processing, AI has the potential to reconfigure how leaders attend to, interpret, and prioritize information. From this perspective, AI functions as a cognitive augmentation mechanism. It expands leaders’ informational bandwidth, reduces the burden of manual analysis, and surfaces patterns that might otherwise remain obscured within large or dispersed datasets. In doing so, AI alters the structure of bounded rationality itself. The constraints do not disappear; rather, they are redistributed.

This redistribution can be understood through the lens of attention-based theory. Organizational action is shaped not only by available resources but by what leaders notice and choose to prioritize. AI systems, particularly predictive analytics and intelligent agents, influence this attentional architecture by highlighting anomalies, forecasting risk trajectories, and modeling alternative scenarios. What becomes visible to leadership changes, and consequently, what is considered strategically urgent may also shift. In sustainability-oriented SMEs, where environmental data is often under-measured or inconsistently tracked, AI can render previously peripheral sustainability indicators salient within executive deliberation. This has implications not only for efficiency, but for strategic cognition.

The role of AI in leadership sensemaking is similarly significant. Sensemaking theory emphasizes that leaders do not passively receive information; they actively interpret ambiguous signals to construct meaning and guide action. AI-generated outputs do not replace this interpretive function, but they influence its starting point. Predictive models, risk alerts, and scenario simulations provide structured interpretations of reality that shape how leaders frame problems. The decision process becomes less dependent on retrospective reporting and more oriented toward anticipatory reasoning. In this way, AI supports a transition from reactive to forward-looking cognition.

However, cognitive augmentation is neither automatic nor universally beneficial. The expansion of informational capacity may generate new forms of dependency or overconfidence. When AI systems produce outputs that appear precise or authoritative, leaders may defer to algorithmic recommendations without sufficiently interrogating underlying assumptions or data quality. Algorithmic opacity presents an additional challenge. In many machine learning applications, the logic linking input to output is not fully transparent, which may complicate accountability in high-stakes sustainability decisions. These concerns are particularly salient in SMEs, where formal governance structures and analytical oversight mechanisms are often limited.

Trust therefore emerges as a mediating factor in AI-enabled cognitive augmentation. Leaders must develop the capacity to critically interpret AI outputs rather than accept them unconditionally. This requires not only technical literacy, but also epistemic awareness: an understanding of how data is generated, how models are trained, and where predictive limitations lie. Without such interpretive competence, AI risks reinforcing existing cognitive biases rather than mitigating them. For example, if historical data reflects unsustainable procurement patterns or risk-averse decision cultures, predictive systems trained on those datasets may inadvertently reproduce them.

Furthermore, the relationship between AI and cognitive load is complex. While automation reduces administrative burden and frees managerial time, it may simultaneously introduce new cognitive demands associated with monitoring, validating, and contextualizing AI outputs. Leaders must balance reliance and skepticism, efficiency and oversight. This dynamic tension underscores that AI does not eliminate bounded rationality; instead, it reshapes its contours.

In sustainability-driven SMEs, the implications of this reshaping are particularly pronounced. Leaders frequently confront trade-offs between short-term financial performance and long-term environmental impact. These decisions are often made under uncertainty, with incomplete measurement of sustainability outcomes. AI-enabled systems can integrate environmental metrics with operational and financial data, allowing leaders to simulate consequences before committing resources. Such predictive capacity supports anticipatory leadership behavior, a core dimension of agility. Yet the transformative potential of AI materializes only when sustainability data is structured, accessible, and embedded within decision routines.

This analysis suggests that AI should not be conceptualized merely as an operational efficiency tool, but as part of a broader socio-technical cognitive infrastructure. When integrated into governance structures and interpretive practices, AI augments leadership cognition by expanding attention, enhancing anticipatory reasoning, and reducing certain forms of cognitive overload. When superficially adopted or poorly governed, its impact remains marginal.

Accordingly, the contribution of AI to leadership agility is contingent upon how deeply it becomes embedded in leaders' sensemaking processes. AI does not replace human judgment, nor does it dissolve uncertainty. Rather, it modifies how uncertainty is perceived, structured, and navigated. In sustainability-driven SMEs operating within the MENA region, where complexity and resource constraints intersect, this cognitive augmentation may represent one of the most significant mechanisms through which AI influences adaptive and anticipatory leadership behavior.

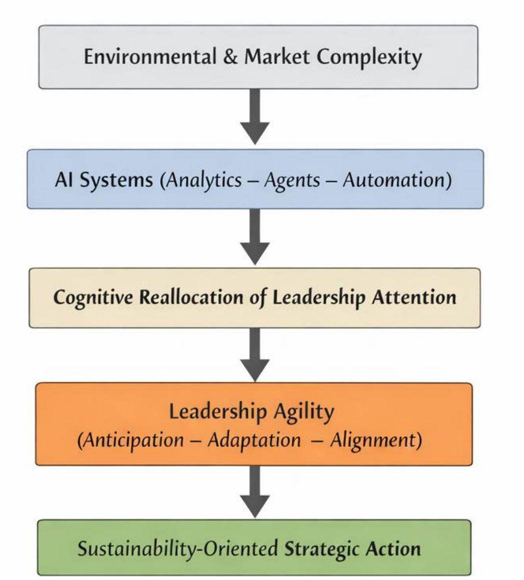

Figure 2.1 Theoretical Model of AI-Enabled Leadership Agility
Source: Author's own elaboration based on empirical findings

This figure synthesizes the core theoretical argument developed in Chapter 2. It positions artificial intelligence not as an operational enhancement, but as a cognitive infrastructure that reshapes how leadership attention is distributed under conditions of uncertainty. AI reduces informational overload and surfaces strategic signals, enabling leaders to redirect cognitive resources toward anticipatory and adaptive action. Leadership agility therefore emerges not directly from technological intensity, but from the reallocation of executive attention toward sustainability-oriented strategic choices.

2.2.1Theoretical Tensions Underpinning the Research Problem

The research problem addressed in this study is situated at the intersection of three evolving bodies of literature: Artificial Intelligence adoption, leadership agility, and sustainability-oriented management. While each stream has developed independently, their integration remains theoretically fragmented, giving rise to several unresolved tensions.

Decision theory provides a critical foundation for understanding AI's relevance to leadership agility. Classical models of managerial decision-making assume bounded rationality, whereby leaders operate under constraints of limited information, time, and cognitive capacity (Simon, 1997). Under such conditions, leaders rely on heuristics, experience, and simplified representations of reality, which may be effective in stable environments but problematic under volatility and complexity.

Recent scholarship emphasizes the concept of human-AI complementarity, arguing that the value of AI lies in its interaction with human cognition rather than in autonomous decision execution (Brynjolfsson et al., 2018). In leadership contexts, this implies that AI augments leaders' sensing and interpretive capacity while leaving normative, ethical, and strategic choices firmly within human authority.

This distinction is particularly relevant for SMEs, where leadership authority is concentrated and decisions carry disproportionate risk. Over-automation in such contexts may undermine trust and accountability, reinforcing resistance rather than agility. Accordingly, leadership agility depends not on the degree of AI autonomy, but on the quality of human-AI integration within leadership routines.

AI-enabled analytics and intelligent agents partially relax these constraints by expanding leaders' access to relevant information and enabling real-time pattern recognition. From this perspective, AI functions as a cognitive extension rather than a decision substitute, supporting leaders in navigating uncertainty without eliminating the need for judgment (Davenport and Harris, 2007).

First, AI literature often frames technology as either a driver of automation and efficiency or as a source of strategic advantage, with limited attention to its implications for leadership cognition and judgment (Brynjolfsson & McAfee, 2017) . This techno-centric orientation risks overlooking the role of leaders as interpreters, sensemakers, and ethical decision-makers.

Second, leadership agility research emphasizes adaptability, responsiveness, and learning, yet frequently treats digital technologies as contextual enablers rather than as active elements shaping leadership processes (Joiner, 2007). As a result, the mechanisms through which AI may enhance or constrain leadership agility remain insufficiently specified.

Third, sustainability scholarship often focuses on outcomes, reporting frameworks, and performance indicators, with limited engagement with the micro-level decision processes through which sustainability strategies are enacted (Hart and Dowell, 2011). This creates a disconnect between sustainability objectives and leadership behavior, particularly in SMEs operating under resource constraints.

These theoretical tensions highlight a gap in existing research: the lack of integrative models explaining how AI-enabled systems interact with leadership cognition to support agile and sustainable decision-making in SMEs. Addressing this gap forms the central motivation for the present study.

Despite extensive research on AI adoption and leadership effectiveness, existing studies rarely integrate decision theory, leadership cognition, and sustainability into a unified analytical framework. As a result, the mechanisms through which AI influences leadership agility remain under-theorized, particularly in SME and emerging market contexts. This theoretical fragmentation motivates the present study's integrative approach, which conceptualizes AI as a cognitive and strategic enabler embedded within leadership decision systems rather than as a stand-alone technological artifact.

2.2.2 Human–AI Complementarity and Augmented Leadership Models

Contemporary scholarship increasingly rejects deterministic narratives of technological substitution and instead advances models of human-AI complementarity (Brynjolfsson & McAfee, 2017).Rather than replacing managerial judgment, AI systems function as analytical collaborators that augment human interpretation, scenario evaluation, and risk assessment. This perspective is consistent with socio-technical systems theory, which posits that performance optimization arises from the joint alignment of social and technical subsystems rather than from technological sophistication alone.

In leadership contexts, complementarity manifests through distributed cognition, where AI performs high-volume analytical processing while leaders provide contextual reasoning, ethical judgment, and relational coordination. (Jarrahi, 2018) argues that algorithmic systems enhance decision-making most effectively when embedded within human oversight structures that allow iterative questioning, validation, and interpretation. This hybrid configuration avoids both automation bias, where leaders over-rely on algorithmic outputs, and algorithm aversion, where leaders dismiss machine-generated insights due to mistrust.

For sustainability-driven SMEs, the complementarity model is particularly salient. Resource constraints and centralized authority structures amplify the influence of individual leaders on organizational direction. In such settings, AI-enabled augmentation may strengthen leadership agility by expanding the range of alternatives considered and by enabling structured comparison of sustainability trade-offs. However, this effect remains contingent upon leadership willingness to engage with AI outputs critically and to embed them within strategic routines.

In relation to the study's second research question, which examines the relationship between AI-enabled leadership agility and sustainability within SMEs, complementarity theory clarifies that AI does not directly produce sustainability outcomes. Rather, AI contributes to the development of leadership capabilities that enable more informed, anticipatory, and context-sensitive decision-making. Sustainability is therefore understood not as an immediate performance consequence, but as a capability-mediated orientation embedded within leadership cognition and governance processes. AI strengthens leadership agility when it enhances interpretive depth, temporal awareness, and adaptive responsiveness, thereby reinforcing leaders' capacity to navigate environmental complexity and integrate sustainability considerations into strategic deliberation.

2.2.3 AI as Cognitive Infrastructure Rather Than Technical Asset

The conceptualization of Artificial Intelligence as a leadership capability requires a departure from technology-centric interpretations that frame AI primarily as a tool for efficiency or automation. Instead, AI is more accurately understood as a form of cognitive infrastructure that reshapes how leadership work is performed.

As cognitive infrastructure, AI influences leadership through three interrelated mechanisms.

First, it restructures information availability by filtering, prioritizing, and visualizing complex datasets, thereby shaping what leaders notice and how strategic issues are framed. Second, it alters temporal orientation by enabling forward-looking analysis and scenario modeling, extending leadership attention beyond immediate operational cycles. Third, it redistributes cognitive load by automating routine analytical tasks, allowing leadership capacity to be redirected toward strategic interpretation and judgment.

These mechanisms align AI closely with leadership agility, which depends on anticipatory sensemaking and adaptive response rather than static planning. However, this alignment is not automatic. It depends on leaders' active engagement with AI outputs and their capacity to interpret, question, and contextualize what analytical systems produce. Without such interpretive competence, AI-generated insights risk remaining decoupled from strategic decision-making processes.

In SME contexts, AI's role as cognitive infrastructure is particularly salient due to constrained managerial bandwidth and centralized decision authority. When effectively integrated, AI can compensate for structural limitations by extending leaders' analytical reach and supporting earlier recognition of emerging risks and opportunities. When poorly integrated, however, AI tends to remain operationally bounded, reinforcing existing decision patterns rather than enabling adaptive leadership behavior. This distinction emerged inductively during early engagement with the case organizations and proved analytically significant.

Understanding AI as cognitive infrastructure also draws attention to how leadership cognition itself is reshaped. Predictive analytics, scenario modeling, and anomaly detection expose leaders to emerging signals earlier in the decision cycle, shifting attention away from retrospective performance indicators toward prospective considerations. This temporal reconfiguration does not eliminate uncertainty; rather, it changes when uncertainty becomes salient and how it is addressed within leadership deliberation.

At the same time, this shift introduces new cognitive demands alongside new capabilities. AI-generated insights rarely present themselves as definitive answers. They require validation against organizational realities, judgment regarding relevance and reliability, and reconciliation with competing stakeholder expectations. In sustainability-driven SMEs, where data completeness is uneven and institutional conditions remain volatile, AI can intensify rather than simplify decision complexity.

This dynamic underscores why AI should be understood as augmenting leadership cognition rather than automating leadership decisions. While advanced analytics expand the range of considerations leaders must weigh, such as longer-term environmental risks, resource dependencies, and regulatory exposure, they also increase the importance of framing problems appropriately and recognizing the limits of algorithmic outputs.

Leadership agility becomes central in managing this balance between analytical possibility and practical judgment.

Finally, the cognitive influence of AI depends on how deeply it is embedded within leadership routines. Where AI outputs remain detached from strategic discussions or are consulted selectively, their impact on leadership cognition is limited. By contrast, when AI is incorporated into regular leadership processes, such as strategic reviews, investment decisions, or sustainability planning, it becomes part of the cognitive environment through which leadership judgment is exercised. In this way, AI as cognitive infrastructure helps explain why leadership agility emerges as a mediating capability in AI-enabled contexts, capturing the adaptive adjustments leaders make as they navigate increasingly complex and data-mediated decision environments.

2.3 Leadership Agility: Conceptual Foundations

Leadership agility has emerged as a critical capability for navigating organizational complexity, uncertainty, and rapid environmental change. According to Joiner and Josephs (2007), leadership agility is defined as a leader's capacity to anticipate emerging challenges, make timely sense of complex information, and initiate adaptive action. This perspective emphasizes both cognitive flexibility and behavioral responsiveness, positioning leadership agility as a dynamic competence rather than a static trait. The study adopts Joiner's definition of leadership agility as its primary anchor due to its emphasis on anticipatory action, which aligns more closely with AI-enabled decision environments than reactive adaptability frameworks

While leadership agility is often used interchangeably with related constructs such as adaptability and resilience, important distinctions exist. Adaptability typically refers to reactive adjustment following environmental change, whereas resilience emphasizes the capacity to absorb shocks and maintain function (Lengnick-Hall et al., 2011). Leadership agility, by contrast, incorporates a proactive and anticipatory dimension, emphasizing early sensing, rapid interpretation, and timely intervention (Joiner, 2007).

This distinction is analytically important for AI-enabled leadership. AI systems are particularly effective at supporting anticipatory functions, such as forecasting, anomaly detection, and scenario modeling. As such, AI aligns more closely with leadership agility than with reactive adaptability alone.

From a micro-foundational perspective, leadership agility is enacted through cognitive processes, attention allocation, and decision routines rather than through formal structures alone (Teece, 2007). Leaders' ability to interpret weak signals, reframe problems, and mobilize adaptive responses depends on how information is filtered, prioritized, and acted upon.

AI reshapes these micro-foundations by altering leaders' attentional landscape. By automating data processing and surfacing salient patterns, AI influences what leaders notice, how quickly they respond, and which strategic options are considered viable. This reinforces the view of leadership agility as a socio-technical capability rather than a purely behavioral trait.

The concept is closely aligned with adaptive leadership theory, which views leadership as the practice of mobilizing individuals and systems to confront adaptive challenges that lack clear technical solutions (Heifetz et al., 2014.)Adaptive leadership underscores the importance of learning, experimentation, and reframing problems, capabilities that become increasingly salient in digitally disrupted environments. Similarly, complexity leadership theory argues that effective leadership in complex systems emerges through distributed interactions, enabling adaptive responses beyond formal hierarchical authority (Uhl-Bien and McKelvey, 2007; Uhl-Bien, Marion, and McKelvey, 2007).

From a strategic perspective, dynamic capabilities theory provides an additional lens for understanding leadership agility. Teece (2007; 2014) conceptualizes dynamic capabilities as the firm's ability to sense opportunities and threats, seize them through timely decisions, and transform organizational resources accordingly. Leadership agility can thus be understood as the human and cognitive dimension through which dynamic capabilities are enacted, particularly in SMEs where leaders play a central role in strategic decision-making.

Despite these theoretical contributions, much of the leadership agility literature implicitly assumes stable organizational infrastructures and mature decision-support systems. Classical leadership models were developed largely in contexts where decision-making relied on human judgment, experience, and bounded rationality (Simon, 1997). As a result, these frameworks offer limited insight into how emerging technologies such as Artificial Intelligence, predictive analytics, and automation**,** reshape leaders' sensemaking processes, decision speed, and strategic responsiveness.

In SME contexts, especially within emerging markets, leadership agility is further shaped by resource constraints, informal governance structures, and strong founder-centric decision authority(Kamoche and e Cunha, 2001). These conditions intensify the importance of leadership agility while simultaneously constraining its expression. This gap points to the need for an updated conceptualization of leadership agility that explicitly accounts for AI-enabled cognition, data-driven foresight, and technologically augmented decision-making.

Accordingly, this study extends existing leadership agility frameworks by examining how AI technologies function as enablers of adaptive leadership, augmenting leaders' ability to sense environmental change, interpret complex data, and respond strategically within sustainability-driven SMEs.

2.3.1 Positioning the Study Within Applied Doctoral Research

As a Doctorate in Business Administration (DBA) study, this research is positioned within an applied research paradigm that seeks to bridge theory and practice. Unlike purely theoretical inquiry, DBA research emphasizes the generation of contextually grounded insights that inform managerial action while contributing to scholarly understanding (Van de Ven, A.H. ;, 2007)

The study does not aim to test predictive models or establish universal causal relationships. Instead, it adopts an interpretive, exploratory approach to examine how AI tools are understood, adopted, and utilized by leaders within sustainability-driven SMEs. This positioning aligns with calls for more qualitative, process-oriented research in leadership and digital transformation studies, particularly within emerging market contexts(Eisenhardt et al., 2016).

By focusing on leadership capability development rather than performance outcomes, the study acknowledges the complexity and path-dependent nature of AI adoption in SMEs. This orientation allows for a nuanced examination of leadership agility as an emergent capability shaped by organizational context, technological readiness, and managerial sensemaking.

2.3.2 Micro foundations of Leadership Agility in Digital Contexts

Dynamic capabilities theory emphasizes that organizational agility emerges from micro-foundations embedded within managerial cognition, decision routines, and resource orchestration processes (Teece, 2014). Leadership agility therefore cannot be treated solely as a behavioral attribute; it is enacted through attention allocation, interpretive framing, and strategic coordination mechanisms.

The attention-based view of the firm (Ocasio, 1997) suggests that what leaders notice and prioritize directly shapes organizational action. In digitally mediated environments, AI systems influence attentional structures by surfacing anomalies, forecasting risks, and visualizing performance interdependencies. Consequently, AI does not merely provide information; it reconfigures the cognitive salience of issues competing for leadership focus.

Upper echelons theory (Hambrick & Mason, 1984) further underscores that strategic outcomes reflect the cognitive frames and experiential backgrounds of top executives. AI-enabled systems may expand or challenge these cognitive frames by presenting data-driven counterfactuals, scenario simulations, and predictive insights that destabilize entrenched assumptions. However, such cognitive expansion occurs only when leaders actively engage with algorithmic outputs rather than treating them as technical artifacts.

Within SMEs, where leadership authority is centralized and governance structures are less formalized, these micro foundations are magnified. Leadership agility becomes highly dependent on the individual leader's interpretive capacity and openness to technological augmentation. In alignment with the study's third research question concerning contextual moderators in MENA SMEs, this section clarifies that AI-enabled leadership agility is mediated by cognitive and attentional processes that operate at the micro level of decision-making.

2.3.3 Leadership Agility as a Mediating Capability

Leadership agility occupies a mediating position between technological augmentation and strategic orientation. Rather than functioning as an independent leadership trait, agility emerges through leaders' capacity to integrate information, interpret uncertainty, and enact timely reconfiguration.

From a capability-based perspective, leadership agility is best understood as the micro-foundational mechanism through which dynamic capabilities are enacted. Sensing, seizing, and transforming require not only organizational resources but leadership judgment capable of interpreting weak signals and acting under ambiguity. AI-enabled systems may strengthen these processes by extending leaders' perceptual and temporal reach; however, they do not substitute for interpretive authority.

This mediating role is particularly relevant in sustainability-driven SMEs, where leadership decisions directly shape organizational priorities and resource allocation. Leadership agility determines whether AI-supported insights translate into sustainability-oriented action or remain analytically disconnected from strategic choice.

Accordingly, this study conceptualizes leadership agility not as an outcome of AI adoption, but as the capability through which AI exerts influence on sustainability orientation and adaptive behavior. This framing provides a coherent link between decision theory, leadership scholarship, and sustainability research.

2.4 Automation, Predictive Analytics, and Strategic Capacity

Automation and predictive analytics represent two interrelated mechanisms through which Artificial Intelligence enhances strategic capacity and leadership agility. Automation, particularly in the form of intelligent process automation and robotic process automation, reduces cognitive and administrative load by standardizing routine activities, thereby potentially freeing leadership attention for higher-order strategic tasks, depending on how work is redistributed within the organization (Davenport and Kirby, 2016). In organizational settings, this shift enables leaders to reallocate time from operational supervision toward strategic reflection, experimentation, and sustainability-oriented decision-making.

From a behavioral decision-making perspective, automation and predictive analytics also influence leadership agility by mitigating systematic cognitive biases. Leaders operating under uncertainty are prone to overconfidence, availability bias, and escalation of commitment, all of which can constrain adaptive response (Kahneman, 2011). Predictive models provide counterfactual insights that challenge intuition and support more disciplined decision evaluation.

However, the literature cautions that AI may also introduce new biases if data quality is poor or models lack transparency (Schein, 2010). Leadership agility therefore depends on leaders' capacity to critically interpret AI outputs rather than accept them uncritically.

Recent studies suggest that digital technologies may reconcile this paradox by enabling dynamic sustainability management (Porter and McKramer, 2011). AI-supported monitoring and analytics allow sustainability metrics to inform real-time decisions, transforming sustainability from a constraint into a source of strategic flexibility. Leadership agility thus becomes a critical mechanism for integrating sustainability objectives into adaptive decision-making.

Predictive analytics extends this capacity by enabling leaders to move beyond retrospective analysis toward anticipatory sensemaking. Drawing on historical, real-time, and external data, predictive models identify emerging patterns, forecast potential outcomes, and support scenario-based planning (Davenport and Harris, 2007). From a decision-science perspective, such tools mitigate cognitive biases associated with intuitive judgment under uncertainty, including overconfidence and availability bias (Kahneman, 2011). As a result, predictive analytics enhances both decision quality and responsiveness in volatile environments.

Strategic management literature suggests that these capabilities are particularly valuable in dynamic contexts where rapid reconfiguration of resources is required. Teece (2007) emphasizes that sensing and seizing opportunities depend on timely access to relevant information and the ability to interpret weak signals. Automation and predictive analytics thus function as enablers of dynamic capabilities, supporting leaders in detecting change earlier and acting more decisively. However, the effectiveness of these technologies depends on their integration into leadership routines and decision forums rather than their standalone technical deployment.

In SME contexts, automation and analytics offer disproportionate benefits by compensating for limited managerial bandwidth and formal systems (OECD, 2021). Nevertheless, empirical studies indicate that SMEs often deploy automation tactically to improve efficiency, without embedding predictive insights into strategic decision-making (Brock and Von Wangenheim, 2019).This disconnect limits the contribution of AI to leadership agility and long-term value creation.

Furthermore, sustainability-driven SMEs face additional complexity, as leaders must balance economic performance with environmental and social objectives. Predictive analytics can support this balancing act by integrating sustainability metrics such as energy consumption, resource efficiency, and risk exposure into strategic planning models(Porter & McKramer, 2011). Yet, without appropriate leadership interpretation and governance, such insights risk being underutilized or misaligned with organizational priorities.

Accordingly, this study conceptualizes automation and predictive analytics not as isolated technologies, but as strategic enablers that augment leadership cognition and adaptive capacity. By examining how SME leaders in the MENA region engage with these tools, the study contributes to a more nuanced understanding of how AI strengthens strategic capacity under conditions of uncertainty and sustainability pressure. In SME contexts examined in this research, automation was rarely perceived as strategic in itself; rather, its value depended on whether it released leadership attention for higher-order judgment.

2.4.1 AI, Temporal Dynamics, and Strategic Foresight

Leadership agility is intrinsically temporal. Agile leadership requires not only rapid response but also anticipatory positioning relative to emerging risks and opportunities. Time-based competition literature emphasizes that decision speed and early risk detection confer strategic advantage in volatile environments (Eisenhardt, 1989). However, speed without foresight may amplify error under uncertainty.

Artificial Intelligence reshapes temporal dynamics by enabling forward-looking analytics. Predictive models integrate historical and real-time data to generate probabilistic forecasts, thereby extending leaders' future orientation beyond immediate operational cycles. Scenario planning theory highlights the importance of structured anticipation in complex systems; AI enhances this process by modeling multiple contingencies simultaneously (Schoemaker, 1995)

In sustainability-driven SMEs, temporal foresight is critical for evaluating long-term environmental trade-offs, regulatory trajectories, and market transitions toward green technologies. AI-enabled forecasting may therefore strengthen anticipatory leadership agility by compressing feedback loops and enabling earlier intervention. However, absent structured integration into strategic routines, predictive outputs risk remaining descriptive rather than transformative.

This temporal reframing supports the study's central proposition that AI contributes to leadership agility not merely by accelerating decisions, but by reconfiguring when and how decisions are made relative to sustainability pressures.

2.4.2 Strategic Capacity as a Function of Cognitive Reallocation

Existing literature often conceptualizes strategic capacity as an organizational attribute derived from resource availability, planning sophistication, or market positioning. However, in sustainability-driven SMEs, strategic capacity is more accurately understood as a cognitively constrained leadership function, shaped by how decision-makers allocate attention, interpret uncertainty, and sequence action over time.

Automation and predictive analytics contribute to strategic capacity not by generating strategy autonomously, but by reconfiguring the cognitive conditions under which strategy is formed. Automation reduces the volume of routine supervisory and administrative tasks that compete for leadership attention, thereby reallocating cognitive resources toward higher-order interpretive and evaluative work. This reallocation is particularly consequential in SMEs, where leadership roles are multi-functional and managerial overload is structurally embedded.

Predictive analytics extends this effect by altering the epistemic basis of strategic judgment. Rather than relying predominantly on retrospective indicators and experiential intuition, leaders gain access to probabilistic assessments of future states. This does not eliminate uncertainty; instead, it changes the form of uncertainty from opaque ambiguity to structured indeterminacy, enabling comparative evaluation of alternative strategic trajectories.

From a leadership agility perspective, strategic capacity emerges when leaders can move fluidly between operational immediacy and strategic abstraction. Automation supports this movement by stabilizing routine processes, while predictive analytics supports it by enabling anticipatory reasoning. However, these technologies only enhance strategic capacity when leadership retains interpretive control. Where predictive outputs are treated as definitive rather than deliberative inputs, strategic rigidity may increase rather than decrease.

Accordingly, automation and analytics should be conceptualized as enabling infrastructures for strategic cognition, not substitutes for leadership judgment. Their contribution to leadership agility lies in expanding the range of viable strategic options considered, not in determining strategic choice itself.

2.4.3 A Temporal Reconfiguration and Anticipatory Leadership Action

Strategic foresight is fundamentally a temporal capability. It concerns not only the anticipation of future conditions but also the timing of intervention within evolving systems. Traditional strategic planning models assume relatively stable temporal horizons and linear causality, conditions that rarely hold in sustainability-driven SME environments characterized by regulatory flux, technological acceleration, and market volatility.

AI-enabled predictive analytics disrupt these assumptions by compressing feedback loops and enabling continuous temporal reassessment. Leaders are no longer confined to periodic planning cycles but can engage in ongoing temporal sensemaking, adjusting strategic posture as new signals emerge. This reconfiguration does not accelerate decision-making uniformly; rather, it enables selective acceleration, where leaders intervene earlier in some domains while deliberately delaying commitment in others.

From a leadership agility standpoint, temporal reconfiguration enhances adaptive capacity by decoupling responsiveness from reactivity. Leaders gain the ability to distinguish between transient noise and structurally significant signals, a distinction that is critical for sustainability-oriented decision-making where premature action may generate unintended consequences.

However, foresight enabled by AI remains contingent upon interpretive framing. Predictive models offer scenarios, not prescriptions. Leadership agility is therefore expressed in how leaders integrate temporal insights into strategic sequencing, balancing exploration and commitment under conditions of uncertainty. Where such integration is absent, predictive analytics may reinforce short-term optimization rather than long-term sustainability orientation.

2.5 Organizational and Process Agility in Sustainability-Driven SMEs

Organizational and process agility are critical capabilities for firms operating in environments characterized by uncertainty, regulatory pressure, and sustainability imperatives. Organizational agility refers to an enterprise's capacity to realign its structures, strategies, and priorities in response to environmental change, while process agility denotes the ability to rapidly reconfigure workflows, routines, and decision pathways (Doz and Kosonen, 2010).Together, these forms of agility enable firms to respond proactively to both market dynamics and sustainability-related challenges.

A persistent tension within sustainability scholarship concerns the perceived trade-off between agility and sustainability. Sustainability initiatives are often associated with long-term planning, standardization, and compliance, whereas agility emphasizes flexibility and rapid change. For SMEs, this tension is particularly acute, as limited resources restrict their ability to pursue both simultaneously.

Recent studies suggest that digital technologies may reconcile this paradox by enabling dynamic sustainability management (Porter and McKramer, 2011). AI-supported monitoring and analytics allow sustainability metrics to inform real-time decisions, transforming sustainability from a constraint into a source of strategic flexibility. Leadership agility thus becomes a critical mechanism for integrating sustainability objectives into adaptive decision-making.

In the context of sustainability-driven SMEs, agility assumes heightened importance due to constrained resources, limited slack, and heightened exposure to environmental and regulatory risks. Strategic management literature suggests that SMEs rely more heavily on leadership judgment and informal coordination mechanisms than on formalized structures (Mintzberg, 2009). While such flexibility can support rapid adaptation, it may also limit scalability and consistency, particularly when sustainability objectives require systematic measurement and long-term planning.

Sustainability scholarship emphasizes that integrating environmental and social considerations into strategy requires organizational capabilities that go beyond compliance and reporting (Porter and McKramer, 2011).The concept of the "triple bottom line" highlights the need for firms to balance economic performance with environmental stewardship and social responsibility. For SMEs, achieving this balance is especially challenging due to the absence of formal performance measurement systems and sustainability analytics, which constrains leaders' ability to make informed trade-offs.

Process agility is equally critical in sustainability contexts, as firms must continuously adjust operational processes to meet evolving standards, stakeholder expectations, and technological developments. However, without digital and analytical support, such learning often remains tacit and leader-dependent rather than institutionalized.

Artificial Intelligence offers a potential mechanism to bridge this gap by enabling real-time monitoring, predictive insights, and integrated sustainability metrics across organizational processes. Yet, as organizational theory cautions, technology alone does not create agility unless accompanied by aligned leadership practices, culture, and governance structures (Schein, 2010). In SMEs, where leadership authority is concentrated, the successful integration of AI into organizational and process agility depends heavily on leaders' willingness to embed data-driven insights into strategic and operational decision-making.

Accordingly, this study positions organizational and process agility as socio-technical capabilities, shaped by the interaction between leadership, culture, and AI-enabled systems. By examining sustainability-driven SMEs in the MENA region, the study contributes to a deeper understanding of how agility is enacted in resource-constrained contexts and how AI can support the alignment of sustainability goals with adaptive organizational practices.

2.5.1 Theoretical and Practical Significance of the Study

From a theoretical perspective, this study contributes to emerging scholarship at the intersection of leadership, digital transformation, and sustainability by advancing an integrative view of AI as a cognitive and strategic enabler rather than a substitute for leadership. It responds to calls for research that moves beyond technology adoption metrics to examine how digital tools reshape leadership processes and decision dynamics (Jarrahi, 2018).

The study also extends leadership agility theory by embedding it within digitally mediated decision environments, thereby addressing a key limitation of existing models that assume human-centered cognition. Furthermore, by situating the analysis within sustainability-driven SMEs, the research addresses a significant empirical gap in leadership and AI literature, which has historically focused on large organizations in developed economies.

From a practical standpoint, the findings offer actionable insights for SME leaders seeking to leverage AI responsibly and effectively under conditions of uncertainty. The study informs policymakers and practitioners involved in SME digital transformation by highlighting the organizational and leadership conditions necessary for translating AI investment into adaptive and sustainable decision-making capabilities.

2.5.2 Sustainability as Strategic Capability in SMEs

The natural resource-based view conceptualizes environmental capability as a source of sustained competitive advantage when embedded within firm strategy (Hart, 1995) . For SMEs, sustainability may function not only as a compliance requirement but as a strategic differentiator that enhances legitimacy, stakeholder trust, and market positioning.

Stakeholder theory further argues that long-term firm viability depends on balancing the expectations of diverse constituencies, including regulators, customers, investors, and communities (Freeman, 1984). In emerging markets, sustainability pressures are often unevenly institutionalized, creating variability in how SMEs interpret and prioritize environmental commitments.

Institutional theory suggests that firms may adopt sustainability practices symbolically to secure legitimacy (DiMaggio and Powell, 1983).However, without measurement systems and data integration, sustainability remains decoupled from strategic decision-making. AI-enabled systems offer the potential to transform sustainability from symbolic compliance to dynamic intelligence by integrating environmental metrics into financial and operational dashboards.

In alignment with the study's fourth research question, developing frameworks for AI-enabled leadership integration, this section underscores that sustainability outcomes are contingent upon leadership capability. AI strengthens sustainability performance only when embedded within governance structures that allow leaders to interpret, evaluate, and act upon environmental intelligence.

2.6 Cultural and Institutional Context of AI Adoption in MENA

The adoption of Artificial Intelligence and the expression of leadership agility are deeply shaped by cultural, institutional, and governance contexts. In the MENA region, leadership practices are strongly influenced by hierarchical organizational norms, high power-distance cultures, and centralized decision-making structures, which affect how authority, accountability, and innovation are distributed within firms (Hofstede, 2001; House et al., 2004). These cultural characteristics often reinforce top-down leadership styles, which can constrain experimentation, distributed decision-making, and the adaptive use of AI-enabled insights.

Institutional theory provides an additional lens for understanding AI adoption in MENA SMEs. Organizations operating in environments characterized by regulatory complexity and strong state influence often adopt technologies to signal legitimacy rather than to transform internal practices (DiMaggio and Powell, 1983).This symbolic adoption may limit the impact of AI on leadership behavior.

In such contexts, leadership agility is shaped not only by technological capability but also by institutional expectations and cultural norms. Leaders may face tension between experimentation and conformity, particularly where failure carries reputational or regulatory risk. These dynamics moderate the extent to which AI can be leveraged as a leadership capability in emerging markets.

While national initiatives such as Saudi Vision 2030 and the UAE AI Strategy articulate ambitious agendas for digital transformation and sustainability, the translation of these policy-level ambitions into operational practices within SMEs remains uneven. Institutional theory suggests that organizations operating in highly regulated or state-driven environments tend to adopt technologies symbolically to gain legitimacy rather than instrumentally to transform core processes. This phenomenon is particularly pronounced in emerging economies, where regulatory pressure and compliance requirements may outweigh internal capability readiness.

Empirical evidence indicates that digital transformation initiatives in the region are frequently policy-driven and centrally designed, leading to misalignment with the resource constraints, skill gaps, and informal decision structures characteristic of SMEs (World Bank, 2022). From a leadership perspective, this misalignment moderates how AI tools are perceived and embedded into strategic processes, often limiting their use to operational reporting rather than adaptive sensemaking. As Schein (2010) argues, technology adoption is ultimately mediated by organizational culture, shared assumptions, and leadership behavior, underscoring the importance of culturally sensitive and context-aware AI implementation models for fostering leadership agility in MENA-based SMEs.

2.6.1 Institutional Mediation of Leadership Agility in AI-Enabled Contexts

The effectiveness of AI-enabled leadership agility cannot be understood independently of institutional context. In the MENA region, leadership practices are embedded within governance systems characterized by centralized authority, high power distance, and strong regulatory signaling. These institutional features shape not only technology adoption decisions but also the cognitive legitimacy of AI-generated insights within leadership hierarchies.

Institutional theory suggests that organizations operating under strong regulatory and normative pressures may adopt technologies symbolically to signal alignment with policy agendas or modernization narratives. In such cases, AI adoption serves legitimizing rather than adaptive functions. This distinction is critical for leadership agility, which depends on the substantive integration of AI into decision routines rather than its formal presence.

For SME leaders, institutional mediation manifests through risk sensitivity, accountability norms, and tolerance for experimentation. In environments where deviation from established authority structures is discouraged, leaders may limit AI use to confirmatory analysis rather than exploratory sensemaking. This constrains the development of leadership agility by narrowing the scope of interpretive flexibility.

Conversely, where institutional environments provide cognitive and regulatory space for experimentation, AI may support distributed sensemaking and iterative decision adjustment. Leadership agility in such contexts reflects the leader's capacity to navigate institutional expectations while selectively leveraging AI-enabled augmentation.

This analysis positions institutional context not as an external constraint, but as an active moderator of leadership cognition, shaping how AI is perceived, trusted, and utilized within leadership processes.

2.6.2 Contextual Moderation and Non-Linear Capability Development

The integrative model linking AI, leadership agility, and sustainability assumes a non-linear capability development process, particularly within emerging market SMEs. AI adoption does not translate uniformly into leadership agility; instead, its effects are mediated by leadership interpretation and moderated by institutional and cultural conditions.

This non-linearity explains why similar AI tools may generate divergent leadership outcomes across comparable organizations. Where institutional norms favor hierarchical decision-making and risk avoidance, AI may reinforce centralized control rather than enable adaptive reconfiguration. Where norms allow interpretive discretion and learning, AI may enhance anticipatory leadership and strategic flexibility.

Accordingly, leadership agility should be conceptualized as a contextually contingent capability, emerging from the interaction between technological augmentation, leadership cognition, and institutional environment. This framing avoids technological determinism and aligns the model with empirical realities observed in sustainability-driven SMEs.

2.6.3 Integrative Theoretical Model: Linking AI, Leadership Agility, and Sustainability

The preceding review suggests that the relationship between Artificial Intelligence adoption, leadership agility, and sustainability outcomes is mediated and conditional rather than linear. AI technologies, including automation, predictive analytics, and intelligent agents, function as enabling mechanisms that extend cognitive and temporal capacities. However, their strategic impact is contingent upon leadership engagement and organizational readiness.

Leadership agility operates as a mediating capability, expressed through enhanced sensemaking, adaptive reconfiguration, and anticipatory orientation. This capability is shaped by micro foundational processes, including attention allocation, interpretive framing, and governance routines. Sustainability outcomes emerge as downstream effects, dependent upon the quality of agile leadership decisions rather than direct technological causality.

Contextual variables, including institutional structures, cultural norms, and digital maturity levels within MENA SMEs, moderate this relationship. Where governance coherence and data infrastructure are present, AI may amplify adaptive leadership behavior. Where institutional voids and structural constraints persist, AI adoption may remain operationally bounded.

This integrative model positions AI as a cognitive and temporal infrastructure embedded within leadership processes, mediated by agility, and moderated by contextual conditions. The framework provides the theoretical foundation for the empirical investigation undertaken in subsequent chapters and directly informs the study's research questions.

2.6.3A Theoretical Coherence and Mediating Logic of Leadership Agility

While the preceding sections introduce the theoretical components informing this study, their integration requires further clarification. The value of the proposed framework does not lie in the accumulation of established theories, but in how these perspectives collectively explain leadership behavior under conditions of technological augmentation and sustainability pressure. In this respect, leadership agility serves as a connective construct rather than an isolated capability.

Bounded rationality provides an essential starting point by foregrounding the cognitive limitations under which leaders operate, particularly in environments characterized by uncertainty, time pressure, and information overload. Within sustainability-driven SMEs, these constraints are amplified by resource limitations and the concentration of decision authority. Artificial intelligence does not eliminate such constraints; rather, it alters their configuration by expanding informational access while introducing new interpretive challenges.

Leadership agility becomes analytically relevant at this intersection. Unlike static leadership traits or role-based competencies, agility captures how leaders adapt cognitive frames, reprioritize attention, and adjust decision timing in response to changing conditions. This makes it particularly suited to contexts where AI reshapes what leaders see, how early signals emerge, and how rapidly options can be evaluated. The study therefore positions leadership agility not as a derivative outcome of AI adoption, but as the mediating capability through which augmented cognition translates into strategic action.

Sustainability orientation further anchors this framework by situating leadership agility within long-term value creation rather than short-term optimization. Sustainability decisions often involve trade-offs across temporal horizons, stakeholder interests, and performance metrics. These characteristics intensify cognitive demands and heighten the importance of anticipatory judgment. By integrating sustainability orientation into the model, the framework acknowledges that leadership agility is exercised not only in response to market volatility, but also in navigating persistent environmental and social pressures.

All in all, these constructs form a coherent explanatory structure. Bounded rationality defines the cognitive conditions of leadership, AI reshapes the informational environment, leadership agility mediates adaptive response, and sustainability orientation provides strategic direction. This alignment ensures that the theoretical framework reflects the lived realities of SME leadership rather than abstract organizational ideals.

This theoretical positioning has important implications for how AI-enabled leadership agility is examined empirically. If leadership agility operates as the mediating capability between augmented cognition and sustainability-oriented outcomes, then empirical attention must focus on how leaders interpret, engage with, and act upon AI-generated insights within specific organizational and institutional contexts. This perspective informs the research design adopted in this study, which prioritizes leadership sensemaking, adaptive decision processes, and contextual moderation over purely technological or performance-based measures. The following section therefore clarifies the conceptual boundaries within which this model is applied.

2.6.4 Construct Boundaries and Conceptual Delimitations

The conceptual model developed in this chapter requires clear construct boundaries to avoid theoretical ambiguity. Three core constructs underpin this study: Artificial Intelligence-enabled capabilities, leadership agility, and sustainability orientation. Each construct is defined within specific analytical limits to ensure coherence and to prevent conceptual drift into performance determinism.

First, Artificial Intelligence in this study refers specifically to AI-enabled agents, intelligent automation, and predictive analytics that support managerial decision-making processes. It does not include generalized digitalization, basic IT infrastructure, or non-learning rule-based systems. The analytical focus is therefore on AI applications that contribute to data interpretation, anticipatory insight, or structured comparison of alternatives. By delimiting AI to cognitively augmentative technologies, the study avoids conflating technological sophistication with leadership capability development.

Second, leadership agility is conceptualized as a dynamic managerial capability expressed through enhanced sensing, adaptive reconfiguration, and anticipatory orientation. It is not equated with leadership style, personality traits, or rapid decision speed alone. Rather, leadership agility reflects the capacity of decision-makers to interpret complexity, reallocate attention, and recalibrate strategy under uncertainty. This distinction is essential to maintain alignment with a capability-based perspective rather than behavioral description.

Third, sustainability is framed as a strategic orientation embedded within governance and decision-making processes, rather than as a measurable performance outcome. While sustainability performance indicators such as cost efficiency, emissions reduction, or market positioning may emerge downstream, this study focuses on how sustainability considerations are cognitively and structurally integrated into leadership routines. By maintaining this capability orientation, the analysis avoids deterministic assumptions linking AI adoption directly to environmental or financial outcomes.

The contextual boundaries of the study are equally important. The research concentrates on sustainability-driven SMEs operating within MENA institutional environments characterized by uneven digital maturity and evolving regulatory structures. Findings are therefore analytically situated within this specific socio-economic context and are not intended to imply universal generalizability across all firm sizes or regions.

Clarifying these construct boundaries strengthens internal coherence and ensures that subsequent empirical analysis remains focused on capability development rather than outcome measurement.

2.7 Synthesis of Literature and Research Gaps

Synthesizing the reviewed literature reveals several unresolved gaps. First, existing research insufficiently theorizes AI as a leadership capability that reshapes sensemaking, timing, and adaptive judgment. Second, leadership agility frameworks rarely incorporate digital technologies as active constituents of leadership practice. Third, sustainability scholarship remains weakly connected to leadership decision processes, particularly in SME contexts.

Moreover, empirical evidence from emerging markets, and the MENA region in particular, remains scarce. Cultural norms, institutional constraints, and digital maturity levels fundamentally alter how AI and leadership interact, limiting the transferability of Western-centric models.

These gaps justify the present study's focus on AI-enabled leadership agility in sustainability-driven SMEs. By adopting a qualitative, capability-focused approach, the study contributes to theory development while addressing a critical empirical blind spot.

2.7.1 Countervailing Perspectives and Theoretical Reservations

While much of the literature reviewed emphasizes the enabling potential of artificial intelligence for leadership effectiveness, several countervailing perspectives warrant careful consideration. These perspectives do not reject the value of AI outright, but they raise important reservations regarding the conditions under which AI meaningfully contributes to leadership capability rather than reinforcing existing limitations.

One line of critique concerns the risk of symbolic or superficial adoption. In institutional environments characterized by strong regulatory signaling or modernization pressure, organizations may adopt AI tools to demonstrate alignment with policy agendas or technological progress without substantively integrating them into leadership decision processes. In such cases, AI functions as a legitimizing artifact rather than as a cognitive resource, limiting its influence on leadership agility. This risk is particularly relevant in SME contexts, where resource constraints and centralized authority can restrict experimentation and learning.

A second concern relates to data dependency and interpretive bias. While AI systems expand informational access, they also rely on underlying data structures that may be incomplete, biased, or historically anchored. When leaders lack the capacity or confidence to interrogate AI-generated insights, there is a risk that analytical outputs are treated as objective or authoritative, narrowing rather than expanding interpretive flexibility. This concern echoes broader critiques within decision science that caution against over-reliance on quantitative models in complex and uncertain environments.

A further reservation involves the potential attenuation of experiential judgment. Some scholars argue that increased reliance on predictive analytics may marginalize tacit knowledge and context-specific understanding, particularly in settings where informal networks and experiential learning play a central role. In SMEs operating within volatile institutional contexts, such knowledge often compensates for weak formal systems. The uncritical integration of AI risks displacing these adaptive forms of judgment rather than complementing them.

These reservations highlight that AI adoption does not automatically enhance leadership agility and may, under certain conditions, constrain it. Importantly, they also underscore the need to focus analytical attention on leadership behavior rather than technology presence. By positioning leadership agility as a mediating capability, the present study responds to these critiques by shifting the locus of analysis from AI adoption outcomes to how leaders interpret, engage with, and act upon AI-enabled insights.

Rather than assuming positive effects, this approach allows for empirical examination of both enabling and limiting dynamics, capturing instances where AI supports anticipatory leadership as well as cases where its influence remains bounded or symbolic. In doing so, the study addresses a gap in the literature by grounding debates about AI's leadership value in observed leadership practice rather than technological promise alone.

2.8 Theoretical Propositions Guiding the Empirical Inquiry

While this study adopts an exploratory qualitative design rather than a hypothesis-testing approach, the preceding literature review enables the articulation of guiding theoretical propositions that frame the empirical investigation. These propositions do not imply causal determinism but rather conceptual relationships that inform analytical interpretation.

Proposition 1: AI-enabled agents, intelligent automation, and predictive analytics expand managerial sensing capacity by partially relaxing bounded rationality constraints, thereby strengthening cognitive foundations of leadership agility.

Proposition 2: Leadership agility mediates the relationship between AI-enabled augmentation and sustainability orientation, such that AI contributes to sustainability integration only when embedded within adaptive decision-making routines.

Proposition 3: Human–AI complementarity enhances leadership capability development more effectively than substitution-based automation models, particularly within centralized SME governance structures.

Proposition 4: Institutional and digital maturity conditions within MENA contexts moderate the extent to which AI-enabled augmentation translates into enhanced leadership agility.

Proposition 5: AI-enabled temporal reconfiguration, through predictive analytics and scenario modeling, strengthens anticipatory leadership capabilities by extending strategic time horizons.

These propositions provide a structured theoretical lens for analyzing case evidence in subsequent chapters. They ensure coherence between the conceptual framework and empirical interpretation while maintaining alignment with the study's capability-oriented focus.

CHAPTER 3
METHODOLOGICAL DESIGN AND RESEARCH APPROACH

3.1 Methodological Approach

This study adopts a qualitative, multi-case study design to examine how Artificial Intelligence (AI) interacts with leadership agility in sustainability-driven Small and Medium-Sized Enterprises (SMEs). The research focuses on leadership agility as an organizational capability, emphasizing leadership judgment, decision routines, and adaptive behavior rather than measurable performance outcomes.

A qualitative approach is appropriate given the exploratory nature of the research questions and the limited empirical evidence on AI-enabled leadership agility within SME contexts, particularly in emerging markets. Leadership agility is understood as a context-dependent and socially embedded phenomenon that requires in-depth examination of leadership practices, interpretations, and organizational conditions. Qualitative inquiry enables the capture of these dynamics in ways that standardized quantitative measures cannot adequately reflect.

The study does not empirically measure organizational performance as a dependent variable. Comparable and consistently available performance data vary significantly across SMEs due to differences in sectoral context, governance structures, digital maturity, and data availability. Where performance-related indicators are referenced, they are used illustratively to contextualize leadership practices rather than to evaluate or compare organizational outcomes.

A multi-case design supports analytical comparison across organizations exhibiting different configurations of AI adoption, leadership autonomy, and sustainability integration. This approach enables the identification of patterns and contrasts that contribute to theory development rather than statistical generalization.

To provide contextual insight into the professional background of the interview participants, Table 3.1 summarizes key characteristics of the individuals who contributed to this study. Participants were anonymized and coded to maintain confidentiality while allowing the reader to understand their organizational roles, experience, and industry context.

Table 3.1 List of Participants involved in the coding phase

Participant	Gender	Age Range	Role	Organization	Industry	Years of Experience	Contribution Focus
Participant A	Male	40–45	VP Innovation & Smart Building Solutions MENA	EllisDon	Construction & Smart Infrastructure	20+	AI-enabled decision-making, digital twin adoption, sustainability performance, leadership oversight
Participant B	Female	40–45	Managing Director	Enetek Power	Renewable Energy	20+	Sustainability strategy, AI-supported market and partnership decisions, leadership agility constraints
Participant C	Male	50-55	Founder & CEO	LinkHat	Technology & Energy Solutions	25+	Leadership agility, AI adoption barriers, sustainability-driven strategic alignment
Participant D	Male	40-45	Senior Technical Director - Renewable Energy & Data Centers	LinkHat	Renewable Energy & Data Centers	20+	Technical decision-making, AI use for comparison and analysis, data availability constraints
Participant E	Male	40-45	Senior Operations Director - Renewable Energy & Data Centers	LinkHat	Renewable Energy & Data Centers	20+	Operational use of AI for research support, administrative efficiency, and selective automation of repetitive tasks; human-centered

Participant	Gender	Age Range	Role	Organization	Industry	Years of Experience	Contribution Focus
							operational decision-making; limited use of AI for data-driven or predictive analysis due to data maturity and integration constraints
Participant F	Female	30–35	Growth Manager (Capability & Digital Enablement)	LXC - LinkHat Experience Center	Digital Enablement & Capability Development	10+	AI use in growth, marketing, market sensing, proposal development, and capability positioning
Participant G	Male	55-60	Regional Operations / Country Management	NERA	Telecommunications Infrastructure	30+	AI use limitations, centralized governance constraints, operational and engineering resistance.

Source: Author's own elaboration based on empirical findings

3.1.1 Sampling Strategy and Case Selection

A purposive sampling approach was used by selecting four SMEs that:

- Operate in sustainability-related sectors (renewable energy, telecom, sustainable manufacturing, sustainability-driven construction/project management)
- Are small or medium-sized according to national classification
- Have implemented, or are in the process of implementing, AI technologies to support leadership, decision-making, or sustainability initiatives
- Represent different MENA countries to allow for contextual variation

Sampling criteria included:

- Level of AI adoption (minimum: early-stage implementation)
- Digital maturity and sustainability integration
- Availability of leaders and senior professionals involved in AI-enabled initiatives

The sample intentionally reflects cross-country differences (e.g., GCC versus Levant), with clear acknowledgment of limitations, as institutional and digital disparities may constrain direct comparability.

3.1.2 Data Collection Methods

Primary data were collected through semi-structured interviews with senior leaders, founders, and senior managers responsible for strategy, sustainability, digital transformation, or operations. Interviews followed a standardized protocol (Appendix A), ensuring consistency across cases while allowing flexibility to explore organization-specific practices and challenges.

Secondary data included internal documents, sustainability-related materials, strategic presentations, and publicly available organizational information. These sources were used to support contextual understanding and triangulation rather than as independent measures of organizational performance.

3.1.3 Data Handling and Analytical Procedures

Interview data were transcribed and analyzed using a structured, multi-stage coding process. Initial open coding was conducted inductively to identify leadership behaviors, decision-making practices, and perceptions related to AI use and sustainability. Axial coding was then applied to explore relationships between leadership agility dimensions, AI-enabled practices, and organizational conditions. Selective coding supported the synthesis of cross-case themes aligned with the research questions.

Throughout the analysis, leadership agility was treated as an emergent capability rather than a predefined variable. Attention was given to how leaders described their interaction with AI tools, the degree of trust placed in AI-generated insights, and the organizational constraints shaping AI-enabled decision-making.

Table 3.1.3 Illustrative Coding Table.

Raw Interview Statement	**Open Code**	**Axial Category**	**Theme**
"AI is mainly used for repetitive administrative work."	Administrative AI use	Tactical AI application	AI as operational support
"We use AI to compare options, but not to automate decisions."	AI-assisted comparison	Decision support	Human-in-the-loop decision-making
"There is not enough historical data to trust automation."	Data unavailability	Data maturity limitation	Structural constraints on AI
"AI helps sense trends, but strategy remains human."	Market sensing	Strategic support	Limited AI autonomy

Source: Author's own elaboration based on empirical findings

These coding structures were applied consistently across all interviews. Themes were retained only when supported by recurring evidence across multiple participants or when theoretically relevant to leadership agility and sustainability.

3.1.4 Research Quality and Trustworthiness

Credibility was enhanced through the inclusion of participants occupying senior leadership roles and through cross-case comparison. Triangulation of interview data with documentary sources supported contextual accuracy. Dependability was ensured through transparent documentation of the data collection and coding procedures. Reflexivity was maintained to account for the researcher's professional background in digital transformation and leadership practice.

Transferability is supported through detailed contextual description, enabling readers to assess the relevance of the findings to other SME and emerging market settings.

3.1.5 Researcher Bias Management Beyond Triangulation

Beyond methodological triangulation, several measures were implemented to manage researcher bias and enhance analytical rigor. Reflexive awareness was maintained throughout the analysis, particularly given the researcher's professional background in AI, digital transformation, and sustainability. To mitigate interpretive bias, participant language was prioritized during early coding stages through extensive use of in vivo coding, with theoretical interpretation intentionally delayed.

Analytical robustness was further strengthened through sensitivity to negative cases, whereby instances in which AI adoption had limited or no impact on leadership agility or decision quality were retained and examined. Emerging themes were iteratively cross-checked against raw interview data across roles and organizations, and role-based cross-validation was applied by comparing executive, technical, and growth-oriented perspectives to reduce the influence of single-role dominance.

3.1.6 Integration of Case Studies in Framework Development

Cross-case analysis was conducted to identify converging and diverging patterns across the cases, informing the development of a conceptual framework linking AI-enabled practices, leadership agility, and sustainability orientation within the MENA context. The comparative analysis enabled sectoral differentiation, provided empirical grounding for the framework components, and supported the synthesis of mechanisms connecting leadership behaviors to sustainability-related outcomes.

3.1.7 Methodological Scope and Limitations

This study is intentionally scoped to examine leadership capability development rather than to assess causal relationships between AI adoption and organizational performance. Differences in data availability and organizational maturity across cases are treated as analytical features rather than methodological weaknesses. The findings are analytically generalizable and contribute to theory development by clarifying how leadership agility is enacted under conditions of technological change and sustainability pressure

3.1.8 Expected Outcome

The methodological approach is designed to generate a grounded and context-sensitive understanding of how AI is integrated into leadership practices within sustainability-driven SMEs across the MENA region. The empirical insights derived from the case studies inform the development of a conceptual framework that supports theory-building and offers practical and policy-relevant implications, without implying direct measurement of organizational performance outcomes.

3.2 Research Design and Philosophical Positioning

3.2.1 Philosophical Positioning and Epistemological Justification

This study is grounded in an interpretivist epistemological orientation, recognizing that leadership agility and AI-enabled capability development are socially constructed phenomena shaped by contextual meaning-making processes. Rather than assuming objective measurement of performance outcomes, the research seeks to understand how leaders interpret, integrate, and operationalize AI-enabled insights within organizational routines.

An interpretivist stance is particularly appropriate for examining emerging technological capabilities within SME environments, where governance structures, cultural norms, and institutional conditions shape technology adoption trajectories. The study does not aim to quantify causal performance effects but to explore the mechanisms through which AI augments leadership cognition and strategic orientation.

The multi-case qualitative design aligns with this epistemological position by enabling in-depth exploration of managerial sensemaking across distinct organizational contexts. By comparing cases operating under varying degrees of digital maturity and sustainability emphasis, the research captures nuanced patterns of capability development that would be obscured in purely quantitative designs.

This philosophical positioning reinforces the study's analytical focus on capability construction rather than outcome measurement and ensures methodological coherence with the theoretical framework.

CHAPTER 4
EMPIRICAL FINDINGS: CASE STUDIES OF SUSTAINABILITY-DRIVEN SMES

4.1 Introduction to Qualitative Findings and cross- case analysis

This chapter presents the qualitative findings derived from a multi–case study analysis of sustainability-driven Small and Medium-Sized Enterprises (SMEs) operating across the Middle East and North Africa (MENA) region and adjacent emerging markets. The selected cases span three strategically significant sectors: telecommunications infrastructure, renewable and sustainable energy, and construction and project management. These sectors were intentionally chosen due to their high environmental impact, increasing regulatory scrutiny, and growing reliance on digital technologies to meet sustainability and performance objectives.

The study focuses specifically on SMEs, irrespective of whether they operate as independent entities or as subsidiaries within larger multinational or regional groups. This distinction was deliberately incorporated into the research design to capture variation in governance structures, decision-making autonomy, and access to digital and sustainability resources. While some firms benefit from centralized group-level policies, certifications, and technological platforms, others operate with greater independence but more limited institutional support. This variation allows for a nuanced examination of how organizational structure moderates the relationship between AI adoption, leadership agility, and sustainability outcomes.

The selected cases represent SMEs at different stages of digital and sustainability maturity, ranging from early-stage adopters of AI for administrative efficiency to more advanced organizations leveraging predictive analytics and digital twin technologies for sustainability-driven decision-making. All organizations included in the study either actively pursue sustainability objectives through renewable energy solutions, energy-efficient infrastructure, or environmentally optimized project delivery or operate within sectors where sustainability is an inherent operational requirement.

Data were collected through semi-structured interviews with executives, and senior leaders responsible for strategy, innovation, sustainability, or operational decision-making. This approach enabled in-depth exploration of leadership perceptions, behaviors, and practices related to AI adoption and sustainability management. The qualitative analysis does not aim for statistical generalization; rather, it seeks analytical generalization by identifying recurring patterns, contrasts, and mechanisms that explain how AI-enabled tools influence leadership agility within sustainability-oriented SMEs operating under varying market and institutional conditions.

By examining SMEs across telecommunications, renewable energy, and project management, both standalone and group-affiliated, this chapter establishes a robust empirical foundation for understanding how leadership agility emerges at the intersection of digital capability, sustainability governance, and organizational context within the MENA region.

While the case studies examined in this chapter are presented as discrete organizational narratives, leadership agility did not emerge as a static or uniform attribute across cases. Rather, it unfolded over time through sequences of decisions, adjustments, and recalibrations shaped by evolving informational conditions and contextual pressures. Understanding these temporal dynamics is essential for interpreting how AI-enabled augmentation influenced leadership behavior in practice.

Across the cases, leadership engagement with AI tools evolved through identifiable phases. Initial adoption was often driven by operational necessity or external signaling rather than strategic intent. In early stages, AI systems were primarily used to improve visibility, reporting accuracy, or coordination efficiency. While these applications enhanced operational control, they did not immediately alter how leaders framed strategic issues or anticipated future conditions.

As exposure to AI-generated insights increased, some leaders began to engage more actively with predictive outputs and comparative analyses. This transition was not linear. In several cases, leaders oscillated between reliance on experiential judgment and analytical input, particularly when AI outputs conflicted with established assumptions or informal knowledge. Leadership agility during this phase was expressed less through decisive shifts and more through cautious experimentation, selective engagement, and gradual adjustment of decision routines.

Temporal sensitivity proved particularly important in sustainability-related decisions. Environmental and social considerations often surfaced as early signals rather than immediate performance constraints. Leaders who engaged with AI-enabled forecasting tools were better positioned to recognize emerging risks and trade-offs before they became operationally salient. However, acting on these insights required willingness to prioritize longer-term considerations in contexts where short-term pressures remained intense.

Governance arrangements significantly influenced how these temporal dynamics played out. Where AI outputs were incorporated into recurring leadership forums, such as strategic reviews or investment discussions, anticipatory reasoning became more visible over time. In contrast, where AI insights were accessed on an ad hoc basis, leadership behavior remained largely reactive, even when analytical capabilities were technically available. This distinction underscores the importance of routinization in translating AI-enabled information into sustained leadership agility.

Institutional context further shaped the pace and direction of leadership adaptation. In cases characterized by centralized authority and high accountability sensitivity, leaders tended to engage with AI cautiously, using it to validate decisions rather than explore alternatives. While this approach reduced perceived risk, it also limited the transformative potential of AI-enabled augmentation. Leadership agility in these contexts manifested as incremental adjustment rather than proactive reconfiguration.

Importantly, the cases also reveal that leadership agility is not solely a function of individual disposition. It is influenced by how decision authority, informational access, and interpretive responsibility are distributed within the organization. Even in founder-centric or hierarchical settings, moments of agility emerged when leaders created space for analytical interrogation and temporal reflection, often in response to sustainability-related uncertainty.

This temporal framing helps explain why similar AI technologies produced divergent leadership outcomes across the cases examined. Leadership agility did not depend on the presence of advanced tools alone, but on how leaders engaged with these tools over time, how decision routines evolved, and how sustainability considerations were progressively integrated into strategic judgment. These dynamics provide important context for the thematic analysis presented in the following sections and inform the configurational patterns discussed in Chapter 5.

4.1.1 Theoretical Scope and Disciplinary Foundations of the Review

Strategic management theory, particularly the dynamic capability perspective, situates leadership agility within broader processes of sensing, seizing, and reconfiguring organizational resources (Teece, 2007). Information systems research extends this framing by examining how digital technologies and AI in particular reshape decision processes, attention structures, and organizational routines. Finally, sustainability scholarship introduces the normative and temporal dimensions of leadership decision-making, emphasizing long-term value creation, environmental responsibility, and stakeholder accountability.

The review is organized to reflect these interdependencies rather than treating each domain in isolation. Artificial Intelligence is examined not merely as a technological artifact, but as a cognitive and strategic enabler embedded within leadership practice. Leadership agility is explored as an emergent capability shaped by both human judgment and digital infrastructures. Sustainability is positioned as a contextual and strategic imperative that intensifies decision complexity and heightens the relevance of agile leadership.

By structuring the literature in this way, the chapter moves beyond descriptive summaries toward a theoretically grounded synthesis that clarifies how existing research informs, and limits, current understanding of AI-enabled leadership agility in SMEs. This framing establishes the conceptual basis for identifying gaps in the literature and justifies the integrative focus of the present study.

The interviews conducted for this study revealed a consistent perception among leaders that artificial intelligence currently functions primarily as a decision-support capability rather than an autonomous decision-making system. Participants frequently emphasized that while AI tools enhance the speed and scope of information analysis, strategic interpretation and final judgment remain firmly embedded within leadership practice. As one founder of a sustainability-driven SME explained:

“AI helps us process information faster and explore different possibilities, but the interpretation and strategic judgment still remain a leadership responsibility.”

(Participant C, Founder and CEO).

This observation reflects a recurring pattern across interviews: although AI enhances analytical capacity and supports leadership sensemaking, the responsibility for interpreting insights and determining strategic direction continues to reside with human leadership.

4.2 Case Study: LinkHat - Sustainability-Driven SME with Emerging AI Maturity

4.2.1 Company Overview and Scope of Business

LinkHat is a sustainability-driven Small and Medium-Sized Enterprise (SME) operating primarily across the Middle East and North Africa (MENA) region, with its headquarters in Dubai and legal entities in Lebanon and Iraq. The company employs approximately 25 staff and delivers solutions to clients across the telecommunications, data center, and energy-intensive infrastructure sectors. Despite its relatively small size, LinkHat maintains a regional footprint that extends beyond physical borders through digitally enabled solutions and remote service delivery.

The organization operates through two complementary business divisions. The first is a technical sustainability division, which provides engineered energy solutions aimed at reducing fuel consumption, operational expenditure (OPEX), and carbon emissions for mobile network operators and data centers. These solutions include hybrid energy systems, renewable energy integration, and energy-efficient cooling technologies. The second division, the LinkHat Experience Center (LXC), focuses on digital enablement and capability development, offering data analytics, business intelligence dashboards, and learning academies designed to enhance organizational performance and decision-making across industries.

This dual-division structure positions LinkHat at the intersection of sustainability execution and digital enablement, allowing it to address both technical and organizational dimensions of sustainable transformation. While the technical division requires physical presence for installation and maintenance, the digital and learning offerings are scalable and not geographically constrained, enabling the company to expand its market reach without proportional increases in operational footprint.

4.2.2 Sustainability Strategy and Governance Approach

Sustainability is not a peripheral initiative at LinkHat but constitutes a core element of its value proposition. The company's sustainability strategy is primarily focused on reducing fuel dependency and carbon emissions for telecom operators, where energy costs represent a significant proportion of operational expenditure. Sustainability outcomes are therefore framed in both environmental and economic terms, linking CO_2 reduction directly to cost savings for clients.

Unlike organizations with formalized ISO-based sustainability governance, LinkHat does not currently rely on external sustainability certifications or standardized ESG reporting frameworks. Instead, sustainability is governed through technical performance benchmarking, where solutions are designed, measured, and contractually validated against baseline energy consumption models. In several client engagements, the company guarantees CO_2 reduction levels and fuel savings as part of its contractual commitments. While this approach enables tangible sustainability impact at the solution level, it also reveals limitations. Sustainability metrics are largely project-specific and technically oriented, with limited integration into organization-wide sustainability dashboards or broader social and governance indicators. As a result, sustainability performance informs operational execution more than strategic leadership decision-making.

4.2.3 AI Adoption and Digital Maturity

LinkHat demonstrates an early to intermediate level of AI maturity, with AI adoption concentrated primarily in support and enabling functions rather than core operational processes. The company uses generative AI and data analytics tools to enhance efficiency in marketing, human resources, recruitment, and business development. Specific use cases include personalized marketing communications, document summarization, candidate screening, and automated lead generation.

AI is also indirectly embedded within the company's technical operations through a remote monitoring system (RMS) that incorporates predictive analytics to anticipate network or energy system anomalies and generate alerts. While this represents an initial application of AI within sustainability operations, it remains limited in scope and does not yet extend to advanced capabilities such as digital twins, automated anomaly resolution, or AI-driven optimization engines.

From a leadership perspective, AI adoption has resulted in a reported 15–20% improvement in decision-making speed, largely attributable to improved access to data and analytics within sales and commercial functions. However, AI has not yet become a central input into strategic decisions related to sustainability investments, technology roadmaps, or organizational transformation.

The interviews conducted for this study revealed a consistent perception among leaders that artificial intelligence currently functions primarily as a decision-support capability rather than an autonomous decision-making system. Participants frequently emphasized that while AI tools enhance the speed and scope of information analysis, strategic interpretation and final judgment remain firmly embedded within leadership practice.

4.2.4 Leadership Agility and Organizational Constraints

Leadership agility at LinkHat can be characterized as intentional but constrained. Senior leadership demonstrates a clear awareness of AI's strategic potential and expresses confidence in its future role in enhancing sustainability and operational performance.

However, current leadership practices remain largely experience-driven, with AI positioned as a productivity enhancer rather than a strategic decision-support partner.

Key constraints affecting leadership agility include:

- Limited AI knowledge and confidence at executive level: One of the most significant constraints identified in the LinkHat case is the limited depth of AI knowledge and confidence at the executive leadership level. While senior leaders acknowledge the potential of AI to improve efficiency, forecasting, and sustainability outcomes, AI is not yet perceived as a reliable strategic decision-support system. Instead, it is largely viewed as an operational aid that accelerates existing processes rather than reshaping leadership sensemaking or strategic judgment.

This limited confidence manifests in cautious leadership behavior. Strategic decisions, particularly those related to sustainability investments, technology roadmaps, and long-term organizational transformation, continue to rely predominantly on managerial experience, intuition, and historically successful practices. AI outputs are consulted selectively and primarily within commercial or support functions, rather than being embedded into executive-level deliberations. Without sufficient confidence in AI-generated insights, leaders are less likely to engage in scenario exploration, predictive reasoning, or data-driven experimentation, thereby reinforcing a reactive rather than anticipatory leadership posture.

- Absence of formal AI training programs: Closely related to leadership confidence is the absence of structured and formal AI training programs within the organization. At the time of the interviews, AI learning at LinkHat was informal, self-directed, and unevenly distributed across departments. Employees and managers primarily learned through individual experimentation with generative AI tools rather than through coordinated organizational capability-building initiatives.

The lack of formal training has several implications. First, it creates asymmetry in AI literacy across the organization, with some teams leveraging AI effectively while others remain uncertain or disengaged. Second, it limits leaders' ability to assess the quality, reliability, and limitations of AI outputs, reinforcing hesitation at the executive level. Third, it prevents the development of a shared organizational language around AI, sustainability data, and decision-making.

From an organizational learning standpoint, this absence constrains the emergence of collective leadership agility. Agile leadership requires not only individual adaptability but also shared cognitive frameworks that enable rapid alignment and coordinated action. Without formal training, AI remains fragmented and peripheral, rather than institutionalized as a leadership capability.

- Resistance to change among leadership and technical teams accustomed to proven operational models: Resistance to AI adoption at LinkHat is not driven by fear of job displacement, but rather by comfort with proven operational models. Both leadership and technical teams have successfully delivered sustainability projects using established methods, reinforcing a belief that existing approaches are sufficient. As a result, AI is often perceived as an incremental enhancement rather than a necessary transformation.

Among technical teams, resistance is particularly evident in sustainability and energy operations, where engineers and specialists prioritize reliability, safety, and predictability. Introducing AI-driven recommendations into these environments raises concerns about accuracy, accountability, and operational risk. Consequently, AI is more readily accepted in marketing, HR, and business development, areas perceived as lower-risk, than in core sustainability operations.

At the leadership level, resistance is more subtle and manifests as strategic inertia. Leaders may support AI conceptually while delaying its integration into critical decision processes. This pattern aligns with adaptive leadership theory, which highlights that resistance often emerges not from opposition to change itself, but from reluctance to abandon practices that have historically ensured stability and success. This resistance constrains leadership agility by limiting experimentation and slowing the organization's ability to pivot in response to emerging sustainability and market pressures.

- Lack of integrated AI tools linking sustainability data to strategic decision-making: A further constraint limiting AI-enabled leadership agility at LinkHat is the absence of integrated AI systems that connect sustainability data directly to strategic decision-making processes. While sustainability data exists at the project level, such as fuel savings, CO_2 reductions, and energy efficiency improvements, these data points are not consolidated into organization-wide dashboards or AI-driven decision platforms.

As a result, sustainability information remains operational rather than strategic. Leaders can assess the success of individual projects, but they lack real-time, predictive visibility into portfolio-level sustainability performance, future risk exposure, or alternative investment scenarios. AI tools currently used within the organization do not synthesize sustainability metrics with financial, operational, and market data to support holistic leadership decisions.

The interviews conducted for this study revealed a consistent perception among leaders that artificial intelligence currently functions primarily as a decision-support capability rather than an autonomous decision-making system. Participants frequently emphasized that while AI tools enhance the speed and scope of information analysis, strategic interpretation and final judgment remain firmly embedded within leadership practice. As one founder of a sustainability-driven SME explained

"AI supports operations by helping us evaluate different technical scenarios and operational constraints quickly, but the responsibility for selecting the most viable solution still rests with leadership."

(Participant E, Senior Operations Director)

This reflects a recurring pattern across interviews: although AI enhances analytical capacity and supports leadership sensemaking, the responsibility for interpreting insights and determining strategic direction continues to reside with human leadership.

This fragmentation limits the organization's ability to leverage AI as a sensemaking tool, which is essential for leadership agility in complex environments. Without integrated systems, leaders are unable to simulate trade-offs, forecast sustainability outcomes, or dynamically reallocate resources based on predictive insights. Consequently, sustainability remains a core value but not yet a data-driven strategic lever.

As a result, leadership agility is currently expressed more in incremental adaptation than in proactive or anticipatory decision-making. AI supports faster execution but does not yet enable leaders to systematically anticipate sustainability risks, model future scenarios, or dynamically reallocate resources.

4.2.5 Transition Toward AI-Enabled Leadership

Despite these limitations, LinkHat represents a transitional case within the study. The organization has articulated a phased AI integration roadmap, beginning with a comprehensive AI maturity assessment in 2025, followed by organization-wide training initiatives planned for 2026.

These initiatives aim to increase AI awareness, improve tool selection by department, and gradually embed AI into leadership routines. This forward-looking orientation suggests a deliberate shift toward AI-enabled leadership agility, where data-driven insights, predictive analytics, and intelligent agents are expected to play a more prominent role in sustainability decision-making. As such, LinkHat illustrates how sustainability-driven SMEs may evolve from tactical AI use toward strategic AI integration as leadership capability, confidence, and organizational readiness increase.

4.2.6 Analytical Interpretation

The LinkHat case provides an in-depth illustration of how Artificial Intelligence (AI) adoption interacts with leadership agility within a sustainability-driven SME operating in the MENA region. The findings indicate that while LinkHat demonstrates a strong commitment to sustainability and an explicit openness toward AI, the current configuration of AI use does not yet produce a meaningful transformation in leadership agility.

From a sustainability standpoint, LinkHat's leadership has clearly embedded environmental objectives into the core business model. Fuel reduction, energy efficiency, and carbon emissions mitigation are not treated as peripheral initiatives but as central drivers of client value and commercial differentiation. This positions sustainability as an economic and operational priority, rather than a symbolic or compliance-oriented activity. However, sustainability performance remains predominantly project-based and technically measured, with limited aggregation into organization-wide intelligence that could inform higher-level strategic leadership decisions.

In relation to AI adoption, the organization exhibits an emerging but functionally bounded level of maturity. AI tools are actively used across marketing, recruitment, HR, and business development to automate repetitive tasks, improve data processing, and enhance execution efficiency. These applications have delivered observable gains in operational responsiveness and decision speed, particularly in commercial activities. From a leadership agility perspective, this reflects an improvement in process agility, defined as the ability to execute decisions more efficiently once they have been made.

Leadership decisions continue to rely on managerial experience, and decisions related to sustainability investments, technology direction, and organizational transformation continue to rely primarily on managerial experience, technical expertise, and historically validated practices.

A key explanatory factor lies in leadership capability and organizational readiness. Senior leaders demonstrate conceptual awareness of AI's potential but exhibit limited confidence in its strategic application. This constrains the extent to which AI is trusted as a basis for decision-making under uncertainty. The absence of formal AI training programs further reinforces this limitation, as leaders lack a shared analytical framework for interpreting AI outputs, questioning assumptions, or translating insights into strategic action.

Additionally, organizational resistance to change, particularly among leadership and technical teams accustomed to proven operational models, slows the integration of AI into core decision processes. This resistance is pragmatic rather than ideological; it reflects concern over reliability, accountability, and risk in sustainability-critical operations. Consequently, AI adoption is selectively confined to low-risk domains, leaving leadership decision-making structures largely unchanged.

Another critical limitation affecting leadership agility is the lack of integrated AI systems linking sustainability data to strategic decision-making. Although LinkHat generates sustainability-related data at the solution level, this information is not consolidated, analyzed, or visualized through AI-enabled dashboards at the organizational level. Without such integration, sustainability remains an operational outcome rather than a strategic input, limiting leadership's ability to anticipate trends, evaluate trade-offs, or dynamically reallocate resources based on predictive insights.

From the perspective of the study's core research questions, the LinkHat case demonstrates that AI enhances leadership agility only partially and conditionally. AI contributes to operational efficiency and faster execution but does not yet support adaptive, anticipatory, or learning-oriented leadership behaviors. Leadership agility therefore remains primarily human-driven, with AI playing a supportive but non-transformational role.

The case underscores a central insight of this study: the impact of AI on leadership agility is not determined by tool adoption alone, but by the extent to which AI is embedded into leadership cognition, governance structures, and sustainability intelligence systems. Until AI is integrated into strategic decision-making architectures and sustainability measurement frameworks, its influence on leadership agility in sustainability-driven SMEs remains incremental rather than transformative.

4.3 Case Study 2: NERA – Sustainability in Emerging African Telecom Markets Amid Digital Constraints

4.3.1 Company Overview and Scope of Business

The second case study examines NERA, a Small and Medium-Sized Enterprise (SME) operating within the telecommunications infrastructure sector, functioning as a regional subsidiary of a large multinational group headquartered in Singapore. The company operates across six African countries, primarily in French-speaking markets, with approximately 30 employees based in Morocco and smaller operational teams of three to four employees per country, supported by subcontractors for on-site execution.

The organization specializes in telecommunication microwave solutions and power infrastructure, supplying hardware-based products such as microwave links, generators, and associated telecom equipment. Its client base consists largely of telecom operators and government entities, and its commercial model is predominantly tender-driven, reducing the need for active marketing or customer acquisition strategies.

As a subsidiary within a global group that includes more than 1,000 affiliated entities, the company operates with limited strategic autonomy. Core decisions related to technology adoption, data governance, AI strategy, and reporting structures are centralized at headquarters level, significantly shaping local leadership practices and innovation capacity.

4.3.2 Sustainability Orientation and Governance Framework

Sustainability within this organization is operationally embedded rather than strategically articulated. Environmental considerations are primarily addressed through the design and selection of infrastructure products, including compact and energy-efficient microwave solutions and eco-friendly bamboo-based poles used to reduce environmental impact in telecom site deployment.

Despite this product-level sustainability focus, the subsidiary does not hold local ISO certifications related to quality, environmental management, or sustainability. Instead, it operates under:

- A group-level internal quality manual
- Centralized vendor evaluation and compliance standards enforced by headquarters
- Financial, legal, and governance controls aligned with Singapore’s regulatory framework.

On another hand, sustainability performance is monitored indirectly through site acceptance certificates, weekly and monthly operational reports, and annual Key Performance Indicators (KPIs) submitted to headquarters. These KPIs primarily assess project delivery, productivity, and team performance rather than environmental or social impact metrics. The interview highlights significant regional variation in sustainability regulation, with more developed markets such as Morocco showing increasing certification demands, while countries like Burkina Faso and Mali face structural and infrastructural limitations that hinder formal sustainability enforcement. This variability reinforces a compliance-driven sustainability model rather than a proactive or data-driven sustainability strategy.

4.3.3 AI Adoption and Digital Maturity

AI adoption within the organization is nascent and functionally limited, reflecting a low level of digital maturity. AI tools are primarily used for administrative and communication-related tasks, such as drafting emails, preparing presentations, and supporting basic reporting activities.

The organization relies on enterprise systems such as:

- BIPO People for human resources management
- BoldSign for electronic document signing
- NetSuite, an ERP for financial and management reporting

While these platforms support operational efficiency and standardized reporting, they are centrally managed by headquarters, limiting local experimentation with AI-driven process improvements. AI is not embedded in:

- Engineering design
- Project monitoring
- Sustainability optimization
- Predictive maintenance or risk analysis

The interviewee emphasized that the company's hardware-centric business model further constrains AI adoption, as products are largely fixed and offer limited opportunities for AI-driven differentiation at the local level.

4.3.4 Leadership Agility and Organizational Constraints

Leadership agility in this organization is constrained by a combination of structural centralization, cultural resistance, and limited AI integration. NERA Local leaders operate within predefined reporting and governance frameworks, leaving minimal room for autonomous strategic adaptation or experimentation.

Resistance to AI adoption is particularly evident among engineering teams, who prefer traditional methods such as manual note-taking and established workflows. AI is perceived as an optional productivity enhancer rather than a core decision-support mechanism. This resistance is not rooted in fear of job loss, but rather in skepticism regarding AI's reliability and relevance to technical engineering tasks.

From a leadership perspective, decision-making remains largely experience-driven and reactive. Without AI-enabled predictive insights or scenario analysis, leaders respond to sustainability and operational challenges after they emerge rather than anticipating them. AI does not currently support leadership sensemaking, risk anticipation, or strategic agility. Participants further noted that organizational governance structures can slow decision responsiveness even when AI insights are available:

"Even when AI insights are available, many decisions still require centralized approval, which slows the agility of the organization."

(Participant G, Country Manager).

Moreover, the centralized governance model limits local leaders' ability to align AI use with regional sustainability challenges or market maturity differences. AI strategy, data processing, and innovation priorities are dictated by headquarters, reinforcing a compliance-oriented leadership posture.

4.3.5 Market Maturity and Contextual Constraints

A defining characteristic of this case is the uneven digital and infrastructural maturity across the African markets in which the company operates. The interview underscores a stark contrast between digitally advanced ecosystems such as Singapore or Dubai and regions where basic infrastructure: roads, logistics, and connectivity remain underdeveloped.

This digital divide significantly constrains AI adoption and leadership agility. In less mature markets, the focus remains on ensuring basic operational delivery rather than experimenting with advanced digital or sustainability solutions. Consequently, leadership priorities are shaped more by infrastructural constraints than by innovation opportunities.

4.3.6 Future Orientation and Strategic Implications

Despite current limitations, the interviewee articulated a longer-term strategic vision involving a gradual shift from pure hardware sales toward AI-enabled smart solutions, including smart manufacturing, logistics platforms, and IoT-integrated infrastructure within a three- to five-year horizon. However, achieving this transition requires:

- Significant cultural change
- Investment in digital infrastructure
- Greater local autonomy in AI experimentation
- Leadership capability development in AI-enabled decision-making

At present, the organization remains positioned at an early stage of AI-enabled leadership agility, where sustainability is embedded in products but not yet leveraged as a strategic or predictive leadership capability.

4.3.7 Analytical Interpretation

The NERA case illustrates a distinct and theoretically significant configuration within sustainability-driven SMEs: embedded sustainability practices coexisting with structurally constrained leadership agility and minimal AI-enabled decision support. While environmental considerations are clearly integrated into product design and delivery through energy-efficient telecom solutions and eco-friendly infrastructure components, these practices remain operationally embedded rather than strategically leveraged.

From a leadership agility perspective, NERA demonstrates that sustainability embedded at the product or compliance level does not automatically translate into adaptive or anticipatory leadership behavior. Sustainability outcomes are largely predetermined by engineering specifications and group-level standards, leaving limited scope for leaders to dynamically reinterpret environmental data, model alternative scenarios, or reconfigure strategies in response to emerging market or regulatory shifts.

AI adoption at NERA reinforces this pattern. The organization's use of AI is confined to administrative and communicative functions, such as reporting, documentation, and internal efficiency improvements. These applications enhance execution speed but do not influence leadership sensemaking, strategic foresight, or sustainability-related decision-making.

A critical moderating factor in this case is centralized governance. As a group-affiliated SME, NERA operates under tightly controlled AI strategies, reporting systems, and data architectures dictated by headquarters. This centralization limits local leaders' autonomy to experiment with AI tools, develop context-specific sustainability analytics, or adapt decision-making processes to regional market maturity. Consequently, leadership behavior remains compliance-oriented and reactive, shaped more by adherence to predefined standards than by real-time interpretation of complexity.

The interview evidence further highlights the role of market and infrastructural asymmetry across African operating environments. In regions characterized by limited digital infrastructure and uneven regulatory enforcement, leadership attention is directed toward ensuring operational continuity rather than pursuing predictive or AI-enabled sustainability optimization. This reinforces a short-term, execution-focused leadership posture, where agility is expressed through operational resilience rather than strategic adaptation.

NERA therefore represents a critical case of "sustainability without agility", where environmental responsibility exists independently of AI-enabled leadership transformation. This case underscores the importance of organizational structure, governance models, and contextual readiness as mediating variables between AI adoption and leadership agility in sustainability-driven SMEs operating in emerging markets.

4.4 Case Study 3: Enetek Power - Strategic Sustainability Leadership Without Data-Driven Agility

4.4.1 Company Overview and Scope of Business

The third case is relevant to Enetek Power, a sustainability-oriented Small and Medium-Sized Enterprise (SME) operating primarily within the renewable energy and power solutions sector, with a strong regional footprint centered in Egypt and extended coverage across the Middle East and Africa (MEA) region. The company employs approximately 30 staff, managing sales, operations, and regional coordination from its Egypt office, which has been operational since 2020.

Enetek Power operates as part of the wider Eltek Holding, a clean energy and power solutions group established in 2007. While the company benefits from group-level expertise, certifications, and strategic direction, the regional entity maintains responsibility for commercial execution, partner engagement, and operational delivery across MEA markets.

The company's core business focuses on solar energy and sustainable power solutions, supporting clients in reducing carbon emissions, optimizing energy consumption, and transitioning toward cleaner energy sources. Enetek Power positions sustainability not as an ancillary offering but as the central value proposition underpinning customer satisfaction, market differentiation, and long-term growth.

4.4.2 Sustainability Orientation and Governance Structure

Sustainability is foundational to Enetek Power's business model, with solar energy solutions serving as the primary mechanism for carbon footprint reduction and energy optimization. The company's sustainability narrative is strongly aligned with environmental impact, particularly in markets where energy efficiency and renewable adoption are increasingly prioritized. From a governance perspective, Enetek Power aligns with corporate-level ISO certifications held at the group level, including quality and compliance standards relevant to clean energy operations

However, sustainability governance at the regional SME level remains lightly formalized. The organization does not currently operate dedicated sustainability dashboards, environmental KPIs, or AI-enabled performance tracking systems within the regional authority. Instead, sustainability performance is communicated implicitly through:

- The nature of solutions delivered (solar and green energy systems)
- Client satisfaction and repeat business
- Alignment with global clean energy standards rather than quantified local metrics

The interview highlights a measurement gap, whereby sustainability impact is assumed through solution type rather than explicitly monitored, benchmarked, or reported using structured data tools. This gap limits the organization's ability to systematically evaluate sustainability performance over time or across markets.

4.4.3 AI Adoption and Digital Maturity

Enetek Power demonstrates a selective and functional approach to AI adoption, primarily focused on operational efficiency and strategic market analysis rather than core design or sustainability optimization. AI-enabled systems are embedded mainly within ERP platforms, including SAP-based solutions, which support data management, workflow coordination, and cross-departmental operations. In addition to ERP usage, leadership and staff leverage AI tools and large language models (LLMs) to enhance

Market research, competitor analysis, strategic partnership evaluation, decision preparation for regional expansion.

4.4.4 AI Agents, Automation, and Their Non-Strategic Role in Leadership Decision-Making

Despite a clear awareness of Artificial Intelligence and emerging technologies, Enetek Power's use of AI agents, automation, and advanced analytics remains non-strategic and peripheral to leadership decision-making. AI is not positioned as a leadership enabler or a mechanism for enhancing organizational agility; rather, it functions as a supportive utility applied to isolated tasks.

AI agents are not deployed to:

- Support sustainability scenario modeling
- Anticipate market or regulatory shifts
- Optimize renewable energy portfolios
- Enable predictive sustainability or financial forecasting

Instead, AI usage is confined to information processing and decision preparation, such as market research synthesis, competitor benchmarking, and document analysis. These applications improve individual productivity but do not alter how strategic decisions are made, evaluated, or executed.

From a leadership agility perspective, AI does not enhance leaders' capacity to sense, interpret, or respond dynamically to uncertainty. Decisions related to sustainability investments, market entry, partnerships, and technology selection continue to be made through traditional managerial judgment, experience, and established industry knowledge rather than AI-driven insight.

4.4.5 Leadership Decision-Making and the Absence of AI-Enabled Agility

Leadership decision-making at Enetek Power can be characterized as strategically informed but digitally unsupported. Senior leadership demonstrates strong conceptual understanding of sustainability and renewable energy markets, supported by deep expertise in mergers, acquisitions, and regional market dynamics. However, this expertise substitutes for, rather than integrates with, AI-driven decision infrastructures.

The absence of AI-enabled leadership agility is evident across three dimensions:

1. Anticipatory Agility
   Leadership decisions are largely reactive to market signals and client demand rather than predictive. AI is not used to simulate future energy scenarios, forecast sustainability outcomes, or evaluate alternative strategic paths.
2. Adaptive Agility
   Organizational responses to change rely on managerial coordination and experience rather than real-time data or automated insights. AI does not support rapid reconfiguration of priorities or resources.
3. Learning Agility
   While leaders engage in AI learning at an individual level, there is no organizational learning loop where AI outputs inform continuous strategic refinement.

As a result, leadership agility remains human-centric and experience-driven, with AI acting as a background tool rather than a transformational force. A senior executive explained that the absence of reliable data significantly limits the role that AI can play in leadership decisions:

"Without reliable historical data, it becomes difficult to trust automation in strategic decision processes."

(Participant B, Managing Director)

4.4.6 Sustainability Measurement Gaps and Their Impact on AI Effectiveness

A critical factor limiting the strategic relevance of AI at Enetek Power is the absence of structured sustainability measurement systems. Although the company's solutions inherently contribute to carbon reduction, sustainability data is not systematically captured, quantified, or centralized without:

- Sustainability KPIs
- Energy performance dashboards
- AI-readable datasets

AI agents cannot be meaningfully deployed to analyze sustainability outcomes or support decision-making. The lack of data infrastructure means that even advanced AI tools would have limited value, as leadership decisions are not grounded in measurable sustainability intelligence.

This reinforces a solution-centric sustainability model, where environmental impact is assumed rather than continuously monitored or optimized through AI.

4.4.7 Organizational Readiness and Cultural Orientation Toward AI

Enetek Power exhibits a cautious and pragmatic organizational stance toward AI. Leadership does not resist AI ideologically; however, AI is viewed as an efficiency enhancer rather than a strategic capability. This orientation reflects both industry norms within renewable energy SMEs and the organization's reliance on established engineering and commercial expertise. AI training initiatives are focused on:

- Improving individual analytical capability
- Enhancing market intelligence
- Supporting partnership evaluation

They are not designed to:

- Transform leadership routines
- Embed AI into governance processes
- Enable AI-assisted sustainability or investment decisions

Consequently, AI adoption remains fragmented and decoupled from leadership structures, limiting its potential impact on agility.

4.4.8 Analytical Interpretation: Sustainability Leadership Without AI-Enabled Agility

Enetek Power represents a distinct pattern within the cross-case analysis: strong sustainability intent combined with minimal AI-enabled leadership transformation. Unlike cases where AI enhances leadership sensemaking and adaptability, Enetek Power demonstrates that sustainability leadership can exist independently of AI-driven agility. This case illustrates that:

- AI agents do not inherently enhance leadership agility
- Without integration into decision systems, AI remains operationally marginal
- Sustainability-driven SMEs may prioritize domain expertise over digital augmentation

4.5 Case Study 4: Ellisdon - AI-Enabled Sustainability Leadership in a Digitally Mature Construction SME

4.5.1 Company Overview and Scope of Business

Our Fourth case study is relevant to EllisDon that operates in the Middle East and North Africa (MENA) region as a Small and Medium-Sized Enterprise (SME) subsidiary of a Canadian-based construction and infrastructure group. While the parent organization is a global enterprise, the regional entity exhibits SME characteristics in terms of project management, leadership autonomy, resource allocation, market exposure, and contextual constraints. Strategic decisions related to project execution, innovation prioritization, and client engagement are made at the regional level, positioning the entity as an analytically valid SME case within this study.

The MENA organization employs approximately 500+ staff across four regional offices and manages a diversified portfolio exceeding 140 concurrent projects, spanning healthcare, commercial, residential, mixed-use, and infrastructure developments. Importantly, innovation and digital transformation activities are not centralized in a corporate R&D unit detached from operations; instead, they are embedded directly within live projects, with approximately 50+ projects actively leveraging advanced digital and AI-enabled platforms.

EllisDon's scope of business extends beyond traditional construction delivery into design management, construction risk governance, and post-handover asset performance optimization. This lifecycle-oriented operating model reflects a deliberate strategic shift away from transactional project delivery toward long-term value creation through operational efficiency, sustainability performance, and risk reduction. As such, the organization operates at the intersection of construction, digital infrastructure, and sustainability management, making it particularly relevant to the research focus on AI-enabled leadership agility.

As part of its digital and sustainability-driven offering, EllisDon delivers a structured portfolio of AI-enabled products and services spanning design, construction, and operations. At the design stage, the organization deploys its AI @ Design Stage Platform, supported by the BIM & VDC Design Intelligence Suite, Design Issues Dashboard, and Design-to-Budget Analytics, which enable automated coordination, early risk detection, and scenario-based optimization of cost and sustainability outcomes. During construction, EllisDon relies on the AI @ project control Platform, incorporating 4D Planning & 5D modeling, AI-driven cost Analytics, and Digital Inspections and Snag Management Systems to anticipate schedule delays, control execution risk, and reduce waste and rework. Post-handover, operational performance and sustainability optimization are delivered through the EllisDon Digital Twin Service, anchored by the EKO Digital Twin Platform, which integrates real-time asset monitoring, Predictive Maintenance and Asset Health Engines, and Operational Energy Analytics Dashboards, supported by the AI-powered Digital Portfolio / Digital Wall Room. Collectively, these products embed AI into core decision-making processes, enabling leaders to anticipate operational and sustainability risks, interpret complex data, and respond proactively, thereby reinforcing anticipatory and adaptive leadership agility rather than purely execution-focused efficiency. Accordingly, this case is not presented as representative of typical SME practice, but as an analytically valuable boundary condition illustrating the upper range of AI-enabled leadership agility within SME-like governance structures.

4.5.2 Digital Maturity and AI Readiness

EllisDon is positioned at Level 3 digital maturity, a stage characterized by integrated data environments, predictive analytics, and simulation capabilities, but without full automation or autonomous decision-making. At this level, digital technologies are not experimental or peripheral; they are institutionalized within core workflows, while still requiring human oversight and judgment.

This maturity level manifests in several ways. First, data is systematically collected across design, construction, and operations, rather than remaining siloed by function. Second, AI models are used not only to describe or visualize performance but to anticipate future outcomes, such as schedule delays, equipment failures, and energy inefficiencies. Third, leadership engagement with digital systems is routine rather than exceptional, indicating that AI-supported decision-making has become part of normal governance processes.

However, EllisDon has not yet reached a stage of autonomous execution. Decisions informed by AI outputs remain human-authorized, reflecting both regulatory realities in construction and a deliberate leadership philosophy that emphasizes accountability, safety, and client trust. This balance positions the organization squarely within the "human-in-the-loop" maturity band, which is highly relevant to sustainability-driven SMEs operating in high-risk environments.

4.5.3 AI Adoption Architecture and Platform Ecosystem

EllisDon's AI adoption architecture is characterized by a layered, ecosystem-based design in which artificial intelligence is embedded across the full asset lifecycle rather than deployed as isolated tools. The architecture integrates data from design, construction, and operations into a connected digital backbone that enables predictive insight, real-time visibility, and informed leadership decision-making. At its foundation lies a robust data layer that consolidates Building Information Modeling (BIM), project schedules, cost data, IoT sensor streams, and facilities management records. This integrated data environment is essential for enabling reliable AI outputs and reflects a deliberate shift away from siloed information management toward lifecycle-wide intelligence. In addition to that, the data layer consolidates both legacy and current project data to ensure AI machine learning model are trained to understand trends and anomalies.

At the platform level, EllisDon has developed a suite of AI-enabled systems aligned to each project phase. During design, AI is embedded within BIM and VDC environments to support automated coordination, design-quality scoring, clash prediction, and design-to-budget analytics. These platforms allow design and leadership teams to evaluate technical, cost, and sustainability implications early, when decisions have the greatest long-term impact. During construction, predictive analytics platforms analyze historical project data, live site inputs, and sequencing information to forecast schedule delays, cost overruns, and quality risks. These systems enable leaders to intervene proactively, shifting construction governance from reactive issue resolution to predictive control. The interviews further indicated that AI capabilities at EllisDon are embedded within digital platforms used to monitor project performance and support operational coordination. Rather than functioning as standalone analytical tools, these systems are integrated into the broader digital infrastructure supporting project management and decision processes. As described by a senior innovation leader:

"AI is integrated into several of our digital platforms, allowing teams to monitor project performance and identify potential issues earlier than traditional reporting methods would allow."

(Participant A, VP Innovation & Smart Building Solutions MENA).

This perspective suggests that AI adoption in this case extends beyond isolated experimentation and instead reflects a more integrated digital architecture supporting leadership awareness and operational oversight.

At the operational stage, the ecosystem converges through the EllisDon Digital Twin Service, anchored by the EKO Digital Twin Platform, which integrates real-time sensor data with asset models and maintenance systems. AI engines embedded within the digital twin perform anomaly detection, predictive maintenance, energy optimization, and root-cause analysis across critical building systems. This operational intelligence layer transforms assets into continuously monitored and optimized systems, enabling sustainability outcomes such as energy efficiency improvements, reduced unplanned downtime, and extended equipment lifespan. Importantly, these capabilities are delivered through unified dashboards and interactive environments that make complex analytics accessible to non-technical leaders.

From a governance perspective, EllisDon's architecture follows a human-in-the-loop AI model. While AI agents and predictive engines generate insights and recommendations, decision authority remains with leadership. This governance approach reflects both regulatory realities in construction and a conscious leadership stance that prioritizes accountability, safety, and client trust. AI outputs inform approximately a majority of risk assessment and decision preparation, but final decisions are validated through professional judgment. This balance allows the organization to benefit from AI-driven foresight while avoiding over-reliance on automated systems in high-risk environments.

From the perspective of this study, EllisDon's AI architecture illustrates how leadership agility is enabled not by individual AI tools, but by an integrated platform ecosystem that supports sensemaking, anticipation, and adaptive response. By embedding AI across design, construction, and operations, and by linking sustainability data directly to decision dashboards, EllisDon enables leaders to interpret complexity, anticipate emerging risks, and reconfigure strategies proactively. This architecture positions AI as a cognitive and analytical extension of leadership, reinforcing anticipatory and adaptive leadership agility rather than merely accelerating execution.

4.5.4 Sustainability Strategy and Embedded Measurement

EllisDon's sustainability strategy is grounded in the principle that environmental performance must be measurable, operationally embedded, and decision-relevant, rather than treated as a standalone ESG or compliance exercise. Sustainability is therefore integrated across the full asset lifecycle, from design and construction through to long-term operations where the majority of environmental and cost impacts are realized. This approach reflects a pragmatic sustainability orientation in which energy efficiency, lifecycle cost reduction, and risk mitigation are treated as mutually reinforcing objectives.

A defining characteristic of EllisDon's sustainability model is the embedding of sustainability metrics into digital and AI-enabled decision platforms rather than relying solely on static reports or periodic assessments. Through its digital twin and analytics ecosystem, sustainability performance is continuously monitored using operational indicators such as energy consumption, system efficiency, equipment run-hours, fault frequency, and asset degradation patterns. AI-driven analytics enable early detection of inefficiencies and predictive assessment of sustainability risks, allowing leaders to intervene before energy waste, system failure, or carbon-intensive outcomes materialize. As a result, sustainability is transformed from a retrospective reporting activity into a dynamic, forward-looking leadership input.

EllisDon measures sustainability impact through a combination of direct and indirect performance indicators. While precise attribution of AI-driven sustainability gains remains challenging due to data variability, the organization tracks measurable outcomes such as HVAC energy savings (estimated at 6–7%), electricity efficiency improvements (12–20%), reductions in unplanned maintenance, and extensions in equipment lifespan by approximately one to two years. These metrics are contextualized within broader operational dashboards that link sustainability outcomes with cost efficiency, asset reliability, and operational risk. This integration allows leadership teams to evaluate trade-offs holistically, reinforcing sustainability as a strategic lever rather than a purely technical outcome.

From a governance and standards perspective, EllisDon aligns its sustainability and digital practices with internationally recognized frameworks and certifications, primarily at the group and project levels. The organization adheres to ISO 19650 for information management and BIM governance, ensuring structured, traceable, and reliable data across asset lifecycles. ISO 27001 certification underpins data security and information governance, which is critical for AI-enabled sustainability platforms relying on real-time operational data. In addition, ISO 9001 supports quality management across project delivery, indirectly reinforcing sustainability through process consistency and risk control. While environmental management certifications such as ISO 14001 may be applied selectively at project or regional levels, sustainability compliance is more commonly embedded through alignment with LEED (Leadership in Energy and Environmental Design), PEARL rating system UAE, and BREEAM (Building Research

Establishment Environmental Assessment Method) standards, particularly for design, construction, and operational performance benchmarking.

Importantly, EllisDon's sustainability strategy does not rely solely on certification attainment. Instead, certifications function as enablers of disciplined execution and data integrity, while AI-enabled platforms provide the intelligence required for continuous optimization. This distinction is critical for leadership agility. Leaders are not limited to assessing whether sustainability targets have been met; they are equipped to understand why performance is changing, where risks are emerging, and how alternative decisions may influence future environmental outcomes.

From the perspective of this study, EllisDon illustrates how sustainability-driven SMEs can move beyond compliance-oriented sustainability toward AI-enabled sustainability intelligence. By embedding measurement into operational systems and linking sustainability data directly to leadership dashboards, the organization enhances leaders' capacity to anticipate environmental risks, interpret complex performance signals, and adapt decisions in real time. Sustainability thus becomes a core component of leadership sensemaking and adaptive capacity, reinforcing anticipatory and adaptive leadership agility rather than static goal compliance.

4.5.5 AI Agents, Automation, and the Scope of Autonomy

EllisDon's deployment of Artificial Intelligence is characterized by a selective and governance-conscious use of AI agents and automation, reflecting the high-risk, safety-critical nature of the construction and built-environment sector. AI agents within the organization function primarily as analytical and advisory entities, designed to sense conditions, interpret large volumes of data, and generate actionable insights, rather than to execute decisions autonomously. This distinction is central to understanding how AI contributes to leadership agility without undermining accountability or professional judgment.

AI agents are most prominently embedded within the digital twin and predictive analytics platforms, where they continuously monitor asset performance, construction progress, and operational conditions. These agents autonomously scan thousands of data points from sensors, BIM models, schedules, and historical records to identify anomalies, forecast equipment degradation, predict schedule delays, and surface sustainability risks such as abnormal energy consumption or inefficient system behavior. In this sense, AI agents operate at a high level of cognitive autonomy, they independently detect patterns and generate recommendations, but remain constrained in terms of decision autonomy, as they do not initiate corrective actions without human validation.

Automation at EllisDon is applied more conservatively and is primarily limited to data processing, reporting, and workflow acceleration, rather than decision execution. Examples include automated data ingestion from IoT devices, real-time dashboard updates, automated generation of performance reports, and AI-assisted design and inspection workflows. These automated processes reduce manual effort, shorten feedback loops, and increase information availability, thereby enhancing process agility. However, automation does not replace human roles in approving designs, authorizing construction changes, or implementing operational interventions, underscoring a deliberate separation between automation and authority.

The scope of AI autonomy is further shaped by a human-in-the-loop governance model, where leadership retains final control over decisions that affect safety, cost, sustainability commitments, and client outcomes. AI systems are trusted to support approximately a majority of risk assessment and decision preparation, but leadership judgment remains the final arbiter. This governance approach reflects both regulatory requirements and an organizational recognition that AI outputs are only as reliable as the underlying data, particularly in environments where legacy assets and incomplete records persist.

From a leadership agility perspective, this calibrated scope of autonomy enhances rather than constrains adaptive capacity. By delegating sensing, monitoring, and analytical interpretation to AI agents, leaders are freed from routine data processing and can focus on sensemaking, scenario evaluation, and strategic choice. AI therefore expands leaders' cognitive bandwidth and anticipatory awareness without displacing their role in navigating uncertainty and ethical responsibility. Leadership agility at EllisDon is thus expressed through augmented decision-making, where AI acts as an intelligent collaborator rather than an autonomous decision-maker.

From the standpoint of this study, EllisDon demonstrates that AI agents contribute most effectively to leadership agility when they are embedded as advisory systems within clearly defined autonomy boundaries. Full automation is neither technically nor institutionally appropriate in sustainability-critical construction environments. Instead, agility emerges from the productive tension between machine intelligence and human judgment, where AI enhances foresight and responsiveness while leaders retain ownership of accountability and long-term direction.

4.5.6 Leadership Agility and AI-Supported Decision-Making

Leadership agility at EllisDon is best characterized as AI-augmented, anticipatory, and governance-bounded. Rather than relying solely on experience-driven judgment or retrospective reporting, leaders operate within a digitally enabled decision environment where AI continuously supplies predictive insights, risk signals, and performance indicators across design, construction, and operational phases. This configuration allows leadership to sense emerging challenges earlier, interpret complex multi-dimensional data more effectively, and respond with greater speed and confidence, all while maintaining human accountability.

AI-supported decision-making at EllisDon primarily enhances anticipatory leadership agility. Predictive analytics embedded within digital twin platforms and construction risk engines enable leaders to identify potential equipment failures, energy inefficiencies, schedule slippages, and sustainability risks well before they materialize. This forward-looking capability shifts leadership behavior from reactive problem resolution to proactive intervention. Decisions regarding maintenance prioritization, design adjustments, sequencing changes, or operational reconfiguration are informed by AI-generated forecasts rather than by lagging indicators. As a result, leaders are better positioned to navigate uncertainty and complexity, a defining requirement of agile leadership in sustainability-critical environments. A senior innovation leader described how AI tools enhance leaders' ability to anticipate operational challenges

"Digital models and predictive tools allow leaders to anticipate risks and operational challenges much earlier in the project lifecycle."

(Participant A, VP Innovation & Smart Building Solutions MENA).

In parallel, AI strengthens adaptive leadership agility by supporting rapid evaluation of alternative scenarios. Through integrated dashboards and interactive digital portfolio environments, leaders can compare the cost, sustainability, and risk implications of different decisions in near real time. For example, AI-enabled platforms allow leadership teams to assess trade-offs between energy efficiency and capital expenditure, or between schedule acceleration and quality risk. This capability reduces decision latency and enables dynamic reallocation of resources, reinforcing the organization's ability to adjust course as conditions evolve. Importantly, AI does not prescribe solutions; it expands the option space available to leaders, enhancing strategic flexibility rather than constraining judgment.

AI also contributes to process agility by accelerating decision cycles and reducing cognitive and administrative burden. Automated data ingestion, real-time reporting, and AI-assisted analysis replace manual compilation and fragmented reporting processes that traditionally slow leadership response. By shortening feedback loops, AI allows leaders to engage more frequently with up-to-date information, improving alignment between operational reality and strategic intent. This increased tempo of informed decision-making is particularly valuable in complex construction and infrastructure projects where delays or inefficiencies can quickly cascade into sustainability and cost overruns.

Despite these advances, leadership agility at EllisDon remains deliberately human-centered. AI outputs are treated as advisory inputs rather than authoritative directives. Final decisions, particularly those affecting safety, contractual obligations, sustainability commitments, or client trust, are validated through professional judgment. This human-in-the-loop governance model reflects both regulatory constraints and an organizational recognition that AI insights must be contextualized within broader social, ethical, and operational considerations. Leadership agility therefore emerges not from automation of authority, but from the augmentation of leadership cognition.

From a learning agility perspective, EllisDon demonstrates early but meaningful progress. Exposure to AI-generated insights encourages leaders to question assumptions, reassess established practices, and engage in continuous learning about system behavior and performance drivers. However, organizational learning remains partially implicit rather than fully institutionalized. While AI informs decisions, structured mechanisms to codify lessons learned or translate AI insights into standardized leadership routines are still evolving. This suggests that learning agility is emerging, but not yet fully mature, within the organization.

In contrast to earlier cases in which AI adoption remained limited to analytical support, the EllisDon case demonstrates a more integrated use of AI within leadership decision environments. The discussion with EllisDon leadership also revealed that the value of AI in this context lies not only in automation but in expanding the analytical horizon available to decision-makers. Rather than replacing managerial judgment, AI-supported tools allow leaders to examine multiple potential project outcomes before committing to strategic actions. Reflecting on this capability, one executive noted:

"AI does not replace leadership judgment; it expands the range of scenarios leaders can evaluate before making decisions."

(Participant A, VP Innovation & Smart Building Solutions MENA).

In this perspective, AI appears to function less as a substitute for leadership and more as a capability that broadens the analytical perspective available to decision-makers.

In the context of this study, EllisDon illustrates how AI-supported decision-making enhances leadership agility when AI is embedded within decision architectures, sustainability intelligence systems, and governance routines. Leadership agility is not a function of technological sophistication alone, but of how effectively AI reshapes leaders' ability to anticipate, adapt, and learn in complex environments. EllisDon demonstrates that when AI is positioned as a cognitive partner, rather than a decision substitute, it can materially strengthen agile leadership without compromising accountability or trust.

4.5.7 Organizational Constraints and Readiness Factors

Despite its advanced AI usage, EllisDon faces several constraints that are theoretically significant for this study. Data quality remains a persistent challenge, particularly when dealing with legacy buildings or incomplete historical records. As emphasized in the interviews, AI reliability is highly sensitive to input quality, reinforcing the "garbage in, garbage out" principle.

"AI can generate powerful insights, but the quality of those insights always depends on the quality of the data and inputs provided. If the inputs are weak, the outputs will inevitably reflect those limitations.” (Participant A, VP Innovation & Smart Building Solutions MENA)

Client maturity also constrains AI impact. Many asset owners expect rapid AI deployment without fully understanding the data preparation, sensor infrastructure, and governance required for reliable outputs. This expectation gap necessitates ongoing education and limits the speed at which AI-enabled sustainability optimization can scale.

Internally, the organization has responded to these constraints by creating new roles, such as AI engineers and data analysts, and by promoting continuous learning rather than resistance. AI adoption is framed as a professional growth opportunity, supporting organizational readiness and reducing cultural friction

4.5.8 Analytical Interpretation

The EllisDon case represents a high-maturity configuration within this study, illustrating how Artificial Intelligence (AI) can meaningfully enhance leadership agility when embedded within core decision architectures, sustainability measurement systems, and governance routines. Unlike cases where AI adoption remains peripheral or functionally bounded, EllisDon demonstrates a structurally integrated model in which AI reshapes how leaders’ sense, interpret, and respond to complexity across the asset lifecycle.

From a sustainability standpoint, EllisDon illustrates a transition from compliance-oriented sustainability to intelligence-driven sustainability governance. Environmental performance is not treated as a static outcome verified through post-hoc certification alone, but as a continuously monitored and optimized dimension of operational decision-making. By embedding sustainability metrics, such as energy efficiency, asset health, and lifecycle performance, into digital twin platforms and leadership dashboards, sustainability becomes a strategic input rather than a reporting artifact. This capability directly supports leadership agility by enabling leaders to anticipate environmental risks, evaluate trade-offs in real time, and intervene proactively.

In relation to AI adoption, EllisDon exemplifies a platform-based, ecosystem-level maturity, where AI is distributed across design, construction, and operations rather than concentrated in isolated tools. This architecture allows leadership to operate within a predictive decision environment, replacing retrospective sensemaking with forward-looking insight. Importantly, AI's value does not lie solely in automation or efficiency gains, but in its ability to extend leadership cognition, enhancing situational awareness, pattern recognition, and scenario evaluation in highly complex project settings.

From a leadership agility perspective, the case demonstrates a strong manifestation of anticipatory and adaptive agility, and a developing, but not yet fully institutionalized, form of learning agility. Anticipatory agility is evident in leaders' ability to identify sustainability, operational, and risk signals before failure or inefficiency occurs, supported by AI-driven forecasting and anomaly detection. Adaptive agility is reflected in leaders' capacity to reconfigure plans, resources, and priorities dynamically based on real-time insights, rather than relying on fixed plans or linear decision models. These capabilities align closely with complexity leadership theory, which emphasizes leadership as sensemaking and orchestration rather than command-and-control.

A critical moderating factor is the organization's human-in-the-loop governance model, which deliberately constrains AI autonomy. While AI agents perform high-level sensing, analysis, and recommendation generation, final decision authority remains with leadership. This boundary is shaped by safety considerations, regulatory requirements, accountability norms, and data quality dependencies. Rather than limiting agility, this governance approach enhances trust and adoption, ensuring that AI insights are used meaningfully within leadership deliberations.

Data quality emerges as a central structural dependency in the case. The effectiveness of AI-supported leadership agility is contingent on the availability of clean, consistent, and contextualized data, particularly in environments involving legacy assets and heterogeneous client systems. This reinforces a key insight of the study: AI amplifies existing organizational capabilities but does not compensate for foundational weaknesses. Where data governance, digital infrastructure, and leadership capability are aligned, AI accelerates agility; where they are fragmented, AI impact is constrained.

Comparatively, EllisDon contrasts sharply with cases where AI is confined to administrative automation or where sustainability remains decoupled from decision systems. The case demonstrates that the transformative impact of AI on leadership agility arises not from tool adoption, but from systemic embedding, specifically, the integration of AI into sustainability intelligence, risk governance, and leadership cognition. This distinction supports the study's central argument that leadership agility is an emergent property of socio-technical alignment, rather than a direct output of technology deployment.

From a theoretical perspective, the EllisDon case advances leadership agility scholarship by illustrating how AI functions as a cognitive augmentation mechanism within adaptive and complexity leadership frameworks. AI enhances leaders' capacity to sense weak signals, interpret nonlinear interactions, and respond proactively, while preserving the relational, ethical, and judgment-based dimensions of leadership. This hybrid model challenges deterministic narratives of AI-driven leadership and instead positions AI as an enabler of augmented human agency.

In the context of sustainability-driven SMEs, EllisDon demonstrates that advanced AI-enabled leadership agility is achievable even within resource-constrained or subsidiary structures, provided that leadership autonomy, digital maturity, and governance coherence are present. The case therefore serves as a benchmark reference within this study, illustrating the upper boundary of AI's contribution to leadership agility under emerging-market conditions.

The EllisDon case provides indicative evidence of performance-related outcomes associated with AI-enabled leadership practices, including percentage-based efficiency improvements, higher rates of successful project delivery, and changes in supplier selection informed by digital and sustainability criteria. However, these outcomes should be interpreted as contextual indicators rather than as standardized performance measures.

Comparable and consistently measurable performance data were not available across the other cases due to differences in digital maturity, governance structures, and data infrastructures. Consequently, while the EllisDon case illustrates the potential performance implications of AI-enabled leadership agility, the study does not generalize these outcomes across all cases.

CHAPTER 5
CROSS-CASE ANALYSIS AND THEORETICAL INTEGRATION

5.1 Introduction to Cross-Case Discussion and Theoretical Integration

This chapter integrates findings across the four case studies to identify patterns linking AI adoption to leadership agility in sustainability-driven SMEs, while explicitly accounting for variation in organizational maturity, context, and leadership interpretation. Rather than reiterating case narratives, the objective here is to identify recurring patterns, explain underlying mechanisms, and integrate the findings with leadership and sustainability theory. The chapter moves from descriptive evidence toward analytical generalization, focusing on how and under what conditions Artificial Intelligence (AI) contributes to leadership agility in sustainability-driven SMEs.

The cross-case discussion responds directly to the study's research questions by examining variations in AI adoption, leadership behavior, and organizational context across cases. In doing so, it clarifies the conditions under which AI enhances leadership agility and distinguishes these from situations where AI adoption remains operational or symbolic. This synthesis provides the conceptual foundation for the theoretical contributions discussed in Chapter 8 and the boundary conditions articulated in Chapter 9.

Within this comparative logic, the EllisDon case is treated as a theoretical boundary case rather than as a representative SME model. It illustrates the upper limit of AI-enabled leadership agility achievable under SME-like governance constraints, serving to clarify the conditions under which advanced AI integration meaningfully reshapes leadership practice rather than to suggest typical SME adoption patterns.

5.1.1 Clarifying Scope, Conditions, and Construct Hierarchy

To address risks of analytical overextension and construct overlap, this study explicitly clarifies three foundational elements: necessary versus sufficient conditions, construct hierarchy, and analytical boundaries.

First, the findings demonstrate that AI adoption is a necessary but not sufficient condition for leadership agility in sustainability-driven SMEs. Across all cases, some form of AI use was present, ranging from basic automation and administrative support to advanced predictive analytics and AI agents. However, leadership agility only emerged meaningfully when AI was embedded within leadership sensemaking and strategic decision processes. Where AI remained peripheral or operational, its impact on leadership agility was limited.

Second, the study establishes a clear hierarchy among constructs.

- AI technologies (automation, predictive analytics, AI agents) operate as enabling mechanisms.
- Leadership agility constitutes an intervening organizational capability, expressed through enhanced sensemaking, adaptive decision-making, and temporal responsiveness.
- Sustainability outcomes represent downstream effects, mediated by leadership agility rather than directly produced by AI tools.

This hierarchy avoids conflating AI adoption with leadership behavior or sustainability performance and provides analytical coherence across cases.

Third, the study defines its analytical boundary. The focus is on capability development, not deterministic performance causality. While sustainability outcomes are discussed where evidence exists, the study does not claim direct or uniform performance effects of AI. Instead, it explains how AI reshapes leadership cognition and adaptive capacity within the structural and contextual constraints of SMEs. This distinction reflects an intentional analytical choice to prioritize leadership-mediated mechanisms over deterministic technology–performance relationships, consistent with the applied and exploratory orientation of this DBA study.

5.2 Cross-Case Patterns: Configurations of AI-Enabled Leadership Agility

Three dominant configurations of AI-enabled leadership agility emerged across the cases, differentiated not only by technological deployment but by how leaders interpreted and acted upon AI-generated insights. These configurations reflect differences in AI integration depth, leadership trust in AI, and organizational readiness rather than sectoral differences alone.

5.2.1 Peripheral AI and Reactive Leadership

In the cases of NERA and Enetek Power, AI adoption remained peripheral to leadership decision-making. AI tools were primarily used for administrative efficiency, documentation, or preparatory analysis, without integration into strategic or sustainability-related deliberations.

Leadership behavior in these cases was predominantly reactive. Decisions were guided by experience, established engineering standards, or centralized governance rather than predictive or scenario-based insights. Sustainability practices existed but were embedded at the product or compliance level, not as dynamic inputs into leadership sensemaking. These cases demonstrate that AI presence alone does not produce leadership agility when organizational autonomy, data infrastructure, and leadership confidence are limited.

5.2.2 Functional AI and Bounded Leadership Agility (LinkHat)

In the LinkHat case, AI was primarily deployed at a functional level to support comparison, reporting, and operational decision-making, with its strategic influence remaining mediated by leadership judgment rather than automation. AI was actively used across several functions, including marketing, business development, and operational monitoring, leading to improved execution speed and process efficiency. Leadership demonstrated awareness of AI's potential and openness to further integration.

However, AI remained functionally bounded. It supported operational and commercial decisions but was not embedded into executive-level sensemaking or sustainability strategy formulation. Leadership agility was therefore partial: adaptive at the execution level but constrained at the anticipatory and strategic levels. This configuration illustrates a transitional stage where AI enhances process agility without yet transforming leadership cognition.

5.2.3 Systemic AI and Anticipatory Leadership Agility (EllisDon)

The EllisDon case illustrates a more advanced configuration characterized by systemic AI integration and anticipatory leadership behavior. AI-enabled platforms, predictive analytics, and sustainability measurement systems were embedded within governance structures and project-level leadership routines. Leaders engaged with AI outputs as interpretive resources, using data-informed foresight to evaluate trade-offs, anticipate risks, and recalibrate strategies proactively.

Sustainability was treated as dynamic intelligence rather than static reporting. Environmental objectives were continuously aligned with operational and investment decisions through real-time data integration. This case demonstrates the sufficient conditions under which AI meaningfully enhances leadership agility: coherent governance, leadership willingness to engage analytically, and mature sustainability intelligence systems.

Taken together, these three case-level configurations illustrate that AI-enabled leadership agility cannot be inferred from technological deployment alone. While each organization engaged with AI in different ways, the decisive differences lay in how leadership interpreted, trusted, and embedded AI-generated insights into decision routines. The cases therefore point beyond individual organizational narratives toward patterned alignments between AI integration, leadership cognition, governance structure, and sustainability orientation.

To move from descriptive comparison to analytical generalization, it is necessary to abstract these observed patterns into a configurational framework. Such an approach allows the analysis to capture not only differences in degree of AI adoption, but differences in kind; that is, structurally distinct ways in which AI and leadership interact. The following section therefore develops a configurational typology that synthesizes the cross-case patterns identified above and provides a structured basis for interpreting variation in AI-enabled leadership agility across sustainability-driven SMEs.

5.2.4 Toward a Configurational Typology of AI-Enabled Leadership Agility

The cross-case analysis reveals that the relationship between Artificial Intelligence adoption and leadership agility does not unfold along a linear or uniform trajectory. Rather than observing incremental progression from low to high digital maturity, the cases illustrate distinct configurations in which technological integration, leadership cognition, governance structure, and sustainability orientation intersect in patterned ways. These configurations represent structurally different alignments between AI capability and leadership practice.

Importantly, the cases do not suggest that AI maturity alone determines agility outcomes. Instead, agility emerges through the interaction between digital tools and the interpretive, relational, and institutional conditions within which leaders operate. This interactional dynamic calls for a configurational interpretation rather than a stage-based model.

Drawing from the empirical patterns identified in Section 5.2, four analytically distinguishable configurations can be articulated.

1. Peripheral AI and Reactive Leadership

In this configuration, AI tools are present but functionally marginal. Their use is typically confined to administrative automation, document generation, or limited analytical comparison. Leadership decision-making remains largely experiential and reactive, with AI consulted episodically rather than embedded in strategic routines.

Sustainability considerations may exist at a normative level, yet they are rarely integrated into predictive or scenario-based decision frameworks. Organizational learning remains incremental, and adaptation is triggered primarily by external pressures rather than anticipatory modeling. In this configuration, AI enhances efficiency but does not substantially alter the cognitive architecture of leadership.

This alignment illustrates that digital adoption without structural embedding does not generate transformative agility. The technology exists, yet its influence on strategic reconfiguration remains limited.

2. Functional AI and Execution-Oriented Agility

The second configuration reflects deeper integration of AI within operational processes. Predictive analytics, benchmarking tools, and structured dashboards support decision speed and comparative analysis. Leaders engage with AI outputs more systematically, and certain strategic decisions are informed by data-driven insights.

However, AI remains primarily execution-oriented. It strengthens responsiveness, coordination, and information transparency but does not fully reconfigure long-term strategic orientation. Sustainability metrics may be monitored, yet their integration into forward-looking capital allocation or systemic risk assessment remains partial.

Leadership agility in this configuration is characterized by enhanced execution capacity. Adaptation occurs efficiently, but anticipatory transformation is constrained by incomplete integration of sustainability intelligence systems into core governance mechanisms.

3. Sustainability-Driven but Digitally Constrained Agility

A third configuration emerges where sustainability orientation is strong, yet AI capability remains limited or selectively applied. Leaders demonstrate adaptive behavior grounded in professional expertise, sectoral knowledge, and stakeholder engagement rather than predictive modeling.

In such contexts, environmental responsibility and long-term strategic thinking are central, but the informational infrastructure required to simulate or quantify sustainability trade-offs may be underdeveloped. Agility is relational and values-driven rather than algorithmically supported.

This configuration demonstrates that sustainability commitment alone does not guarantee anticipatory leadership. Without structured digital intelligence systems, leaders operate within bounded informational visibility. Their agility remains dependent on experiential judgment rather than systemic foresight.

4. Systemic AI and Anticipatory Leadership

The fourth configuration represents a deeper alignment between AI capability and leadership cognition. AI tools are integrated across operational, financial, and sustainability dimensions, allowing leaders to engage with predictive scenarios and crossfunctional risk modeling. Governance mechanisms provide oversight while maintaining human interpretive authority.

In this configuration, AI reshapes attentional priorities and temporal orientation. Leaders engage with forward-looking data rather than relying solely on retrospective performance indicators. Sustainability metrics are incorporated into supplier selection, resource allocation, and long-term investment decisions.

Leadership agility here becomes anticipatory rather than reactive. Adaptation is informed by modeled contingencies and structured foresight rather than external shock. Importantly, this configuration is not defined by technological sophistication alone but by coherent integration between digital infrastructure, governance discipline, and leadership interpretive capacity.

Configurational Implications

The typology suggests that AI-enabled leadership agility is not a function of digital intensity alone. Instead, agility emerges from the patterned alignment of:

- AI integration depth
- Leadership interpretive capability
- Governance coherence
- Sustainability measurement maturity

These elements interact in ways that amplify or constrain adaptive potential. Organizations may exhibit high AI usage yet remain reactive if governance structures do not embed predictive intelligence into decision routines. Conversely, sustainability-oriented firms may demonstrate principled adaptability without achieving anticipatory capacity in the absence of structured digital systems.

The findings therefore support a configurational understanding of capability development. AI does not automatically produce leadership agility; it conditionally enhances or stabilizes existing organizational orientations. Where institutional coherence and interpretive competence converge, AI functions as cognitive infrastructure. Where fragmentation persists, AI remains peripheral.

This configurational typology provides a conceptual bridge between the cross-case observations and the mechanisms examined in the following section. Rather than treating AI adoption as a uniform driver of agility, it positions digital capability as part of a broader socio-technical alignment that shapes the form and intensity of leadership adaptation.

The quadrant below illustrates the configurational patterns observed across cases, highlighting how varying degrees of AI integration and leadership agility combine to produce distinct strategic orientations within sustainability-driven SMEs.

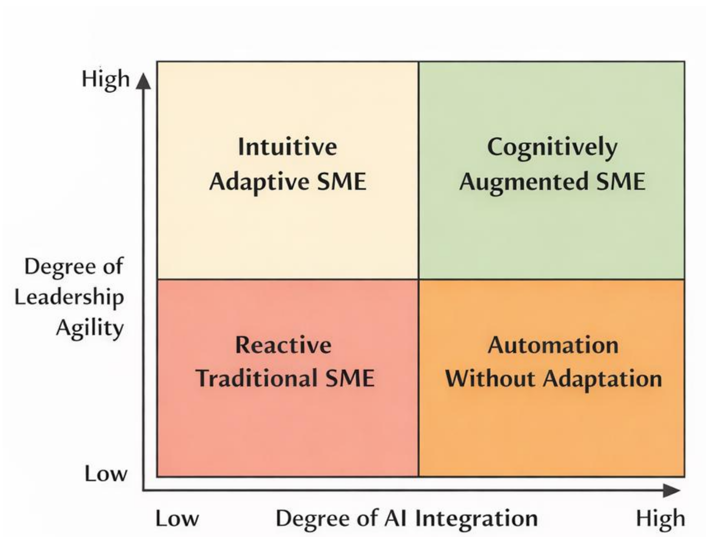

Figure 5.2 Configurational Typology of AI-Enabled Leadership Agility

Source: Author's own elaboration based on empirical findings

Cognitively Augmented SME

This configuration reflects organizations where AI systems are embedded into decision processes and leaders actively reinterpret technological outputs through adaptive strategic reasoning. AI enhances anticipation, while leadership judgment ensures contextual alignment. This represents the most strategically resilient configuration observed in the cases.

Automation Without Adaptation

In this quadrant, SMEs invest in AI tools but leadership behavior remains operationally rigid. Technology is used for efficiency, yet strategic interpretation and adaptive decision-making are limited. AI functions as an automation mechanism rather than a cognitive enabler.

Intuitive Adaptive SME

Here, leaders demonstrate high agility despite limited AI integration. Strategic responsiveness is driven primarily by experiential knowledge and informal sensing mechanisms. While adaptable, this configuration may struggle with scalability and predictive depth under increasing complexity.

Reactive Traditional SME

Organizations in this quadrant display limited AI adoption and low adaptive leadership behavior. Decision-making is reactive, operationally constrained, and minimally anticipatory. Sustainability initiatives tend to follow external pressure rather than proactive strategic intent.

5.2.5 Boundary Conditions of AI-Enabled Leadership Agility

Although the preceding sections have outlined the mechanisms through which AI appears to support leadership agility, the cases also make something equally clear: these mechanisms do not operate in a uniform or automatic manner. The presence of digital tools, dashboards, or predictive systems does not in itself translate into anticipatory leadership. Across the organizations studied, AI's contribution was shaped and at times constrained by contextual realities that sit beyond the technology itself.

One of the most visible boundaries concerns data maturities. In organizations where operational and sustainability data were fragmented, inconsistently recorded, or weakly integrated, AI systems could only offer partial insight. Leaders often continued to rely on experience and informal consultation, not because they resisted digital tools, but because the informational substrate required for robust prediction was incomplete. In such cases, AI improved efficiency without fundamentally altering decision logic. The technology functioned, but its strategic influence remained limited.

Governance structure also played a defining role. Where AI outputs were incorporated into formal review processes and embedded in routine strategic discussions, their influence was more visible. In contrast, in settings where governance remained centralized or loosely structured, AI insights were consulted selectively. They informed decisions, but did not systematically reshape them. This distinction proved important. AI appears to strengthen agility when it becomes part of institutionalized decision architecture rather than an optional advisory layer.

Another boundary emerged around leadership interpretive capacity. AI systems produce outputs, but they do not interpret themselves. In several cases, leaders demonstrated a healthy balance between openness and skepticism, engaging with analytics while still interrogating assumptions. In others, digital tools were either underutilized or treated as authoritative without sufficient scrutiny. Both tendencies limited the developmental potential of AI-enabled agility. What became evident is that the strategic value of AI is mediated by leaders' ability to contextualize and question what the system produces.

Institutional context further shapes these dynamics. In environments characterized by hierarchical decision norms or founder-centric authority, the diffusion of analytical insight across teams was often restricted. Even where data visibility improved, final decision authority remained concentrated. This concentration did not eliminate agility, but it altered its expression. Adaptation tended to be centralized rather than distributed, and anticipatory shifts were dependent on a limited set of actors. Regulatory volatility and resource constraints added additional pressure, narrowing the horizon within which long-term predictive reasoning could operate.

A final condition relates to the integration of sustainability metrics into digital systems. AI can only anticipate what is measured. Where environmental and social indicators were systematically captured and embedded into analytical models, leaders were better positioned to evaluate trade-offs before committing resources. Where sustainability remained primarily narrative or values-driven, predictive capacity was constrained. The technology could optimize operational variables, but not broader impact trajectories.

Collaboratively, these observations suggest that AI-enabled leadership agility should not be understood as a universal outcome of digital adoption. Rather, it emerges under particular combinations of data coherence, governance alignment, interpretive competence, and institutional stability. In some contexts, AI amplifies existing strategic discipline; in others, it remains peripheral. The development of capability is therefore uneven and path-dependent, shaped as much by organizational history and structure as by technological investment.

Recognizing these boundary conditions does not diminish the potential of AI. Instead, it situates that potential within the practical realities of sustainability-driven SMEs operating under constraint. Leadership agility, as observed across the cases, is not a product of technology alone. It is the outcome of how technology, institutional design, and human judgment interact over time.

Beyond acting as static constraints, the boundary conditions identified in this study appear to shape how leadership agility develops over time. In several cases, limitations related to data maturity and informal governance did not prevent early experimentation with AI, but they constrained how far these tools could be embedded into leadership decision-making routines. As a result, AI use often stabilized at a functional or symbolic level, improving visibility and coordination without materially altering how strategic judgment was exercised.

This observation suggests that governance structures, leadership authority arrangements, and the availability of sustainability data do more than limit AI effectiveness. They influence the direction in which leadership capability evolves. Where these conditions remained misaligned, leadership agility tended to manifest as short-term responsiveness rather than anticipatory adaptation. In contrast, when governance arrangements supported deliberation, validation, and interpretive engagement with AI outputs, leadership agility developed in a more forward-looking and adaptive manner. This reinforces the view that AI-enabled leadership agility is path-dependent, shaped by how organizational conditions regulate the interaction between information, authority, and leadership cognition over time.

Viewed dynamically, these boundary conditions do not merely limit AI's effectiveness; they shape how leadership agility develops over time. Viewed dynamically, the boundary conditions identified in this study do not merely limit the effectiveness of AI-enabled initiatives; they shape how leadership agility develops over time. In several cases, constraints related to data maturity and informal governance did not prevent early experimentation with AI, but they limited the extent to which these tools could be embedded into leadership decision-making routines. As a result, AI use often stabilized at a functional or symbolic level, improving visibility and coordination without materially altering how strategic judgment was exercised.

This observation suggests that governance structures, leadership authority arrangements, and the availability of sustainability data do more than moderate AI's immediate impact. They influence the direction in which leadership capability evolves. Where these conditions remained misaligned, leadership agility tended to manifest as short-term responsiveness rather than anticipatory adaptation. Leaders responded more efficiently to emerging issues, yet rarely reconfigured strategic priorities in advance of pressure.

By contrast, in contexts where governance arrangements supported deliberation, validation, and interpretive engagement with AI outputs, leadership agility developed in a more forward-looking and adaptive manner. AI insights were not treated as optional inputs but became part of how strategic issues were framed, debated, and sequenced over time. This integration enabled leaders to intervene earlier, reassess sustainability trade-offs more systematically, and coordinate adaptive responses with greater confidence.

Collectively, these patterns reinforce the view that AI-enabled leadership agility is path-dependent. Its development is shaped not only by technological investment, but by how organizational conditions regulate the interaction between information, authority, and leadership cognition over time. Leadership agility therefore emerges as an evolving capability, formed through repeated engagement with AI within specific governance and institutional contexts, rather than as an automatic outcome of digital adoption.

5.3 Mechanisms Linking AI to Leadership Agility

Artificial Intelligence (AI) does not replace leadership judgment; rather, it augments leadership sensemaking by expanding leaders' capacity to interpret complexity, anticipate future conditions, and act with greater temporal foresight. Leadership agility therefore emerges not from AI autonomy, but from the integration of AI into leadership cognition, governance routines, and sustainability intelligence systems.

Analysis revealed several mechanisms through which AI contributes to leadership agility, as interpreted and enacted by leaders across differing organizational contexts.

These mechanisms explain how AI reshapes leadership behavior when sufficient conditions are present.

5.3.1 Sensemaking Amplification

AI enhanced leadership sensemaking by expanding leaders' capacity to process complex, multi-source information. Predictive analytics and integrated dashboards enabled leaders to detect patterns, interpret weak signals, and contextualize sustainability data alongside financial and operational indicators. Where embedded into leadership routines, this mechanism reduced reliance on intuition alone and supported more informed strategic judgment.

5.3.2 Temporal Reconfiguration of Leadership Action

A second critical mechanism is the temporal reconfiguration of leadership action. Leadership agility is not solely a function of decision speed, but of when decisions are made relative to emerging risks and opportunities. Traditional decision-making structures rely heavily on lagging indicators, monthly reports, post-incident reviews, or periodic performance assessments, thereby compressing leaders' response windows.

AI altered the temporal dimension of leadership by compressing decision cycles and extending leaders' future orientation. Predictive tools enabled earlier identification of risks and opportunities, shifting leadership behavior from reactive response toward proactive planning. This temporal reconfiguration was absent in cases where AI was limited to retrospective reporting.

5.3.3 Cognitive Load Redistribution

The third mechanism operates at the level of cognitive capacity. Leadership agility requires continuous monitoring of complex systems, rapid interpretation of evolving information, and coordination across multiple stakeholders. In the absence of AI, these demands often overwhelm leadership attention, resulting in simplified heuristics, delayed decisions, or overreliance on established routines.

Automation reduced administrative and analytical burdens, allowing leaders to redirect cognitive attention toward higher-order strategic and sustainability considerations. However, this mechanism only contributed to leadership agility when freed capacity was reinvested into strategic sensemaking rather than absorbed by additional operational tasks. Importantly, the extent of cognitive redistribution varied across cases and depended on whether leaders actively restructured decision routines or merely layered AI tools onto existing practices.

5.3.4 Sustainability as Dynamic Intelligence

A critical mechanism through which Artificial Intelligence enhances leadership agility in sustainability-driven SMEs is the transformation of sustainability from a static performance outcome into dynamic, decision-active intelligence. Traditional sustainability practices, particularly within SMEs, tend to treat environmental metrics as retrospective indicators, assessed periodically for compliance, reporting, or certification purposes. Under such conditions, sustainability information is disconnected from leadership sensemaking and has limited influence on how decisions are framed or enacted.

In more mature configurations, AI transformed sustainability from a static outcome into a dynamic leadership input. Real-time monitoring, scenario modeling, and integrated sustainability metrics enabled leaders to balance environmental and economic objectives adaptively. Where sustainability data was fragmented or absent, this mechanism remained inactive.

5.3.5 Integrative Mechanism: From Tool Use to Cognitive Infrastructure

The preceding mechanisms: sensemaking amplification, temporal reconfiguration, cognitive load redistribution, and sustainability as dynamic intelligence, do not operate independently. Their combined effect produces a qualitatively different leadership condition in which Artificial Intelligence (AI) ceases to function as a discrete tool and instead becomes a cognitive infrastructure embedded within leadership practice. This distinction is central to understanding the transformational, rather than incremental, impact of AI on leadership agility.

Collectively, these mechanisms illustrate a shift from tool-based AI use toward cognitive infrastructure, a transition observed only where leadership engagement and interpretive capacity were sufficiently developed. AI enhances leadership agility only when it becomes embedded in how leaders interpret complexity, allocate attention, and coordinate adaptive action. This integration requires not only technological capability but also leadership trust, governance alignment, and organizational readiness.

5.4 Summary of Cross-Case Insights

The cross-case analysis presented in this chapter demonstrates that the relationship between Artificial Intelligence (AI) adoption and leadership agility in sustainability-driven SMEs is neither linear nor automatic. While all case organizations exhibited some level of AI use, the extent to which AI contributed to leadership agility varied significantly across contexts, governance structures, and levels of organizational readiness. These variations confirm that AI adoption alone does not generate agile leadership outcomes.

Across cases, AI emerged as a necessary enabling condition, providing access to data, automation, and analytical support. However, leadership agility materialized only when AI was embedded within leadership sensemaking, decision-making routines, and sustainability intelligence systems. Where AI remained peripheral or functionally constrained, its contribution was limited to operational efficiency and execution speed, without materially altering leadership behavior or strategic adaptability.

The analysis further establishes leadership agility as a mediating organizational capability rather than a direct outcome of technological deployment. AI technologies influenced leadership agility indirectly by reshaping how leaders interpret complexity, allocate attention, and engage with temporal uncertainty. In this sense, AI functioned as a cognitive and informational infrastructure that conditioned leadership action, rather than as a deterministic driver of organizational outcomes.

Importantly, sustainability outcomes did not emerge as direct or uniform consequences of AI adoption. Instead, sustainability performance was contingent upon the degree to which leadership agility enabled adaptive alignment between environmental objectives, operational priorities, and strategic decision-making. In digitally mature configurations, sustainability was leveraged as dynamic intelligence supporting anticipatory leadership behavior. In contrast, where sustainability data was fragmented or non-integrated, environmental impact remained operationally embedded rather than strategically enacted.

These findings support the proposed conceptual framework linking AI, leadership agility, and sustainability orientation, while also highlighting boundary conditions that constrain transferability across SME contexts. The cross-case synthesis thus positions leadership agility as the critical explanatory mechanism linking AI adoption to sustainability outcomes in SMEs, while acknowledging the contextual constraints that moderate this relationship in emerging-market environments.

Building on the empirical patterns identified across cases, Chapter 6 develops the theoretical contributions of this study. These contributions move from leadership theory, through cognitive and socio-technical mechanisms, into sustainability leadership, and are subsequently bounded by SME and MENA-specific contexts.

CHAPTER 6
THEORETICAL CONTRIBUTIONS AND IMPLICATIONS

6.1 Reframing the Role of AI in Leadership Theory

Building on the core mechanism established in Chapter 7, this study contributes to leadership theory by reframing Artificial Intelligence as an enabler of leadership agility rather than a replacement for human judgment, emphasizing the interpretive and contextual role of leaders in AI-augmented decision environments. The findings show that the value of AI for leadership lies in how it conditions decision contexts, alters information availability, and reshapes the boundaries within which leadership judgment is exercised. By situating AI within a capability-based and context-dependent framework, the study extends adaptive and complexity leadership theories to account for leadership practice in digitally mediated and sustainability-oriented organizational settings.

6.1A Contribution to Leadership Cognition and Sensemaking in AI-Enabled Contexts

Beyond its contribution to leadership agility theory, this study contributes to a deeper understanding of how leadership cognition and sensemaking evolve in AI-enabled environments. Much of the existing leadership literature focuses on observable behaviors, adaptive actions, or leadership styles, often paying less attention to the internal cognitive work through which leaders interpret complexity and uncertainty. This research shifts attention toward that internal dimension, highlighting how leadership agility is shaped by the way leaders make sense of information when decision environments are increasingly mediated by artificial intelligence.

The findings suggest that Artificial Intelligence does not simply improve decision quality by providing faster or more accurate data. Rather, AI reshapes the conditions under which leadership judgment is formed. AI-enabled agents, predictive analytics, and automated insights influence what leaders notice, which issues are elevated for attention, and how future possibilities are imagined. In this sense, leadership agility emerges not from the presence of AI technologies alone, but from leaders’ capacity to engage with AI-generated insights as part of an ongoing sensemaking process.

What becomes particularly evident across the cases is that AI does not replace leadership interpretation. Instead, it introduces new layers of interpretation. Leaders are required to assess the relevance of algorithmic outputs, question underlying assumptions, and reconcile data-driven insights with experiential knowledge, organizational values, and sustainability priorities. Leadership agility, therefore, is not a technical outcome of AI adoption, but a cognitive practice through which leaders actively interpret and contextualize AI-supported information.

This study also highlights an important tension in AI-enabled leadership cognition. While automation and analytics can reduce certain forms of cognitive and administrative burden, they simultaneously introduce new demands related to judgment, validation, and responsibility. Predictive models rarely offer definitive answers; they present scenarios, probabilities, and risk signals that require interpretation. Leaders who demonstrated higher levels of agility were not those who deferred to AI recommendations uncritically, but those who treated AI outputs as inputs into reflective deliberation rather than as decision substitutes.

From a sensemaking perspective, the study extends existing theory by showing how algorithmic outputs become embedded within leaders’ interpretive environments. AI systems shape the framing of problems by making some signals more visible than others, thereby influencing how uncertainty is perceived and prioritized. However, the findings also reveal that this influence is uneven. Where leaders lacked interpretive confidence, AI insights were either ignored or over-relied upon, both of which constrained adaptive response. Where leaders actively engaged with AI outputs, questioning and contextualizing them, leadership agility was more pronounced.

This contribution is particularly relevant for sustainability-driven SMEs, where leaders often operate with incomplete data, limited analytical infrastructure, and high levels of uncertainty. In such settings, leadership cognition remains central. AI enhances leadership agility not by eliminating uncertainty, but by reshaping how uncertainty is encountered and managed. Leaders who were able to integrate AI-generated insights into their sensemaking processes demonstrated greater anticipatory capacity and strategic flexibility, especially in relation to sustainability-related trade-offs.

By foregrounding leadership cognition and sensemaking, this study adds nuance to leadership agility scholarship. It positions AI not as a neutral decision-support tool, but as part of a broader cognitive environment that leaders must actively navigate. Leadership agility, in this view, reflects the leader's ability to work with AI-enabled insights thoughtfully and critically, rather than simply acting upon them. This perspective advances understanding of how leadership judgment is exercised in digitally mediated contexts and underscores the continuing importance of human interpretation in AI-enabled decision-making.

6.2 Reframing Leadership Agility as a Socio-Technical Capability

Existing leadership agility literature has largely conceptualized agility as an individual or behavioral capability, rooted in leaders' cognitive flexibility, learning orientation, and responsiveness to change. While these perspectives offer valuable insight, they often treat the informational environment of leadership as relatively stable or human-centered. The findings of this study suggest that such assumptions warrant reconsideration in digitally mediated contexts.

By examining leadership practice within AI-enabled sustainability-driven SMEs, this research reframes leadership agility as a socio-technical capability emerging from the interaction between human judgment and algorithmically mediated information environments. Leadership agility, in this sense, is not exercised in isolation, nor is it reducible to individual disposition. It is enacted through ongoing engagement with digital systems that shape what leaders notice, how they interpret complexity, and when they intervene.

Artificial intelligence (AI) does not replace leadership cognition, but it alters the conditions under which cognition operates. Predictive analytics, scenario modeling, and comparative dashboards reorganize attention and extend temporal horizons, exposing leaders to future-oriented considerations earlier in the decision cycle. Leadership agility therefore involves not only adaptive response, but adaptive interpretation; deciding which signals matter, which projections are credible, and how competing temporal demands should be prioritized.

This perspective challenges linear accounts of leadership development that assume greater technological sophistication automatically enhances leadership effectiveness. Instead, the findings demonstrate that leadership agility depends on how AI is embedded within governance routines and sensemaking processes. Where AI outputs are integrated into strategic deliberation and subjected to critical interrogation, leadership agility is amplified. Where they remain detached or symbolically adopted, agility remains constrained, regardless of technological capability.

Reframing leadership agility as socio-technical also clarifies why variation persists across organizations using similar AI tools. Differences in leadership interpretive capacity, governance coherence, and sustainability measurement maturity shape how digital augmentation translates into adaptive behavior. Agility emerges not from technology alone, but from the patterned alignment between digital infrastructure and leadership practice.

From a theoretical standpoint, this reframing contributes to leadership scholarship by bridging micro-level cognitive perspectives with broader socio-technical systems thinking. Leadership agility can no longer be understood solely as a human capability exercised despite technology; it must also be understood as a capability exercised through technology. This shift expands the conceptual boundary of leadership agility and invites future research to examine how evolving digital infrastructures continue to reshape leadership cognition over time.

Importantly, this reframing does not imply technological determinism. Leadership agency remains central. AI shapes informational conditions, but leaders retain responsibility for interpretation, judgment, and ethical consideration. Leadership agility therefore reflects the capacity to engage productively with digital augmentation while preserving human discretion and contextual awareness

6.3 Contribution to Sustainability Leadership

The study advances sustainability leadership literature by demonstrating how AI-enabled tools may support sustainability-oriented decision-making when mediated by leadership agility rather than embedded as standalone technical solutions. The findings demonstrate that sustainability leadership in resource-constrained contexts depends on leaders' capacity to dynamically integrate environmental considerations into strategic and operational decisions under uncertainty. By positioning leadership agility as the mechanism through which sustainability intent is translated into adaptive action, the study extends sustainability leadership theory toward a capability-based and context-sensitive perspective.

6.4 Contribution to Emerging Market and SME Leadership Scholarship

A further theoretical contribution of this study lies in its contextualization of AI-enabled leadership agility within emerging-market SMEs, particularly in the MENA region. Much of the existing literature on AI, leadership, and sustainability is grounded in large organizations operating within digitally mature and institutionally stable environments. Such assumptions limit the applicability of prevailing theories to SMEs operating under conditions of infrastructural asymmetry, regulatory fragmentation, and centralized decision authority.

This research contributes to SME leadership scholarship by providing empirical insights from sustainability-driven SMEs operating in the MENA region, where leadership agility often compensates for institutional and digital infrastructure constraints. The findings show that centralized authority, uneven data maturity, and constrained organizational autonomy shape how leadership capabilities are enacted in sustainability-driven SMEs across the MENA region. By foregrounding context as a moderating force, the study extends leadership agility theory beyond large-firm and developed-economy assumptions, offering a more realistic account of leadership under constraint

6.4.A Contribution to MENA SME Leadership and Emerging Market Scholarship

This study contributes to leadership scholarship in emerging market contexts by offering a grounded and contextually informed account of how leadership agility is shaped in sustainability-driven SMEs operating across the MENA region. Much of the existing leadership and digital transformation literature is built on assumptions derived from institutionally mature, Western settings, where governance structures are formalized, data infrastructures are relatively stable, and leadership roles are distributed across layers of management. The empirical evidence presented in this research suggests that these assumptions do not adequately reflect the conditions under which many MENA-based SMEs operate.

One of the key contributions of this study lies in questioning linear and universal models of leadership capability development. In dominant digital maturity and leadership frameworks, increased technological sophistication is often assumed to lead to more effective leadership and improved strategic responsiveness. The findings of this research complicate that relationship. Across the cases examined, the presence of advanced AI tools did not consistently translate into higher levels of leadership agility, nor did limited digital capability necessarily prevent leaders from acting adaptively. Instead, leadership agility appeared uneven, situational, and closely tied to how leaders interpreted information and exercised judgment within their specific organizational and institutional contexts.

This insight is particularly relevant for SME leadership scholarship, where leadership authority is frequently concentrated in founders or small executive teams. In such settings, decision-making is rarely governed by formal routines alone. It is shaped by personal experience, relational trust, and informal coordination practices that sit outside conventional management models. The study shows that leadership agility in these environments is less about formal capability frameworks and more about leaders' ongoing sensemaking efforts, including their willingness to engage with uncertainty and to experiment with new forms of intelligence, such as AI-generated insights, without fully relinquishing judgment.

The research also contributes to emerging market scholarship by reframing how sustainability is understood in SME leadership practice. In the cases examined, sustainability was not primarily approached through standardized ESG frameworks or formal reporting systems. Instead, it was embedded in everyday strategic considerations, including regulatory anticipation, cost exposure, market positioning, and long-term organizational survival. AI-enabled leadership agility influenced how leaders navigated these pressures by supporting earlier awareness of emerging risks and constraints, rather than by directly driving measurable sustainability outcomes. This perspective shifts attention away from sustainability as a static performance metric and toward sustainability as an ongoing leadership challenge shaped by context and judgment.

Another contribution of this study lies in its treatment of institutional influence. National digital and sustainability agendas in the region created strong signals encouraging AI adoption and sustainability alignment. However, the findings indicate that these signals did not translate automatically into leadership capability at the firm level. Leadership agility depended on how individual leaders interpreted, prioritized, and acted upon these external pressures. This reinforces the view that institutional frameworks shape opportunity structures, but leadership capability mediates how those opportunities are realized in practice.

By grounding its analysis in the lived realities of MENA-based SMEs, this study extends leadership and digital transformation scholarship beyond Western-centric perspectives. While the findings are not intended to be statistically generalizable, they offer analytical insights into mechanisms and boundary conditions that are likely to resonate with SMEs operating under similar constraints in other emerging markets. In doing so, the research contributes to a more context-aware understanding of leadership agility, one that recognizes institutional variation as central rather than peripheral.

Overall, this contribution suggests that leadership agility in AI-enabled environments should not be understood primarily as a function of technological advancement. Instead, it emerges through leaders' capacity to interpret, integrate, and act upon AI-supported insights within complex and often ambiguous institutional settings. By situating this analysis within the MENA region, the study adds nuance to SME and emerging market leadership scholarship and highlights the importance of judgment, interpretation, and contextual awareness in shaping adaptive leadership under conditions of sustainability pressure.

6.5 Integrative Theoretical Implications

Collectively, these contributions extend existing leadership agility frameworks by bringing AI-enabled capabilities into closer conversation with leadership interpretation, organizational readiness, and institutional context. Rather than generating leadership agility directly, digital technologies appear to shape the environment within which leadership judgment, adaptation, and learning take place. This perspective advances leadership theory by drawing attention to socio-technical alignment and contextual readiness as underlying conditions for agile leadership, particularly in sustainability-oriented and resource-constrained settings.

What is equally clear is that these theoretical implications do not suggest technological determinism. The findings consistently point to leadership agency as the primary mechanism through which AI influences adaptive and sustainability-oriented outcomes. AI alters what leaders are exposed to, how quickly issues surface, and the range of alternatives that can be evaluated, but it does not substitute for judgment or responsibility. Leadership agility therefore remains a human capability, exercised within increasingly data-mediated decision environments.

Seen in this light, the study invites a reconsideration of how leadership agility is typically understood in digitally enabled contexts. Much of the existing literature assumes that cognition, attention, and temporal orientation remain largely human-centered, even as digital tools become more prevalent. The evidence presented here suggests a more nuanced picture. AI reshapes the conditions under which leadership agility is enacted, without displacing human judgment or decision authority.

When AI is understood as a form of cognitive infrastructure, leadership agility can be seen as a socio-technical capability emerging from the interaction between human interpretation and algorithmic augmentation. Agility does not become automated, nor is it handed over to technology. Instead, it is subtly reconfigured through expanded cognitive reach, shifts in attentional focus, and an extended temporal horizon. This framing helps explain why similar AI technologies lead to different leadership outcomes across organizations and why AI adoption alone rarely produces adaptive leadership behavior.

In a nutshell, these theoretical implications suggest that leadership agility in AI-enabled environments is better understood as an evolving capability shaped by how digital intelligence is embedded into leadership cognition, governance arrangements, and everyday decision routines. This repositioning clarifies how AI contributes to adaptive capacity while preserving the central role of human agency in sustainability-oriented leadership, and why AI adoption, in isolation, is insufficient to generate adaptive leadership behavior. Figure 6.4 summarizes this integrative perspective by illustrating how AI-enabled capabilities, leadership cognition, and contextual conditions interact to shape leadership agility in sustainability-driven SMEs.

Cumulatively, this integrative perspective emphasizes that the strategic value of AI for leadership lies not in automation or optimization alone, but in its capacity to reconfigure how leaders engage with complexity over time. Leadership agility emerges through iterative interaction with AI-supported insights, as leaders learn to recalibrate judgment, revisit assumptions, and sequence decisions under uncertainty. This process is neither uniform nor linear; it unfolds unevenly across organizations depending on leadership experience, interpretive confidence, and institutional constraint. By situating leadership agility within this evolving socio-technical and contextual landscape, the study offers a more realistic and practice-sensitive account of how adaptive leadership develops in sustainability-driven SMEs. In doing so, it reinforces the view that AI-enabled leadership agility is less a destination achieved through technological maturity, and more an ongoing capability shaped through judgment, learning, and contextual awareness.

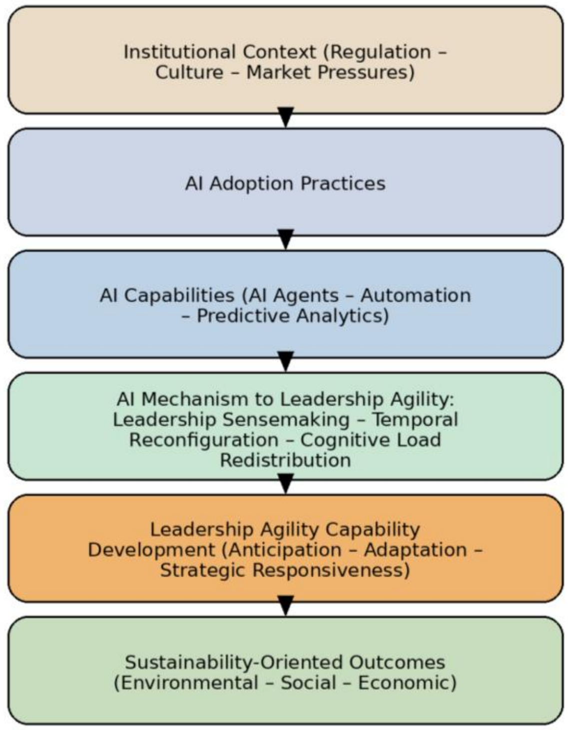

Figure 6.4 Integrated AI Leadership agility Framework
Source: Author's own elaboration based on empirical findings

This figure brings together the argument developed across the study. What became evident through the cases is that AI, on its own, does not transform leadership practice. Its influence is filtered through institutional realities, governance norms, cultural expectations, and varying levels of digital maturity. In some contexts, AI remained operational and peripheral; in others, it reshaped how leaders interpreted complexity and made sustainability-related trade-offs. Leadership agility therefore did not arise directly from technology, but from the way leaders engaged with it. The framework reflects this mediated relationship, emphasizing that AI becomes meaningful only when embedded within leadership cognition and aligned with contextual conditions.

CHAPTER 7
STUDY BOUNDARIES, LIMITATIONS, AND DIRECTIONS FOR FUTURE RESEARCH

7.1 Research Design and Methodological Limitations

This study adopts a qualitative multi–case study design to explore how Artificial Intelligence (AI) influences leadership agility in sustainability-driven Small and Medium-Sized Enterprises (SMEs) operating in the MENA region. While this approach is appropriate for examining complex and context-dependent leadership phenomena, it also presents several methodological limitations.

First, the qualitative nature of the research limits the generalizability of the findings. The study is designed to generate in-depth insights rather than statistically representative results. As such, the findings are analytically generalizable, meaning they contribute to theory development and conceptual understanding, but they cannot be directly generalized to all SMEs in the region. This limitation reflects a deliberate methodological choice, as the research seeks to capture nuanced leadership behaviors that are not easily measurable through quantitative methods.

Second, the study relies primarily on semi-structured interviews with senior leaders. Although this method enables rich exploration of leadership perceptions and decision-making processes, it also introduces the risk of subjective bias. Participants may overestimate the effectiveness of AI initiatives or present leadership practices in a favorable manner. To reduce this risk, data triangulation was applied through document review and cross-case comparison; however, some degree of interpretive bias remains unavoidable in qualitative leadership research.

Third, the research captures AI adoption and leadership agility at a single point in time. Leadership agility is a dynamic capability that evolves as organizations develop digital maturity and learning capacity. The cross-sectional design therefore limits the ability to observe changes in leadership behavior over time or to assess long-term impacts of AI on sustainability and performance outcomes. Consequently, causal relationships should be interpreted cautiously.

Overall, these methodological limitations do not undermine the value of the study. Instead, they define its scope and reinforce its role as an exploratory, theory-building investigation into AI-enabled leadership agility in sustainability-oriented SMEs.

7.2 Contextual and Regional Constraints

A key strength of this research is its contextual grounding in the MENA region and comparable emerging markets. However, this focus also introduces limitations related to contextual specificity.

Initially, the MENA region is highly heterogeneous in terms of economic development, regulatory maturity, digital infrastructure, and cultural leadership norms. While the study deliberately includes cases from different sub-regions (GCC, Levant, and Africa-linked markets), it cannot fully account for all intra-regional variations. Institutional differences may therefore shape AI adoption and leadership agility in ways not fully captured within the selected cases.

On a second note, regulatory and infrastructural constraints in emerging markets may limit the transferability of findings to digitally advanced economies. Conversely, leadership models derived from developed markets may not fully apply to the SMEs examined in this study. While this limitation reduces universal generalizability, it reinforces the study's contribution to context-sensitive leadership and SME scholarship.

Third, geopolitical instability and market volatility in parts of the MENA region may influence leadership behavior independently of AI adoption. In such environments, leaders may prioritize short-term survival over long-term sustainability optimization, thereby moderating the observable impact of AI on leadership agility. These external shocks are difficult to isolate within qualitative case research.

7.3 SME-Specific Structural Limitations

The study's focus on SMEs introduces structural characteristics that shape both AI adoption and the expression of leadership agility.

SMEs typically operate under resource constraints that limit investment in advanced AI infrastructure, dedicated analytics functions, and formal governance mechanisms. As a result, AI implementation is often incremental and functionally fragmented rather than enterprise-wide. This constrains the depth at which AI can be embedded within leadership decision architectures, particularly in sustainability domains requiring integrated, longitudinal data.

Leadership structures in SMEs are frequently centralized, with authority concentrated among founders or senior executives. While such concentration may enable rapid strategic shifts, it also means that leadership agility is heavily influenced by individual cognition, experience, and openness to technological augmentation. The institutionalization of AI-enabled practices across organizational layers may therefore remain limited.

Sustainability measurement within SMEs is often underdeveloped. Many sustainability-driven SMEs create environmental value through products or services but lack formalized sustainability metrics or AI-readable datasets. This restricts the extent to which AI systems can generate structured sustainability intelligence, thereby limiting the observable integration of sustainability considerations into agile leadership processes.

These structural characteristics define the operational boundaries of AI-enabled leadership agility within SMEs and reinforce the importance of context-sensitive capability frameworks.

7.4 Theoretical Scope and Boundary Conditions

From a theoretical perspective, this study conceptualizes leadership agility as the mediating capability between AI-enabled augmentation and sustainability orientation. This focus provides analytical clarity by foregrounding how AI reshapes leadership judgment and adaptive capacity. At the same time, it necessarily narrows the theoretical scope by prioritizing leadership cognition over a broader set of organizational and contextual constructs that may also influence AI effectiveness.

More specifically, the study does not examine organizational culture, employee digital readiness, trust in algorithmic systems, or ethical AI governance in depth. These factors may significantly shape how AI-generated insights are interpreted, accepted, and acted upon by leaders, as well as how such insights diffuse beyond the leadership level and become embedded within organizational routines. Similarly, the research does not directly assess firm-level financial or operational performance outcomes such as profitability, growth, or market share. Instead, it emphasizes capability formation, cognitive adaptation, and sustainability orientation as its primary analytical outcomes.

In addition, the study adopts a human-in-the-loop perspective, positioning AI as an augmentative cognitive infrastructure rather than an autonomous decision authority. This framing reflects current realities within sustainability-driven SMEs, where accountability, ethical responsibility, and strategic judgment remain closely tied to leadership roles. While appropriate for the contexts examined, this perspective limits exploration of more autonomous AI configurations that may emerge as data infrastructures mature, algorithmic trust evolves, and regulatory clarity increases.

In combination, these theoretical boundaries do not weaken the study's contribution. Rather, they clarify the conditions under which its findings should be interpreted. The study should therefore be understood as refining leadership agility theory within present socio-technical conditions, rather than prescribing a fixed or universal model of AI–leadership interaction. By explicitly delineating its scope, the research ensures conceptual coherence and avoids extending claims beyond the analytical foundations established in earlier chapters.

7.5 Methodological and Analytical Boundaries

Beyond the categorical limitations discussed above, the study operates within broader methodological and analytical boundaries that shape interpretation.

The research prioritizes capability development over measurable performance outcomes. While AI-enabled leadership agility may influence sustainability performance over time, the study does not empirically validate such relationships through quantitative metrics. This boundary reflects a deliberate theoretical choice to focus on cognitive and structural capability formation rather than deterministic performance claims.

Furthermore, case selection involved a degree of imbalance in organizational scale and digital maturity. Some cases exhibited more advanced AI integration than others, which may influence the visibility of capability shifts. While cross-case comparison mitigates this effect, analytical symmetry cannot be fully ensured within qualitative inquiry.

Researcher positionality also represents an interpretive boundary. Familiarity with digital transformation contexts informed analytical sensitivity but required deliberate reflexivity to prevent confirmatory bias. Systematic coding, iterative theme refinement, and alignment with theoretical propositions were employed to enhance analytical discipline.

These methodological and analytical boundaries reinforce the study's contribution as a theory-refining exploration of AI-enabled leadership capability within defined contextual parameters.

7.6 Directions for Future Research

Future research should empirically validate the performance outcomes associated with AI-enabled leadership agility in sustainability-driven SMEs. While this study adopts a qualitative and theory-building orientation, quantitative or mixed-method research designs could examine the relationship between leadership agility capabilities and measurable outcomes such as financial performance, operational efficiency, sustainability KPIs, and supplier selection practices. Longitudinal research designs would be particularly valuable in assessing whether the capability-level transformations identified in this study translate into sustained performance improvements over time, rather than short-term or situational gains.

The findings of this research open several additional avenues for future inquiry into the evolving relationship between Artificial Intelligence, leadership agility, and sustainability within SMEs, particularly in emerging market contexts. Given the exploratory nature of this study, further empirical work is required to deepen, validate, and extend the proposed conceptual framework. Longitudinal studies could track how AI-enabled leadership agility develops as leaders gain experience with AI systems, build trust in algorithmic outputs, and gradually institutionalize data-driven decision routines. Such approaches would allow scholars to observe learning effects, shifts in leadership cognition, and cultural adaptation processes that are difficult to capture through cross-sectional analysis.

Future studies could also expand methodological approaches by integrating large-scale surveys or structured measurement instruments to empirically test the relationships between AI maturity, leadership agility dimensions, and sustainability outcomes identified in this study. While qualitative insights are critical for understanding mechanisms, quantitative validation would enhance analytical generalizability and support theory refinement.

Comparative research represents another promising direction. Examining differences between SMEs and large enterprises, or between organizations operating in varying regulatory, cultural, and digital maturity environments, would clarify how organizational scale and institutional context shape AI-enabled leadership agility. Such work would help determine which mechanisms are context-specific and which may apply more broadly across organizational settings.

There is also significant scope for deeper investigation into the governance and ethical dimensions of AI-enabled leadership. As AI becomes more embedded in leadership decision-making, issues related to transparency, accountability, bias, and trust are likely to become increasingly salient, particularly in sustainability-oriented contexts. Exploring how SME leaders navigate these tensions would extend the framework beyond capability development toward responsible and sustainable leadership practice.

Finally, future research could adopt sector-specific lenses to examine how AI-enabled leadership agility manifests across sustainability-intensive industries such as renewable energy, construction, agriculture, and logistics. Sectoral studies would enable more fine-grained analysis of how regulatory pressures, risk profiles, and technological characteristics interact with AI adoption and leadership behavior.

When considered in combination, these directions reinforce the view that AI-enabled leadership agility is not a static or universal phenomenon, but an evolving capability shaped by learning, governance, and contextual conditions. Continued research along these lines would strengthen both theoretical understanding and practical guidance for sustainability-driven SMEs navigating digital transformation.

7.7 Concluding Reflection on Research Boundaries

Despite these limitations, the study provides a robust and contextually grounded contribution to the understanding of AI-enabled leadership agility in sustainability-driven SMEs. The acknowledged constraints do not undermine the validity of the findings; rather, they define the boundary conditions within which the proposed framework operates.

By explicitly articulating these limitations and future research directions, the study reinforces its theoretical integrity and invites further scholarly engagement. The complexity of AI-enabled leadership in emerging-market SMEs warrants continued investigation, and this research serves as a foundational step toward a more nuanced, context-aware leadership theory for the digital and sustainable economy.

CHAPTER 8
CONCLUSIONS AND REFLECTIONS

8.1 Research Summary

This study set out to examine how Artificial Intelligence (AI) influences leadership agility in sustainability-driven Small and Medium-Sized Enterprises (SMEs) operating in the MENA region and comparable emerging markets. Responding to gaps in existing literature, which largely focuses on large organizations in digitally mature economies, the research adopted a qualitative multi–case study approach to explore how AI-enabled agents, automation, and predictive analytics interact with leadership behavior under conditions of uncertainty, resource constraint, and sustainability pressure.

The study positioned leadership agility as a mediating capability linking AI adoption to sustainable performance outcomes. Rather than treating AI as a standalone technological intervention, the research investigated how AI reshapes leadership sensemaking, decision timing, and adaptive capacity within SMEs.

8.2 Key Findings

The findings demonstrate that artificial intelligence does not uniformly enhance leadership agility across sustainability-driven SMEs. Rather than acting as a generalized accelerator of leadership effectiveness, AI's influence is highly conditional, shaped by organizational structure, leadership capability, governance arrangements, and the maturity of sustainability-related data. This explains why similar technologies produced markedly different leadership outcomes across the cases examined.

In organizations where AI adoption remained peripheral or functionally constrained, leadership behavior continued to be largely reactive and experience-driven. Even in SMEs with strong sustainability intent, AI was often used to optimize reporting, automate monitoring, or improve operational efficiency without materially influencing how strategic decisions were made. In these contexts, AI supported execution but did not alter leadership attention, timing, or decision logic, limiting its contribution to leadership agility.

By contrast, where AI was embedded into leadership decision architectures and sustainability intelligence systems, a different pattern emerged. Leaders in these organizations used AI outputs to anticipate risks, explore alternative scenarios, and assess sustainability trade-offs before pressures became acute. This enabled earlier intervention, more informed risk management, and a shift from corrective to anticipatory leadership action. Importantly, these effects were not tied to technological sophistication alone, but to how AI insights were integrated into leadership routines and governance processes.

A central insight of the study is that leadership agility is strengthened not through AI autonomy, but through cognitive integration. AI enhanced agility only when it functioned as a cognitive augmentation mechanism that expanded leaders' capacity to interpret complexity, recognize emerging signals, and coordinate timely responses. Where AI outputs were treated as inputs for sensemaking rather than as prescriptive solutions, leaders retained judgment while benefiting from enhanced analytical reach.

Considered as a whole, these findings suggest that AI's leadership value in sustainability-driven SMEs lies in its ability to reshape how leaders think, not merely what organizations automate. Leadership agility emerged where AI was embedded into the cognitive and temporal dimensions of leadership practice, reinforcing the view that AI-enabled transformation is fundamentally a leadership and governance challenge rather than a purely technological one.

8.3 Contributions of the Study

This research makes several important contributions to theory, empirical understanding, and practice. At a theoretical level, it extends leadership agility scholarship by embedding artificial intelligence within adaptive and complexity leadership frameworks, demonstrating that leadership agility in digital and sustainability contexts is inherently socio-technical rather than purely behavioral or structural. In doing so, the study reframes AI from a contextual enabler into a form of leadership infrastructure that reshapes sensemaking, timing, and strategic responsiveness under conditions of uncertainty.

A second contribution lies in advancing current assumptions about how leadership agility manifests in AI-enabled environments. Rather than treating agility as a uniform or maturity-based capability, the findings show that it emerges in different patterns, shaped by leadership orientation, governance arrangements, and contextual pressures. This configurational understanding helps explain why similar AI investments generate divergent leadership outcomes across organizations.

From an SME and emerging market perspective, the research challenges the prevailing assumption that AI-enabled leadership agility is largely the domain of large enterprises. The study demonstrates that sustainability-driven SMEs can achieve meaningful forms of agility despite resource constraints, provided that AI adoption remains aligned with leadership autonomy, governance coherence, and decision relevance. In this respect, the study contributes a context-sensitive framework tailored to SMEs operating in volatile institutional and market environments.

The research further clarifies leadership agility as a mediating capability between AI use and sustainability-oriented strategic outcomes. The findings suggest that AI does not directly enhance sustainability performance; instead, its impact depends on how leaders recalibrate decision authority, attention, and strategic priorities in response to AI-generated insights.

Practically, the study offers guidance for SME leaders, policymakers, and ecosystem actors by emphasizing incremental, human-in-the-loop AI adoption, leadership capability development, and the centrality of sustainability data integration. Rather than advocating accelerated automation, the study underscores the importance of deliberate AI embedding that enhances strategic responsiveness while preserving human judgment.

While these contributions advance understanding of AI-enabled leadership agility in sustainability-driven SMEs, the study is necessarily bounded by methodological, contextual, and empirical constraints, which are acknowledged in the following section.

8.4 Practical Implications

For SME leaders, the findings indicate that the strategic value of artificial intelligence lies less in operational automation and more in its deliberate integration into leadership decision-making processes. Leadership agility is strengthened when AI is used to support anticipation, scenario evaluation, and strategic alignment with sustainability objectives, rather than being confined to efficiency-driven or back-office applications. When positioned as a decision-support capability, AI enhances leaders’ ability to detect early signals, compare strategic options, and respond proactively to environmental and market volatility.

The study further suggests that leadership agility is reinforced when AI-enabled insights are embedded within existing leadership routines, such as strategic reviews, investment prioritization, and sustainability planning. SMEs that treat AI outputs as inputs for collective sensemaking rather than as prescriptive recommendations are better positioned to preserve leadership judgment while improving decision coherence and timing. This finding highlights the importance of maintaining human-in-the-loop decision structures, particularly in contexts characterized by uncertainty, uneven data maturity, and high founder involvement.

For policymakers and SME support institutions, the findings underscore the limitations of technology-centric AI promotion strategies. While access to AI tools and digital infrastructure remains important, leadership outcomes depend equally on AI literacy, sustainability measurement capabilities, and governance frameworks adapted to SME realities. Investment in leadership development initiatives that build interpretive, ethical, and strategic AI competencies is therefore critical to translating technological adoption into leadership capability.

In addition, the study highlights the role of enabling environments that support experimentation and learning without imposing disproportionate compliance burdens on SMEs. Policymakers can act as facilitators by encouraging shared data platforms, sector-specific sustainability benchmarks, and advisory ecosystems that reduce the cognitive and financial costs of AI adoption. Governance approaches that emphasize proportional oversight, transparency, and accountability, rather than standardized regulatory templates, are particularly relevant in emerging market contexts.

When combined, these implications suggest that unlocking AI's leadership value in sustainability-driven SMEs requires coordinated action across leaders, institutions, and ecosystems. AI initiatives that neglect leadership capability development and contextual governance risk reinforcing symbolic or superficial use. By contrast, approaches that align technology adoption with leadership practice and sustainability objectives are more likely to generate durable strategic impact.

8.5 Concluding Reflection

As demonstrated throughout this study, the leadership implications of artificial intelligence in sustainability-driven SMEs are realized primarily through leadership agility rather than through technological substitution. AI does not replace leadership judgment or decision authority; instead, it reshapes how leaders engage with complexity, manage timing, and act under uncertainty. Leadership agility therefore emerges as the central mechanism through which AI becomes strategically meaningful in SME contexts.

Beyond this core insight, the findings highlight the decisive role of organizational and contextual conditions in shaping how leadership agility is enacted in practice. Across the cases examined, variation in leadership outcomes reflected differences in governance arrangements, leadership proximity, and decision authority, particularly within resource-constrained and institutionally complex environments. These differences help explain why AI-enabled initiatives produced uneven leadership effects, even among organizations with comparable sustainability ambitions.

The study further underscores the relevance of these dynamics for SMEs operating in emerging markets. Limited data maturity, fragmented regulatory frameworks, and centralized decision-making structures constrain the direct transferability of digital transformation models developed in large enterprises. At the same time, these conditions amplify the importance of contextual judgment, leadership proximity, and adaptive capacity. Leadership agility thus functions both as a compensatory capability; addressing structural constraints, and as an enabling capability that allows SMEs to navigate uncertainty more intentionally.

From a sustainability perspective, the research suggests that durable value creation is most effectively advanced when sustainability considerations are embedded within everyday leadership practice rather than treated as parallel or compliance-driven agendas. Leadership agility supports continuous alignment between strategic intent, operational realities, and evolving environmental and market pressures, enabling SMEs to pursue digital transformation and sustainability objectives in a mutually reinforcing manner.

Overall, this research contributes a context-sensitive understanding of AI-enabled leadership agility in sustainability-driven SMEs. It emphasizes that the successful integration of AI is as much a leadership and governance challenge as it is a technological one. By foregrounding leadership agility as the critical mediating capability, the study offers a grounded basis for scholars, practitioners, and policymakers seeking to support adaptive and sustainable leadership in emerging market contexts. As AI continues to reshape organizational decision-making, future research may further explore how AI-enabled leadership agility evolves over time across diverse SME settings and institutional environments.

While this study offers a context-sensitive understanding of AI-enabled leadership agility in sustainability-driven SMEs, its insights should be interpreted in light of the conceptual, empirical, and contextual boundaries that frame the scope of the research. At this point, the inquiry leads to a broader question for further investigation: as artificial intelligence continues to evolve and sustainability pressures intensify, how can SME leaders cultivate the forms of leadership agility required to engage with AI not merely as a technological resource, but as a catalyst for responsible judgment, anticipatory action, and long-term value creation?

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APPENDIX A: INTERVIEW PROTOCOL / SEMI-STRUCTURED INTERVIEW GUIDE

1- Purpose of the Interviews

The purpose of these semi-structured interviews is to explore how Artificial Intelligence (AI), including AI-enabled agents, automation, and predictive analytics, influences leadership agility in sustainability-driven Small and Medium-Sized Enterprises (SMEs). The interviews aim to capture leaders' experiences, perceptions, and decision-making practices in relation to AI adoption, sustainability management, and organizational adaptability.

2- Target Participants

- CEOs, Managing Directors, Founders
- Senior leaders responsible for strategy, sustainability, digital transformation, or operations

3- Interview Duration

Approximately 45–60 minutes

4- Interview Structure

Section 1: Organizational Context

- Can you briefly describe your organization's core business, size, and markets of operation?
- How is sustainability positioned within your business strategy?
- What are the main market or operational challenges your organization currently faces?

Section 2: AI Adoption and Digital Maturity

- What types of AI technologies or digital tools are currently used in your organization?
- In which functions or decision areas is AI most actively applied?
- What motivated your organization to adopt AI-related tools?

Section 3: Leadership Decision-Making

- How are strategic and sustainability-related decisions typically made in your organization?
- To what extent do AI-generated insights influence leadership decisions?

- Can you describe a situation where AI supported or failed to support a leadership decision?

Section 4: Leadership Agility

- How do leaders in your organization respond to sudden changes or uncertainty?
- Has AI changed the speed, quality, or timing of leadership decisions?
- Do you believe AI has improved your ability to anticipate risks or opportunities? Why or why not?

Section 5: Sustainability and Measurement

- How do you measure sustainability performance (e.g., energy efficiency, emissions, resource use)?
- Is sustainability data used in leadership decision-making? How?
- What role does AI play, if any, in sustainability monitoring or optimization?

Section 6: Organizational Constraints and Enablers

- What barriers limit deeper use of AI in leadership or sustainability decisions?
- What capabilities or changes would be needed to increase AI's value for leadership agility?

Section 7: Future Orientation

- How do you see AI shaping leadership roles in your organization over the next 3–5 years?
- What advice would you give other SME leaders considering AI adoption?

APPENDIX B CONSENT FORM

Participant Information Sheet and Consent Form

Participant Information Sheet

Title of Study: "Evaluating Artificial Intelligence's Impact on Leadership Agility in Sustainability - Driven SMEs in MENA Amid Market Challenges"

Researcher: Stephanie Ayoub
Executive Doctor of Business Administration (DBA) Candidate
Purpose of the Study

This research examines how Artificial Intelligence (AI) influences leadership agility and sustainability-related decision-making in Small and Medium-Sized Enterprises (SMEs) operating in emerging market contexts.

What Participation Involves

- Participation in a one-on-one interview (45–60 minutes)
- Questions related to leadership practices, AI use, and sustainability
- Interviews will be audio-recorded with consent

Confidentiality

- All data will be treated confidentially
- Organizations and individuals will be anonymized
- Data will be used for academic purposes only

Voluntary Participation

Participation is voluntary. You may withdraw at any time without consequence.

Consent Form

I confirm that:

- I have read and understood the participant information sheet
- I voluntarily agree to participate in this research
- I consent to the audio recording of the interview
- I understand that my identity will remain confidential

Participant Name: Dany Mrad - Founder & Managing Director

Signature:

Date: December 2nd, 2026

Participant Name: Johny Mrad - Operations Director

Signature:

Date: December 2nd, 2025

Participant Name: Gaby Samia - Senior Technical Director

Signature:

Date: December 2nd, 2025

Participant Name: Jessica Chweih - Growth Manager

Signature:

Date: December 2nd, 2025

Participant Name: Wissam Hijazi - Vice President of Innovation

Signature:

Date: December 2nd, 2025

Participant Name: George Raad - Country Manager

Signature: 

Date: December 17th, 2025

Participant Name: Dr. Marwa Farrouk - Country Manager

Signature: 

Date: December 8th, 2025

APPENDIX C- CONCEPTUAL FRAMEWORK DIAGRAM

C.1 Purpose of the Conceptual Framework

This conceptual framework illustrates how Artificial Intelligence (AI) technologies influence leadership agility within sustainability-driven SMEs in the MENA region, and how this relationship ultimately affects sustainable performance outcomes. The framework integrates insights from adaptive leadership theory, complexity leadership theory, and dynamic capabilities theory, while explicitly positioning AI as a leadership-enabling infrastructure rather than a purely technical resource.

C.2 - Conceptual Framework Diagram

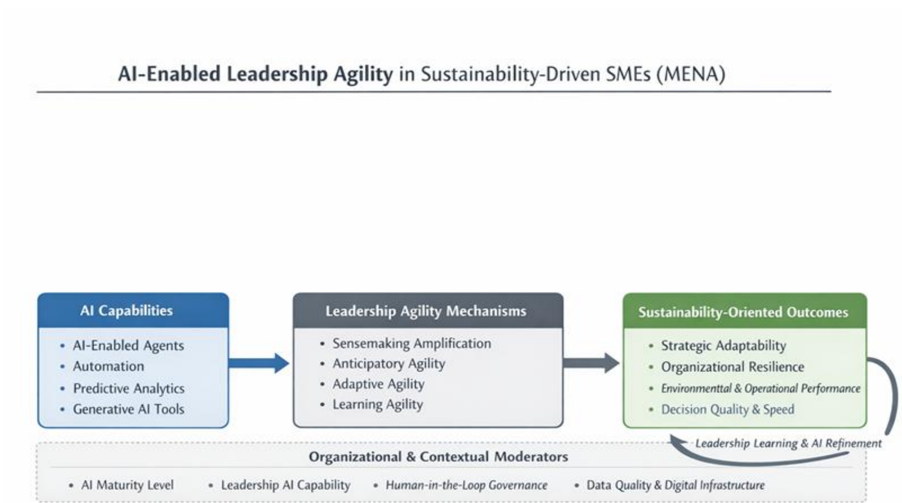

Figure C.1: Conceptual Framework of AI-Enabled Leadership Agility in Sustainability-Driven SMEs
Source: Author's own elaboration based on empirical findings

The above framework proposes that AI technologies, specifically AI-enabled agents, automation, and predictive analytics, do not directly produce leadership agility. Instead, their impact is mediated by leadership sensemaking, governance structures, and organizational readiness. Leadership agility emerges through three interrelated mechanisms: sensemaking amplification, anticipatory decision-making, and adaptive reconfiguration. These mechanisms, when embedded within sustainability intelligence systems, enhance SMEs' ability to achieve sustainable environmental, social, and economic outcomes under volatile market condition.

APPENDIX D - CASE STUDY SUMMARY TABLES

These tables allow examiners to quickly compare cases, which is highly valued in DBA assessments.

Table D.1 - Overview of Case Study Organizations

Case	Sector	Geographic Scope	SME Structure	Sustainability Orientation	AI Maturity Level
LinkHat	Telecom, Data Centers, Energy Solutions	MENA (GCC, Levant, Iraq)	Independent SME	Energy efficiency, CO_2 reduction	Early–Intermediate
NERA	Telecom Infrastructure	Africa (Subsidiary)	Group-affiliated SME	Product-embedded sustainability	Low
Enetek Power	Renewable Energy	MEA	Group-affiliated SME	Clean energy solutions	Early
EllisDon (MENA)	Construction & Infrastructure	MENA	Autonomous regional SME	Lifecycle sustainability	Advanced

Source: Author’s own elaboration based on empirical findings

Table D2 - Case Overview Matrix

Dimension	Case 1	Case 2	Case 3	Case 4
Industry Sector	Renewable Energy & Data Infrastructure	Construction & Engineering	Energy Solutions	Sustainability-Driven SME (Emerging Market)
Geographic Context	GCC	North America	Levant	Africa-linked Emerging Market
SME Size Classification	Upper-Mid SME	Large Enterprise (Comparative Benchmark)	Mid-SME	Small SME
Sustainability Orientation	Core strategic orientation	Integrated but compliance-driven	Product-based environmental value	Mission-driven sustainability

Source: Author’s own elaboration based on empirical findings

Table D.3 - AI Adoption and Leadership Agility Characteristics

Case	AI Use Focus	Leadership Decision Style	AI Role in Leadership	Agility Profile
LinkHat	Support functions, analytics	Experience-driven	Execution accelerator	Process agility
NERA	Administrative efficiency	Reactive	Peripheral	Low agility
Enetek Power	Market intelligence	Expertise-based	Informational	Bounded agility
EllisDon	Digital twin, predictive analytics	Anticipatory	Cognitive enabler	Anticipatory & adaptive agility

Source: Author's own elaboration based on empirical findings

Table D.4 - AI Capability Deployment Comparison

Capability Dimension	Case 1	Case 2	Case 3	Case 4
AI-Enabled Agents	Used for proposal generation & data comparison	Integrated enterprise AI tools	Limited use for administrative tasks	Early-stage adoption
Intelligent Automation	Partial process automation	Advanced operational automation	Incremental task automation	Minimal automation
Predictive Analytics	Applied for technical evaluation & risk comparison	Embedded in forecasting & project management	Limited structured forecasting	Emerging interest, limited data infrastructure
Decision Support Integration	Human-validated augmentation	Structured integration in leadership routines	Informal use	Ad hoc experimentation

Source: Author's own elaboration based on empirical findings

Table D.5 - Leadership Agility Capability Comparison

Leadership Capability	Case 1	Case 2	Case 3	Case 4
Sensing Capacity	Enhanced through structured comparison	Strong predictive sensing	Moderately enhanced	Limited but developing
Interpretive Depth	AI supports analytical framing	Data-driven strategic modeling	Human-dominant interpretation	Experience-driven
Temporal Orientation	Medium-term anticipatory	Strong long-term foresight	Mostly short-to-medium term	Short-term reactive
Risk Evaluation	Scenario comparison enabled	Quantitative risk modeling	Experience-based	High uncertainty, limited modeling
Sustainability Integration in Decisions	Embedded in strategic deliberation	Operationalized with metrics	Value-driven but informal	Mission-aligned but unstructured

Source: Author's own elaboration based on empirical findings

Table D.6 - Governance and Structural Moderators

Structural Variable	Case 1	Case 2	Case 3	Case 4
AI Governance Formalization	Emerging formalization	Structured enterprise governance	Informal	Minimal
Data Infrastructure Maturity	Moderate	High	Low-to-moderate	Low
Centralization of Leadership	High	Distributed	High	Highly centralized
Sustainability Metrics Formalization	Partial dashboards	Structured KPIs	Limited metrics	Informal tracking

Structural Variable	Case 1	Case 2	Case 3	Case 4
Institutional Stability	High	High	Moderate	Volatile environment

Source: Author's own elaboration based on empirical findings

Table D.7 - Capability Development Stage Classification

Based on cross-case synthesis, each organization can be classified into capability development stages:

Case	Capability Stage	Justification
Case 1	Structured Augmentation	AI embedded in analytical preparation, but governance still evolving
Case 2	Embedded Cognitive Infrastructure	AI integrated into leadership routines and predictive modeling
Case 3	Incremental Adoption	AI supports tasks but limited strategic embedding
Case 4	Early Augmentation	AI experimentation under structural constraints

Source: Author's own elaboration based on empirical findings

This classification reflects degree of AI integration into leadership cognition rather than technological sophistication alone.

Table D.8 - Key Constraints and Outcomes

Case	Key Constraints	Leadership Impact	Sustainability Impact
LinkHat	Lack of AI training, fragmented data	Incremental adaptation	Project-level sustainability
NERA	Centralized governance, low autonomy	Reactive leadership	Compliance-oriented
Enetek Power	Lack of sustainability metrics	Experience-dominated decisions	Assumed impact

Case	Key Constraints	Leadership Impact	Sustainability Impact
EllisDon	Data quality, client maturity	AI-augmented leadership	Measurable, optimized outcomes

Source: Author’s own elaboration based on empirical findings

Table D.9 - Cross-Case Analytical Patterns

Across the cases, several patterned insights emerge:

1. AI most consistently strengthens **sensing and interpretive capabilities**, even where governance structures are weak.
2. Leadership agility appears more influenced by **human–AI complementarity** than by level of automation.
3. Sustainability integration improves when AI outputs are embedded into structured decision routines rather than used for isolated analysis.
4. Institutional maturity moderates the depth of AI integration into leadership processes.
5. SME structural constraints limit scalability but do not eliminate augmentation effects.

These patterned relationships support the mediation logic advanced in Chapter 2: AI contributes to sustainability orientation through leadership agility rather than through direct performance effects.

APPENDIX E: CODING FRAMEWORK AND THEMATIC DEVELOPMENT

E.1 - Overview of Analytical Procedure

This study employed a structured thematic analysis approach to examine how Artificial Intelligence (AI) contributes to leadership agility within sustainability-driven SMEs. The coding process was iterative and theory-informed while remaining grounded in empirical data.

E.2 - First-Order Codes

First-order codes were derived directly from participant language and case documentation. These codes captured observable behaviors, perceptions, and organizational practices related to AI integration and leadership processes.

Examples of first-order codes included:

- Use of AI for administrative task automation
- AI-assisted product comparison
- Reliance on human validation of AI outputs
- Limited trust in autonomous decision-making
- Predictive modeling for supplier evaluation
- Sustainability considerations in strategic planning
- Centralized executive decision authority
- Incremental AI implementation
- Data fragmentation across departments
- Informal governance of digital tools
- Manual sustainability reporting processes
- Scenario simulation for operational planning
- Short-term risk prioritization

These codes reflected concrete manifestations of AI usage and leadership interaction with technological systems.

E.3 - Second-Order Themes

Through axial coding, first-order codes were grouped into higher-level interpretive categories representing emerging capability patterns.

Thematic categories included:

1. AI as Cognitive Support Mechanism

- Structured comparison of alternatives
- Risk scenario evaluation
- Decision-preparation enhancement
- Data synthesis for strategic deliberation

This theme reflects AI's role in expanding managerial sensemaking rather than replacing leadership authority.

2. Bounded Rationality Mitigation

- Reduction of information overload
- Improved visibility of trade-offs
- Structured forecasting
- Enhanced interpretive depth

This theme aligns with the theoretical framing of AI as partially relaxing cognitive constraints.

3. Human–AI Complementarity

- Human validation of algorithmic outputs
- Preference for augmentation over automation
- Trust calibration processes

- Iterative review of AI recommendations

This theme reinforces the human-in-the-loop configuration observed across cases.

4. Incremental AI Institutionalization

- Fragmented AI adoption
- Lack of formal AI governance structures
- Resource-constrained implementation
- Absence of integrated data architecture

This reflects SME-specific structural constraints.

5. Sustainability Orientation Integration

- Sustainability considered in strategic discussions
- Limited formal sustainability KPIs
- AI supporting environmental trade-off evaluation
- Environmental data embedded in operational dashboards (where present)

This theme captures sustainability as a capability orientation rather than an outcome.

6. Temporal Reconfiguration

- Predictive analytics extending planning horizon
- Early detection of supply chain risk
- Forward-looking scenario analysis
- Proactive rather than reactive leadership posture

This reflects AI's influence on anticipatory agility.

E.4 - Aggregate Capability Dimensions

Selective coding integrated second-order themes into three aggregate capability dimensions consistent with the conceptual framework.

Dimension 1: Enhanced Sensing and Interpretive Capacity

Derived from:

- AI as Cognitive Support
- Bounded Rationality Mitigation

This dimension captures how AI expands leaders' ability to process information, evaluate alternatives, and interpret uncertainty.

Dimension 2: Adaptive Decision Architecture

Derived from:

- Human-AI Complementarity
- Incremental Institutionalization

This dimension reflects the structural embedding of AI into leadership routines and governance processes.

Dimension 3: Sustainability-Oriented Strategic Agility

Derived from:

- Sustainability Orientation Integration
- Temporal Reconfiguration

This dimension captures the integration of environmental considerations into anticipatory strategic decision-making.

E.5 - Coding Matrix Illustration

The table below provides a representative illustration of the coding process:

Interview Excerpt (Condensed)	**First-Order Code**	**Second-Order Theme**	**Aggregate Dimension**
"We use AI mainly to compare technical options before deciding."	AI-assisted comparison	AI as Cognitive Support	Enhanced Sensing Capacity

Interview Excerpt (Condensed)	First-Order Code	Second-Order Theme	Aggregate Dimension
“We never rely on AI alone; final decisions remain human.”	Human validation	Human–AI Complementarity	Adaptive Decision Architecture
“AI helps us forecast supplier risk before committing.”	Predictive risk modeling	Temporal Reconfiguration	Sustainability-Oriented Agility
“We don’t yet have structured sustainability dashboards.”	Limited sustainability metrics	Sustainability Integration Gaps	Sustainability-Oriented Agility
“AI saves time, but strategy is still driven by leadership.”	Augmentation not automation	Complementarity	Adaptive Decision Architecture

Source: Author’s own elaboration based on empirical findings

This matrix demonstrates the systematic progression from raw data to conceptual abstraction.

E.6 - Alignment with Theoretical Propositions

The coding framework directly informed evaluation of the theoretical propositions articulated in Chapter 2:

- Evidence of cognitive augmentation supported Proposition 1.
- Observed mediation of sustainability orientation through leadership routines supported Proposition 2.
- Human-in-the-loop configurations reinforced Proposition 3.
- Institutional constraints shaping AI deployment aligned with Proposition 4.
- Predictive modeling extending strategic time horizons supported Proposition 5.

This structured alignment ensured coherence between conceptual development and empirical interpretation.

E.7- Reflexive Considerations

Throughout the coding process, deliberate reflexive practice was maintained to distinguish empirical patterns from theoretical expectations. While the conceptual framework informed analytical sensitivity, themes were validated across cases before being elevated to aggregate dimensions.

Repeated cross-case comparison reduced the likelihood of over-interpreting isolated narratives and strengthened analytical consistency.

APPENDIX F: PROPOSITION-TO-EVIDENCE ALIGNMENT TABLE

F.1 - Purpose of the Alignment Table

This appendix provides a structured mapping between the theoretical propositions articulated in Section 2.8 and the empirical evidence derived from cross-case analysis. The purpose is not hypothesis testing but analytical coherence, demonstrating how empirical patterns inform, refine, and contextualize the study's conceptual framework.

The table below illustrates how each proposition is supported, moderated, or qualified by case evidence.

F.2 - Proposition-to-Evidence Mapping

Proposition 1

AI-enabled agents, intelligent automation, and predictive analytics expand managerial sensing capacity by partially relaxing bounded rationality constraints.

Analytical Element	Empirical Evidence	Cross-Case Pattern	Interpretive Insight
Cognitive Augmentation	Leaders used AI to compare technical alternatives and evaluate supplier risks	Observed across all cases at varying depth	AI most consistently enhanced information synthesis rather than autonomous decision-making
Reduction of Information Overload	AI assisted in consolidating fragmented datasets	Stronger in digitally mature cases	Bounded rationality was mitigated but not eliminated
Structured Risk Framing	Predictive modeling supported anticipatory evaluation	Most visible in higher-maturity cases	AI extended sensing capacity, particularly in risk-sensitive contexts

Source: Author's own elaboration based on empirical findings

Conclusion: Proposition 1 is supported across cases, though degree of augmentation varies with digital maturity.

Proposition 2

Leadership agility mediates the relationship between AI-enabled augmentation and sustainability orientation.

Analytical Element	**Empirical Evidence**	**Cross-Case Pattern**	**Interpretive Insight**
AI Supporting Strategic Deliberation	AI insights integrated into executive discussions	Stronger in governance-structured cases	Sustainability integration depends on leadership interpretation
Sustainability Framing in Decisions	Environmental considerations embedded in planning routines	Informal in lower-maturity SMEs	AI does not directly generate sustainability impact; mediation occurs through leadership routines
Adaptive Reconfiguration	Leaders recalibrated strategy based on AI insights	More systematic in mature cases	Leadership agility is the mechanism through which AI influences sustainability orientation

Source: Author's own elaboration based on empirical findings

Conclusion: Proposition 2 is strongly supported; mediation effect is evident across cases.

Proposition 3

Human-AI complementarity enhances leadership capability development more effectively than substitution-based automation models.

Analytical Element	**Empirical Evidence**	**Cross-Case Pattern**	**Interpretive Insight**
Human Validation of AI Outputs	Leaders consistently retained final authority	Universal pattern	Augmentation preferred over autonomy
Trust Calibration	AI outputs reviewed before strategic adoption	Particularly strong in sustainability-critical decisions	Complementarity enhances interpretive depth
Automation Boundaries	AI limited to analytical preparation	No case exhibited full autonomy	Human-in-the-loop configuration dominant in SMEs

Source: Author's own elaboration based on empirical findings

Conclusion: Proposition 3 is fully supported; substitution-based AI models were not observed.

Proposition 4

Institutional and digital maturity conditions moderate the extent to which AI-enabled augmentation translates into enhanced leadership agility.

Analytical Element	**Empirical Evidence**	**Cross-Case Pattern**	**Interpretive Insight**
Governance Formalization	Structured AI governance in mature case; informal in others	Clear variation	Institutional maturity shapes depth of integration
Data Infrastructure	Integrated dashboards vs fragmented systems	Strong differentiator	Capability development linked to data coherence
Resource Availability	Resource constraints limited systemic embedding	Most visible in smaller SMEs	Institutional constraint moderates augmentation impact

Source: Author's own elaboration based on empirical findings

Conclusion: Proposition 4 is supported; contextual moderators significantly shape capability outcomes.

Proposition 5

AI-enabled temporal reconfiguration strengthens anticipatory leadership capabilities.

Analytical Element	**Empirical Evidence**	**Cross-Case Pattern**	**Interpretive Insight**
Predictive Modeling	AI used to anticipate supplier risk and operational constraints	Present but uneven	Temporal orientation improved where forecasting tools existed
Scenario Planning	Simulation tools integrated into strategic evaluation	Limited to higher-maturity case	AI extended planning horizons beyond immediate cycles
Proactive Risk Adjustment	Early identification of sustainability-related trade-offs	Emerging pattern	Temporal reconfiguration remains dependent on governance integration

Source: Author's own elaboration based on empirical findings

Conclusion: Proposition 5 is partially supported; temporal extension is strongest in digitally mature contexts.

F.3 Synthesis of Proposition Validation

Across the cases, the propositions demonstrate differentiated support:

- Propositions 1, 2, and 3 receive strong cross-case validation.
- Proposition 4 is contextually moderated.
- Proposition 5 is conditionally supported depending on AI maturity and data infrastructure.

Importantly, no case demonstrated direct causal linkage between AI deployment and sustainability performance outcomes. Instead, evidence consistently supports the capability-mediated model articulated in Chapter 2: AI contributes to sustainability orientation through leadership agility under defined contextual constraints.

F.4 Contribution of the Alignment Table

This alignment table strengthens internal coherence across:

- Theoretical development (Chapter 2)
- Empirical analysis (Chapter 4 & 5)
- Theoretical contribution (Chapter 6)

It reinforces that the study's contribution lies in conceptual clarification and capability development logic rather than deterministic performance claims.