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WEAK SIGNALS MANAGEMENT AS A STRATEGIC TOOL FOR ENHANCING ORGANIZATIONAL AGILITY IN NIGERIAN MANUFACTURING FIRMS

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ABSTRACT

This study seeks to explore weak signals management: problems and plausible solutions. The study identified some categories of weak signals, real time response problems, and probable strategies to managing weak signals as well as the managerial implications. It was discovered that weak signals can be transformed into meaningful knowledge and the cost of ignoring weak signals can be very high and as such, strategies ought to be instituted to detect and effectively manage weak signals to forestall operational impediments. It was thus concluded that weak signals management is key to ensuring success in today's turbulently dynamic, unpredictable and competitive business world. Findings revealed that if weak signals are not well managed, it can impede survival and growth of firms and pose a threat to organizational performance. The study advocates amongst others, that managers must therefore be sensitive and responsive to the weak signals and recommends early detection of weak signals, identification of strategic opportunities and/or threats. They should continually monitor emerging trends, issues and tipping points knowing that weak signals are a vital intelligence tool to help an organization survive and thrive in a fiercely competitive and dynamic business environment.

Keywords: *weak signals, weak signal management, weak signal detection and interpretation, early warning signs, early detection, environmental scanning, strategic decision making, organizational responsiveness, organizational culture and leadership support, strategic foresight, weak signal interpretation and sense-making, organizational responsiveness, strategic agility,*

INTRODUCTION

In an increasingly volatile and complex business environment, organizations are under mounting pressure to anticipate change and respond to emerging threats and opportunities. manufacturing firms face unprecedented for instance, is increasingly experiencing challenges ranging from technological disruptions and supply chain uncertainties to economic volatility and policy shifts. These challenges are often preceded by subtle, early-stage indicators known as weak signals—vague or incomplete pieces of information that hint at the possibility of significant change (Ansoff, 1975). Recognizing and acting on these signals can offer firms a critical head start in responding to change proactively rather than reactively. The Nigerian manufacturing sector seems to have a pressing need particularly, for strategic agility. The sector grapples with infrastructural deficits, fluctuating policy regimes, and global economic pressures. Yet, many firms remain reactive, often blindsided by changes they could have anticipated. Weak signals, if properly managed, offer an

opportunity to sense disruptions early, innovate in response, and stay ahead of competitors (Haefner et al., 2023).

This has brought renewed attention to the concept of weak signals—early indicators of potential significant developments that may initially appear ambiguous or fragmented (Ansoff, 1975; Hiltunen, 2008). Weak signals are valuable in strategic foresight and early warning systems, enabling firms to recognize disruptions before they fully materialize. However, the challenge lies not in their existence but in their detection, interpretation, and integration into decision-making processes (Rohrbeck & Kum, 2018). Recent studies emphasize the increasing relevance of weak signals in the age of digital transformation, climate change, geopolitical instability, and rapid technological advancements (Lindgren & Bandhold, 2023). The rise of big data and artificial intelligence has both enhanced and complicated the detection of weak signals, requiring new and improved methods of scanning and sense-making (Gunkel & Wenzel, 2022). Organizations now face not only information overload but also the risk of ignoring faint signals that may evolve into disruptive trends.

Despite these developments, many firms still struggle with formalizing weak signal management processes, leading to missed opportunities or delayed responses (Pereira et al., 2022). There remains a gap between the theoretical understanding of weak signals and their practical application, especially in terms of organizational learning, strategic planning, and innovation management. Moreover, weak signals are context-dependent, making their interpretation a complex cognitive and cultural task. The role of organizational learning, culture, leadership cognition, innovation management, and cross-functional collaboration has been highlighted in recent literature as critical to successfully leveraging weak signals (Haefner et al., 2023). This underscores the need for both technological tools and human-centric approaches to manage weak signals efficiently and effectively. Given this backdrop, the study of weak signals management is not only timely but crucial for enhancing and sustaining organizational resilience, strategic agility, and long-term competitiveness in uncertain environments.

However, weak signals are inherently difficult to detect and interpret due to their ambiguous nature. Many organizations in Nigeria lack the formal structures, cultural readiness, and analytical tools necessary to integrate weak signal management into their strategic planning processes (Pereira et al., 2022). Moreover, the prevailing top-down decision-making culture in many firms often stifles the bottom-up insights where weak signals are most likely to emerge. The digital age presents both opportunities and challenges in this regard. On one hand, data analytics and AI tools provide powerful mechanisms for environmental scanning. On the other, they contribute to information overload, making it harder to distinguish meaningful weak signals from noise pollution (Gunkel & Wenzel, 2022). This study, therefore, seeks to explore how Nigerian manufacturing firms can develop and institutionalize weak signal management practices to strategically enhance their agility. By identifying the gaps in organizational learning, and already established gaps including strategic application, this study seeks too building more foresight-driven and responsiveness in this sector.

Statement of the Problem

In an ever evolving world of rapid technological change, global competition, and economic uncertainty, firms' ability to anticipate and respond to emerging trends is becoming more critical than ever. Weak signals (early indicators of impending change) offer a strategic and sustainable advantage by enabling firms to detect disruptions before they fully unfold. However, in many Nigerian manufacturing firms, the concept of weak signal management remains poorly understood and largely underutilized. Also, the level of awareness and understanding of weak signals among managers in Nigerian manufacturing firms seems to be at its low ebb. Many of these firms operate with rigid, reactive decision-making processes and lack the foresight capabilities needed to scan the environment for subtle shifts. The absence of structured frameworks, analytical tools, and a foresight-oriented culture makes it difficult to distinguish weak signals from background noise. As a result, Nigerian manufacturing firms often miss early warning signs of market shifts, technological disruptions, or policy changes leading to delayed responses, strategic misalignment, and missed opportunities. Notwithstanding, strategic **a**gility has become a necessity for both corporations and public institutions (the ability to sense change, pivot quickly, process re-engineering and reconfiguring resources to seize emerging opportunities, is what separates thriving organizations from those left behind.

This study is therefore motivated by the need to explore how Nigerian manufacturing firms can adopt and implement weak signal management practices to improve strategic agility and enhance global competitiveness. It seeks to fill the gap in knowledge and practice regarding how weak signals can be identified, interpreted, and integrated into organizational planning and work processes.

Objectives of the study

The main objective of this study is to examine how weak signal management can be utilized as a strategic tool for enhancing organizational agility in Nigerian manufacturing firms. Specifically, the study seeks to:

1) Identify how organizational culture and leadership support could influence firm's response to weak signals
2) Examine the nexus between weak signals detection, interpretation and firm's flexibility.

REVIEW OF RELATED LITERATURE

Concept of Weak Signals Management

The concept of weak signals was first introduced by Igor Ansoff (1975) as early indicators of significant future trends or events that are not yet widely recognized or fully developed. eak signals are defined as early, ambiguous, and often fragmented indicators of change that may have significant future implications (Rossel, 2009) (Fang et al., 2010). These signals are characterized by their subtlety and the uncertainty they carry, making them challenging to identify and interpret. Weak signals are typically characterized by low visibility, ambiguity, and uncertain implications. Despite their subtlety, they often precede major disruptions or shifts in the business environment, making them valuable for organizations seeking to anticipate change. Hiltunen (2008), posit that weak signals are

"observations of change that can point to future developments." She emphasized that weak signals are not predictions but potential indicators of trends, requiring interpretation and contextual analysis. The ability to detect and interpret weak signals is therefore essential for foresight and proactive decision-making.

Weak signal(s) is an aspect of real time response management which helps organizations in responding to threats and opportunities and dealing with discontinuities and surpriseful events in turbulently dynamic business environment. Examples of such terms are "distress, emerging issues, surprise, dramatic development, dramatic short-term events, shocks, unique events, sudden events, disruptive events, unprecedented developments, etc. It is sometimes difficult to access and gather all relevant and adequate strategic information that will aid effective and timely response. Weak signals may be regarded as scanty information about threats and opportunities resulting from environmental turbulence. These weak signals are real time events (Onwuchekwa, 2000 Nonetheless, the available partial information about the surpriseful turbulence in the business environment can provide necessary background response until full information is made available for full managerial response. Weak signals are early, often ambiguous signs of change that may herald significant future developments. Recognizing these signals enables organizations to proactively adapt, fostering resilience and strategic agility.
Harris and Zeisler (2002) opined that weak signals are weak because they are easily obfuscated by other factors including our mindsets, attitudes, environment, and biases of those involved in the search; they indicate a mismatch between our assumptions and the real world (Brabandere, 2005); they are inconsistent and open to many interpretations and often rejected by credible people in positions of authority and thus contradictory, confused and arguable (Saul, 2006). A major dilemma is that of determining whether or not a signal is weak or strong and others would be spurious (not indicative of a true change). Thus, as the speed of the surprising changes increases, the predictability drops (Choo, 2006). Again, when a real time issue occurs, the information is usually vague and the future course of action seems unclear, the real time response may be correspondingly unfocused.

From the foregoing, weak signals are those ambiguous and controversial bits of information about the competitive environment that are typically hidden among the "noise" of the prevailing sense-making paradigm and that gradually coalesce to form a pattern of intelligence that alerts sensitive leaders that it may be time to up their game, thus helping to anticipate changes in the future, possibly indicated by limited data points and observations of change. The weakness of a signal is linked to the difficulty in interpreting or assigning a meaning to it. The strong signal clearly has potential implications. Thus, weak signals are weak because they are easily blurred by other factors, including current mind-sets, attitudes, and biases of those involved.

Organizational Culture and its nexus with Weak Signal Detection

A culture that values vigilance, promotes openness, continuous learning, and psychological safety encourages employees to share observations, enhancing collective awareness inquiry and enhances the detection of weak signals. Such environments encourage employees to share observations without fear of reprisal, facilitating the identification of subtle cues. High-

reliability organizations exemplify this by fostering mindfulness and continuous learning, which are essential for recognizing and acting upon weak signals. The detection of weak signals often relies on a combination of human intuition, structured scanning tools, and increasingly, digital analytics. Gunkel and Wenzel (2022) highlight the role of AI and big data analytics in enhancing weak signal detection, especially in complex and dynamic environments. However, they note that interpretation still requires human judgment to assign meaning and assess relevance. Empirical studies (e.g., Haefner et al., 2023) show that successful weak signal detection is influenced by organizational culture, leadership support, and cross-functional collaboration. Companies that encourage curiosity, experimentation, and open dialogue are better at surfacing weak signals and integrating them into strategy.

Cultivating an organizational culture that promotes openness and learning, combined with adaptive leadership styles, enhances an organization's ability to detect and respond to weak signals. This synergy is vital for navigating the complexities of today's business environment and achieving long-term success. Early detection of weak signals—subtle indicators of potential opportunities or threat which is crucial for organizations aiming to earn and sustain a competitive edge. The interplay between organizational culture and leadership support and influences a firm's capacity to anticipate and respond to emerging changes given our ever evolving market trends/shifts

Leadership Styles and Weak Signal Detection

Leadership styles profoundly impact how organizations perceive and respond to weak signals:

- **Transformational Leadership**: Leaders inspire innovation and critical thinking, motivating teams to challenge the status quo and explore new ideas. This approach cultivates an environment where weak signals are more likely to be noticed and acted upon in a proactive manner and making all necessary strategic adjustments. This also portrays the transformational leader as a type of person not limited by followers' perception (Schultz & Schultz, 2018 and Carless, Wearing & Mann, 2017). The main objective is to work to change or transform their followers' needs and redirect their thinking as cited in (Ogbeta-Ogwu, Edeme & Okoh, 2021).
- **Ambidextrous Leadership**: Combining transformational and transactional elements, ambidextrous leaders balance exploration with exploitation. They adeptly switch between fostering innovation and ensuring operational efficiency, enabling organizations to respond effectively to weak signals.

Thus, leadership styles shape organizational culture, which in turn influences how weak signals are perceived and addressed. Leaders who model openness and responsiveness establish norms that encourage vigilance and proactive behaviour. Conversely, cultures that discourage dissent or prioritize conformity may suppress the identification of weak signals and increase the vulnerability to unforeseen challenges. Similarly, leadership styles dictate how leaders interact with their teams and influence organizational responsiveness to emerging signals. By treating false alarms as learning opportunities rather than failures, these leaders enhance the organization's adaptive capacity. By providing appropriate support and autonomy, leaders can empower employees to recognize and act on weak signals relevant to their roles as it sets the tone for openness and responsiveness.

The interconnection between Weak Signals and Organizational Agility

There is growing evidence that effective weak signal management enhances organizational agility—the capacity to sense and respond to change quickly. Doz and Kosonen (2010) argue that strategic agility is built on timely insight, including the early recognition of weak signals. Similarly, Rohrbeck and Kum (2018) found that firms with mature foresight systems are more agile and perform better in uncertain markets.

Table: Key Tools and Techniques for Weak Signals Management

Tool/Technique	Description	Citation
Business Intelligence	Systems like PUZZLE use tracking forms to interpret weak signals for decision-making.	(Rouibah & Ould-Ali, 2002)
Predictive Analytics	Uses statistical models and machine learning to forecast trends and optimize decisions.	(Daraojimba et al., 2024)
Scenario Planning	Creates future scenarios to anticipate changes and develop strategic responses.	(Милько, 2021) (Suvorova et al., 2024)
Framing and Meta-Framing	Provides context for interpreting signals, considering biases and stakeholder views.	(Rossel, 2009)
Text Mining	Analyzes unstructured data to detect patterns and trends as weak signals.	(Griol-Barres et al., 2020)
Organizational Learning	Fosters a culture of knowledge sharing and adaptability to respond to signals.	(Fonseca & Barreto, 2012) (Janissek-Muniz & Blanck, 2014)
Ambidexterity	Balances exploration and exploitation to capitalize on opportunities.	(Khaddam, 2024)
Cognitive Bias Mitigation	Strategies to address biases like confirmation and anchoring in decision-making.	(Yuwen, 2024) (Földesi & Sós, 2024)

Empirical Studies on Weak Signals Management

Several empirical studies have been conducted globally and nationally, to examine how organizations identify, detect, interpret and apply weak signals in their strategic processes. These studies provide practical evidence in enhancing foresight, agility, and innovation across different sectors and contexts.

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Haefner, Wincent, and Parida (2023) in their study on manufacturing firms in Europe, explored how organizational culture and leadership styles influence the ability to detect and respond to weak signals. Using a mixed-methods approach, they found that companies with open communication channels, decentralized decision-making, and a learning-oriented culture were more effective in recognizing and acting on early-stage signals. This research supports the argument that beyond tools, human factors are critical to weak signal management.

Pereira et al. (2022) examined weak signal detection in Brazilian industrial firms, focusing on the implementation of early warning systems using case studies on five firms and found that those which embedded structured environmental scanning practices were significantly better at adapting to strategic proactive adjustments, regulatory and market shifts. However, lack of trained personnel and resistance to change were identified as common barriers.

Rohrbeck and Kum (2018) in a longitudinal study of German companies, investigated the impact of corporate foresight capabilities, including weak signal sensing, on firm performance. The study showed that firms with formalized foresight units and weak signal monitoring practices experienced better innovation outcomes and faster responsiveness to environmental changes. This reinforces the strategic importance of institutionalizing foresight functions.

Gunkel and Wenzel (2022) in their research focused on how digital tools and AI are being used to support weak signal detection in tech-driven firms. Through qualitative interviews and digital trace data analysis, the study revealed that AI-enhanced systems could identify emerging trends with greater accuracy. However, interpretation and sense-making still relied heavily on human expertise, indicating a need for integrated approaches combining technology and intuition.

Koivisto et al. (2021) in a study on public sector organizations in Finland, assessed how weak signals were used in long-term policy planning. They found that weak signal workshops and cross-departmental scenario planning significantly improved the government's ability to anticipate social and technological shifts. This case illustrates how even bureaucratic systems can adopt weak signal frameworks with the right institutional support.

Summarily, these empirical studies reveal consistent outcomes that:

- Weak signal management improves strategic agility, innovation, and responsiveness.
- The strategic decision-making process in weak signals management involves several key steps, including signal detection, interpretation, and response. Each of these steps requires a combination of analytical techniques, organizational capabilities, and strategic thinking.
- Success depends on a combination of technological tools and organizational culture.
- Challenges include lack of awareness, insufficient training, and resistance to change.
- Firms that formalize foresight processes and foster cross-functional collaboration tend to perform better in dynamic environments.
- Organizational culture affects interpretation & sense-making
- Leadership support supports weak signal detection
- Technological tools enhances strategic decision-making

These findings are particularly relevant for the Nigerian manufacturing context, where strategic foresight capabilities are still emerging. The insights from these studies provide a foundation for adapting weak signal management practices to the local industrial landscape.

Sources of weak signals

Day and Schoemaker (2006) emphasized the potentiality of Internet and blogs as good sources for scanning the periphery. Human sources (internal sources and external sources), textual sources (published sources and internal documents) and online sources (on-line databases and Internet). One good way to find weak signals generally, is being at alert, sensitive to changes, intuitive and being curious, life itself, school activities, conferences and traveling are some other sources as well as interaction with others.

. Order of superiority of the sources of weak signals in all areas of life.

number of order	A good source of weak signals
1	scientists/researchers
2	futurists
3	colleagues
4	academic and scientific journals
5	reports of research institutes
6	consultants in areas other than futures
7	popular science and economic magazines
8	television/radio
9	educational and scientific books
10	Internet: companies' or organizations' web pages
11	ordinary people (e.g. observing them)
12	media people
13	Internet: electronic journals
13	Internet: homepages of individual people/consultants
15	email newsletters
16	science fiction movies, books etc.
17	government and other public sector reports
17	Internet: discussion groups
19	Internet: blogs
20	marginal/underground press
21	Periodicals
22	local newspapers
23	Internet: electronic databases
24	government officials
25	email lists
26	movies
27	artists
28	market research studies
29	politicians
30	annual reports of companies
31	family/friends
32	patents
33	doctoral dissertations
34	proposals for laws
35	other source?
36	art exhibitions

Source: Emergence from weak signal to mainstream (Molitor, Schultz, Rogers 2012)
Source: Hiltunen, E. (2008). Good Sources of Weak Signals: A Global Study of Where Futurists Look For Weak Signal. *Journal of Futures Studies, May 2008, 12(4): 21 - 44.*

Categorization of Sources of Weak Signals

The sources were divided into three categories: human, textual and online sources. More precisely the following sources belonged to these three categories:

Human sources:	**Textual sources:**	**Online sources**
·Colleagues, ·Scientist/researchers in universities or institutes ·Consultants in other area than futures ·Politicians ·Government officials ·Media people	·Educational and scientific books ·Academic and scientific journals ·Popular science and economic magazines and papers ·Periodicals	·Internet: companies' or organizations' web pages ·Internet: homepages of individual people/consultants ·Internet: online databases ·Internet: online journals

·Artists ·Family/friends ·Ordinary people (e.g. observing them	·Marginal/underground press ·Local newspapers ·Doctoral dissertations ·Patents ·Government and other public sector reports ·Annual reports of companies ·Reports of research institutes ·Proposals for laws ·Market research studies ·Television/ radio ·Movies ·Art exhibitions ·Science fiction movies, books etc.	·Internet: blogs ·Internet: discussion groups ·Email newsletters, etc.

Discontinuities do not emerge without warning. These warning signs are described as "weak signals" (Ansoff, 1975), a concept aimed at early detection of those signals which could lead to strategic surprises -- events which have the potential to jeopardize an organization's strategy.

There are nine proven approaches that managers can use actively to reveal, amplify and clarify potentially important weak signals.

Actively Detecting/revealing weak signals

1. **Tap local intelligence**: Organizations may wish to drive more of their sense making to local levels and think locally.
2. **Leverage extended networks:** A valuable but frequently overlooked way to reveal weak signals is for executives to query their extended networks to partners, suppliers, customers and others in the company's ecosystem. Thus, ***managers must be selective about which signals to pay attention to*** and stay within the boundaries of the company's absorption capacity.
3. **Mobilize search parties:** Senior leaders can identify weak signal areas that merit separate task forces to canvass further.
4. **Test multiple hypotheses**: Organizational sense making is usually driven toward a single interpretation, so new data are force-fit into the existing mental model. Managers often have limited tolerance for ambiguity and may be reluctant to devote additional time to develop alternative hypotheses. However, organizations need competing hypotheses to escape the trap of getting stuck on a simple, single view that is wrong.
5. **Canvass the wisdom of the crowd:** To handle the dangers of groupthink or the problem of distributed intelligence (where key information is dispersed around the

organization), managers may wish to pay more attention to the grapevine. Groups often make far better judgments than individuals. This is particularly true if companies can create forecasting methods to pool the collective wisdom of an organization without fostering undue conformity.

6. **Develop diverse scenarios:** Unfortunately, no method is perfect, and uncertainty can never be fully tamed or conquered. It may be wise to create multiple scenarios about the issues under debate. By considering multiple scenarios at the same time, the organization can keep from being locked into one view of what future might emerge and yet share a common set of frameworks for discussing new signals. Scenario planning systematizes the hunt for weak signals that may foreshadow fundamental shifts in the business world and society at large.
7. **Probing and clarifying:** Seek new information to "confront reality." The greatest business failures are usually not due to poor management but rather reflect failure to "confront reality.
8. **Encourage constructive conflict:** Wisdom requires constructive conflict to ascertain and interprete the facts as they are. But the conflict must be among ideas, not people, and remain within reason. Several academic studies show that moderate conflict, as opposed to little or extreme conflict, leads to the best decisions. This results in better intelligence gathering, a wider exploration of options and a deeper examination of the issues. Unfortunately, the opposite often happens.
9. **Trust seasoned intuition:** Experienced managers often possess far more knowledge than they realize, especially when operating within their domains of expertise. If so, they should learn when and how to trust their hunches. It takes many years of experience, with good feedback, to develop reliable intuition. But once it has been honed, intuitive hunches should be viewed as valuable inputs, along with more analytical ones, for the judgement process.

Other Process approach to weak signal management

- Planning activities
- Developing methods/processes/systems for detecting weak signals.
- Estimating the impact of the weak signals on the organization's operations.
- Adopting alternative response strategies.
- Building flexible and adequate surveillance capacity on flexible response systems.

Challenges in Weak Signal Management

Despite its strategic value, weak signal management faces several challenges. These include:

- **Ambiguity and noise:** Distinguishing valuable signals from irrelevant data (Pereira et al., 2022).

Cognitive bias: Decision-makers may ignore or undervalue weak signals due to overconfidence in existing strategies (Schoemaker & Tetlock, 2017). Cognitive biases that may hinder accurate interpretation. Organizations must balance proactive signal management with awareness of these biases to ensure effective decision-making.

Organizational inertia: Firms may resist change even when weak signals indicate a need for transformation (Day & Schoemaker, 2008). Also, in a world full of myriads of choices

advocated by various stakeholders, many politicians and business leaders adopt the strategy of waiting until there is irresistible evidence of the need for change before committing time and resources to new ways of doing things. When the weak signal is new and it is inconsistent with the manager's past experience it is easily rejected as inaccurate or irrelevant. Weak signals that do not fit are often ignored, distorted or dismissed, leaving the company exposed (Schoemaker & Day 2009; Harris and Zeisler, 2002). The ability to see sooner and more clearly is compromised by information overload, organizational filters and cognitive biases that afflict sense making in all organizations. All managers are susceptible to the distortions and biases that beset them all. Organizations get blindfolded not so much because decision makers aren't seeing signals, but because they jump into the most convenient or plausible conclusion.

Responsiveness to Weak Signals

Regarding organizational responsiveness, constructive cultural norms, reinforced by supportive leadership, correlate with higher organizational quality and effectiveness and leaders who prioritize anticipation and encourage reporting of anomalies create a culture where weak signals are more readily detected and addressed. This early detection of weak signals is a collaborative outcome of conducive organizational culture and adaptive leadership. By fostering environments that value openness, critical inquiry, and psychological safety, leaders enable organizations to anticipate changes and navigate complexities effectively. Organizational culture, encompassing shared values, norms, and practices, shapes how information is perceived and acted upon within an organization.

In contrast, organizations with strict hierarchies and limited communication channels may suppress early warnings, strategic surprises and unconventional ideas, causing weak signals to be overlooked (Lescab (2019). This can lead to strategic blind spots which detect and address such vulnerabilities.

Learning to respond to weak signals of environmental changes constitutes the development of dynamic capabilities for environmental adaptation, or what we call simply, *adaptive capabilities*. It concerns how firms organize to achieve dynamic fit with these [high velocity, rapidly changing] business environments. Operational capabilities enhance the value generating potential of the firm"s resources (Makadok, 2001). They allow firms to create new products and processes, and to respond to changing market circumstances (Teece & Pisano, 1994). In times of crisis, managers must instead focus on capabilities to orchestrate, leverage and protect resources. This requires a different logic – a logic, not of leverage, but of change (Eisenhardt & Martin, 2000).

The final step in weak signals management is to develop an appropriate response to the identified and interpreted signals. This involves making strategic decisions about how to address the potential opportunities or threats indicated by the signals (Ansoff, 1975) (Fang et al., 2010). The response to weak signals can take various forms, depending on the nature of the signals and the organization's strategic objectives. For example, an organization may choose to adopt a proactive approach by investing in new technologies or entering new

markets, or it may choose to take a more defensive approach by strengthening its existing competitive position (Ansoff, 1975) (Fang et al., 2010).

Consequently, these rapidly morphed environmental changes increasingly bring about uncertain tomorrows resulting in

- Increasing turbulence
- New risks
- Accelerating innovation
- Increasing strategic and surprising events

An improved response by organizations is increasing their resilience to surprises through:

- On-going questioning of potential futures
- Intelligent horizon scanning
- Continuous strategic thinking
- Dynamic action planning
- Engaging in social networking
- Systematically gathering precursory insight of changes happening in the world around them.
- Sensing and adjusting to emerging change.

They know that by looking further ahead and reconnoitering what's next they can change a vicious reactive cycle to a responsive virtuous circle making their work more satisfying and less wasteful of time and resources as anticipating the future and preparing for it early, would mean greater chances of success, less of failure and earn an organization a sustainable competitive advantage.

Strategies to adopt to harness the strength of weak signals

Here are a few principles that organizations can follow to grasp and harness the power of weak signals.

- **Engaging at the top**

  For starters, given the fluid nature of the insights that surface, it's often useful to get senior leaders actively involved with the social-media sources that give rise to weak signals. Executives who are curious and attuned to the themes emerging from social media are more likely to spot such insights.

- **Listening and charting**

  Weak signals are everywhere, of course, so deciding when and where to keep the antennae out is critical. One of such situation involves a product, market, or service that doesn't yet exist—but could.

- **Spotting visual clues**

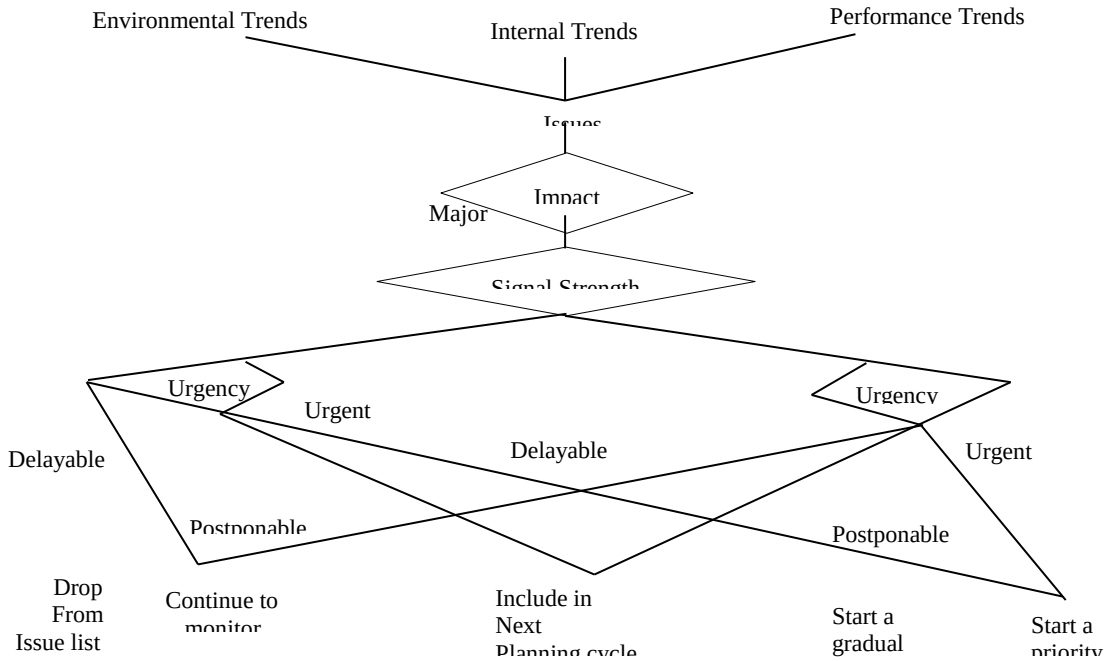
Source: Adapted from Capturing weak signals from the periphery (Day & Schoemaker 2006).

It's also useful to search for weak signals when customers start engaging with products or services in new, tech-enabled ways, often simply by sharing perceptions about a company's offerings and how they are using them. Spotting weak signals in such circumstances requires managers and employees to have the time and space to surf blogs or seek inspiration through services. As intangible as these techniques may sound, they can deliver tangible results.

Strategic decision process in weak signal management

A decision option(s) in weak signal management is diagrammatically represented below. Here, the weak signal issue can be learnt from environmental, internal and/or performance trends. They are dropped from the issue if the impact is minor. But if major, they can be classified as either weak or strong signals.

Strategic Decision option in Real Time Response Management Process



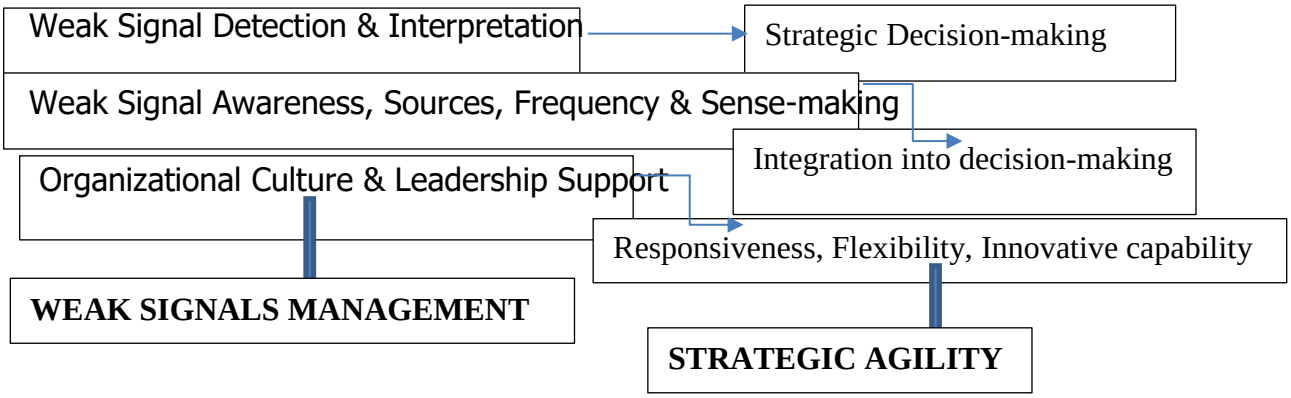
Source: Onwuchekwa, I. C. (2000). Business Policy and Strategic Management. Onitsha: Varsity Press Ltd.

So, the urgency of response would be expected thus:

- Delayable – Continue to monitor
- Postponable – Include in the next planning cycle
- Urgent – Start a gradual commitment project

Thus, continually monitoring emerging trends, issues and events and searching for tipping points to respond accordingly, realizing that weak signal is a vital intelligence tool would help organizations survive and thrive in a fiercely competitive future. It is hoped that Managers would develop fresh insights about new opportunities and threats by systematically finding weak signals and determining their effects on the future.

Conceptual Model guiding the study



Source: Researcher's Model (2024)

Stages in the weak signals management process

There are several stages in the weak signals management process:
(1) Scanning the external and internal environment to identify weak signals
(2) Analyzing these issues for their likely impact and probability of occurrence and
(3) Developing suitable responses for managing these weak signals to the advantage of the organization.

Models for Responding to Weak Signals

- **Management Decision-Making Models**: The integration of Data Flow Diagrams (DFD) and functional modeling creates comprehensive frameworks for decision-making in response to weak signals, enhancing financial and economic security in enterprises(Kozyrieva et al., 2024).
- **Proactive Monitoring**: Organizations can utilize weak signals to anticipate strategically relevant events, thereby improving their competitive positioning and operational efficiency(Fonseca & Barreto, 2012).

Methodologies for Detection and Interpretation

- **Text Mining Techniques**: Employing text mining can enhance the detection of weak signals across heterogeneous documents, facilitating improved strategic decision-making(Griol-Barres et al., 2020).

- **Business Intelligence Systems**: Systems like PUZZLE link weak signals to business strategy, allowing for systematic tracking and interpretation, which is essential for informed decision-making (Rouibah & Ould-Ali, 2002).

Managerial Implication and Strategic Relevance of Weak Signals

Before an organization responds to a real time issue, there must be complete information and concrete outcome. Where the information is scanty and incomplete, and expected outcome is not concretized, the problem definition becomes a weak signal management problem, but becomes a strong signal management problem if the information is complete and expected outcome, complete. Managers should therefore develop skills of acting on and leading others to act on weak signals that may be coalescing into meaningful patterns and develop the ability to describe these patterns in ways that are credible and persuasive for all key stakeholders. Also, they must be sensitive and responsive to the weak signals that may allow early identification of strategic opportunities or threats.

In the Nigerian context, where firms face volatility due to economic, political, and technological shifts, the ability to detect and act on weak signals could serve as a competitive and sustainable advantage. However, there is limited empirical research on how weak signal practices are applied locally, highlighting a gap that this study seeks to address. The literature underscores the strategic relevance of weak signals in enabling proactive, adaptive and strategic decision-making. While global best practices provide valuable insights, contextual factors such as industry dynamics, organizational readiness, and leadership mindset play a significant role in effective implementation. This study builds on existing theory and evidence to explore how weak signal management can be harnessed to improve agility in Nigerian manufacturing firms.
Weak signals as early signs of emerging issues, with a visibility though characteristically low, can help an organization to anticipate future changes and helps to innovate the future by breaking the mental models.

Thus, the practical significance of weak signal information is that it can be transformed into meaningful knowledge for policy action. Building a "weak signal" interpretative capability is a matter of continuous organizational development, in terms of assumption, re-appraisal, sharing of perspectives, collective creativity, and prompt deliberation, analysis, probability (intelligent or educated guess). This aligns with the assertion made by Elimimian and Edevbie, (2013) making weak signal management an ongoing and a systematic institutional exercise. The cost of ignoring weak signals can be very high and as such, strategies ought to be instituted to detect and effectively manage weak signals to forestall operational impediments and this can be interlinked with the view of Freeman (1984) stating that weak signals are capable of affecting the strategic direction of a corporation or business unit and as such they should be closely monitored and tracked.

Theoretical Foundations of Weak Signals Management

The concept of weak signals was first introduced by Igor Ansoff in the 1970s and has since been developed further by various scholars (Rossel, 2009) (Prahalad, 1995). The theoretical foundation of weak signals management is rooted in the idea that organizations must be

proactive in identifying and interpreting these signals to anticipate future trends and make informed strategic decisions. This requires a combination of analytical techniques, organizational learning, and strategic framing (Rossel, 2009) (Rouibah & Ould-Ali, 2002).

Research Method

The purpose of this study is to provide a comprehensive understanding of the strategies that firms can adopt to foster strategic agility by strategically managing weak signals in ways that improve firms' dynamic capability and sustainability against volatility. By conducting a qualitative literature review, this research seeks to outline best practices and offer actionable insights for organizations looking to integrate weak signals management programs into their broader business strategies. Ultimately, this research contributes to both academic and practical discussions on how effective management of weak signals can be leveraged to create more strategic resilience (Grawitch et al., 2015; Nielsen & Daniels, 2016). This study utilizes a qualitative approach, specifically employing a literature review method. A qualitative literature review allows for a comprehensive examination of existing scholarly articles, reports, and case studies, offering an in-depth understanding of the relationship between weak signals management and strategic agility and possible organizational outcomes (Snyder, 2019). This type of research is well-suited for identifying patterns, drawing comparisons, and synthesizing findings from previous studies on weak signals management strategies within various organizational settings, various sources of weak signals and approaches to managing weak signals effectively.

Method of Data Collection

The sources of data for this research are secondary in nature, derived from academic journals, books, conference proceedings, and credible online databases. The inclusion criteria for the data sources were studies published between 2010 and 2023 The literature was chosen based on relevance, credibility, and its contribution to the discourse on the subject matter. Data collection involved systematically reviewing and selecting articles and reports that discussed strategies for implementing weak signal management strategies, their impact on engagement and productivity, and challenges faced by organizations in promoting weak signals management and organizational agility. The data gathered were mesaningful categories, and then interpreting these categories to draw conclusions about the effectiveness of wellness programs in fostering employee engagement (Braun & Clarke, 2006). This method allows for a nuanced understanding of how weak signals management strategies influence employee behaviour, how organizational culture and leadership support impact firms' ability to detect and interpret weak signals early enough to enhance overall performance. By synthesizing findings from multiple studies, this research aims to provide actionable insights for firms.

CONCLUSION

This study revealed that a weak signal might be an early warning against threats but it, of course, might also be about opportunities (Ansoff, 1991) as cited in Elimimian and Edevbie (2013). Ignoring weak signals might result in strategic crisis. If a weak signal related to an opportunity has been taken into account it might induce positive results but, if not, negative results in terms of opportunity costs. The effective management of weak signals requires

not only the right tools and techniques but also the right organizational capabilities, leadership support and culture. This includes the ability to learn, adapt, and innovate in response to changing market conditions (Fonseca & Barreto, 2012) (Janissek-Muniz & Blanck, 2014). Finally, the role of organizational culture in supporting wellness initiatives is highlighted by several studies, including Manuti and Giancaspro (2019), who emphasize that organizational culture is essential for the long-term success of effective weak signal management. When weak signal management strategies are embedded in the organizational culture, employees are more likely to perceive weak signal management initiatives as a core component of their work experience rather than a separate benefit. This cultural shift can enhance participation rates and ensure that these programs are sustainable over time, ultimately contributing to a more engaged and productive workforce. Extant studies also highlighted that early detection of weak signals can help an organization to act with much more confidence in interpreting and converting weak signals into useful decision making, using seasoned intuition and this is in consonance with the view expressed by Schoemaker and Day, (2009). The literature reviewed suggests that weak signals management is a multifaceted process that requires leadership support, holistic process reengineering and strategic initiatives, and a strong organizational culture. The combination of these factors leads to significant reduction in strategic crisis and other benefits further validate the importance of this study. By leveraging strategic approaches, models, tools and techniques organizations can enhance their ability to identify, interpret, and respond to weak signals. Additionally, addressing cognitive biases and fostering a culture of learning and ambidexterity can further improve the quality of strategic decisions.

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