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Identifying disruptive innovation in the IT sector: a framework for evaluating intercompany impact

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Abstract: In the dynamic Information Technology (IT) sector, accurately assessing disruptive potential is crucial for companies aiming to maintain competitive advantages and preempt emerging threats. This study introduces a robust framework for evaluating the disruptive potential of IT companies, with a specific focus on company-to-company impacts. Our approach diverges from traditional models by integrating a holistic, multi-dimensional perspective that includes business model innovation, market dynamics, network effects, and customer adoption trends. Our approach incorporates a situational model that contextualizes disruptive dynamics within specific industry conditions, alongside a scoring model that systematically quantifies the potential impact of innovations. The framework was developed through an extensive literature review, expert interviews, and an analysis of both historical and contemporary case studies. Specifically, the historical case study examines Apple's disruption of Nokia in the smartphone market, while the contemporary case study analyzes the competitive dynamics between Mondoo and Lacework in the cybersecurity domain. These case studies provide an in-depth application of the framework, demonstrating its utility in both retrospective analysis and real-time market evaluation. This development process was significantly enriched by the primary author's direct industry experience in a Silicon Valley cybersecurity startup, ensuring that the framework addresses real-world complexities and needs. Our research contributes a practical tool adapted to the IT sector's unique characteristics, offering strategic insights for IT professionals, strategists, and policymakers to effectively navigate and leverage disruption opportunities. The practical applications of this framework extend beyond academic discussion, providing actionable guidance for identifying and addressing potential disruptions in the IT landscape.

1. Introduction

In the rapidly evolving Information Technology (IT) landscape, the swift pace of innovation makes previously groundbreaking technologies quickly obsolete. This fast-paced environment compels businesses

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to distinguish between transformative innovations and passing trends, a challenge encapsulated by Gates' insight on our tendency to focus on immediate changes while overlooking gradual yet impactful shifts [1]. This study aims to establish a structured framework for identifying disruptive innovations in the IT sector—innovations with the potential to redefine industries and alter competitive dynamics. This approach aligns with the growing body of research that advocates for digital transformation models tailored to the unique needs of small and medium-sized enterprises (SMEs) [2, 3] and prioritizes ICT investments to bridge digital divides [4].

The task of identifying market-disrupting innovations is particularly complex for established IT firms. Managers must filter through numerous advancements, distinguishing between those with incremental impact and those capable of altering competitive landscapes. In conservative corporate environments that often prioritize stability over disruption, Christensen's "disruptive technologies" theory underscores that the real risk often lies not in the innovation itself, but in underestimating its eventual impact [5]. Later research expands on this, highlighting the struggle large firms face in adapting to radical changes [6–9].

Adapting to disruptive change, even in risk-averse organizations, is achievable through a balance of caution and agility—a concept resonant with Schumpeter's 1940s theory of "creative destruction," in which innovation displaces outdated practices to make room for new advancements [10]. This idea remains pertinent today, as IT's unique features—rapid technological shifts [11], fierce competition [12], complex ecosystems, and short product life cycles [5]—require specialized strategies for maintaining resilience. Here, core elements like consumer-driven innovation [13], network effects [14, 15], and global scalability [16] are essential for understanding market shifts and competitive strategies.

Recent studies emphasize that effectively understanding customer needs remains foundational for sustaining competitive advantage in IT. Analyzing unmet customer needs and aligning with functional and emotional requirements provides a robust framework for innovation [17, 18]. Moreover, platforms and online communities continue to reshape consumer expectations, providing a rich source of insights for identifying innovations that resonate with modern consumers [19, 20].

Moreover, business model innovation has become a critical factor in sustaining growth amidst disruption. Business models that embrace adaptability to rapid technological change, foster value creation, and leverage network effects are key to sustaining competitive differentiation in the IT sector [21–23]. Studies like those by Zou (2024) emphasize the integration of digital transformation within business models, underscoring its role as a driver for sustainable development [24].

This framework integrates theoretical principles and empirical research tailored for IT's rapid cycles and unique market dynamics. By addressing existing models' limitations and enriching them with recent insights on consumer behavior, network effects, and business model agility, this study aims to provide IT firms with the essential foresight to effectively predict and navigate the complexities of market disruptions.

2. Literature Review

2.1. Problem Discussion

Christensen's initial focus in 1997 was on post-disruption market analysis, building his theory by examining products already classified as disruptive innovations [5]. He proposed a method for charting technology performance trajectories for these products. However, this method has been critiqued for its retrospective nature, as plotting these trajectories is considerably more challenging before the actual disruption occurs [17]. Tellis (2006) highlights the ambiguity in determining how many characteristics must be met for an innovation to be considered disruptive. The importance of digital maturity models for SMEs in navigating these disruptive innovations has been highlighted in recent research [2]. Similarly,

the prioritization of ICT investments to address digital divides is crucial for fostering innovation and maintaining competitive advantage [4].

Over time, Christensen and others expanded the concept of disruptive innovations to include not just 'Low End,' but also 'High End' and 'New Market' categories [7, 25]. However, a significant unanswered question remains: how can potential disruptive innovations be identified early enough? This identification is crucial for market players, from startups to established companies, and involves numerous factors, including technological levels, shifts in customer needs, business model innovations, and company value chains. The primary challenge is the market players' inability to recognize disruptive technologies/innovations at first glance, lacking measures to alert them to imminent disruption. Therefore, identifying companies that pose a disruptive innovation threat within the IT industry is an intricate challenge, owing to the sector's distinct characteristics and the need for a specialized approach.

2.2. Existing Prediction Models

The literature offers several methodologies for identifying potential disruptive innovations, each with its unique focus and analytical approach. These methods have evolved significantly over time and can be broadly categorized into specific groups.

1. **Economic models:** These models focus on the economic dimensions of innovation, examining its impact on market dynamics, such as prices, demand, market shares, and overall industry structure. They analyze how a new technology or business model influences competitive landscapes and economic outcomes. Recent advancements in this area explore multi-sided markets and ecosystem-level impacts, shedding light on how disruptive innovations reshape industries [26–29].
2. **Patent analysis model:** This approach identifies disruptive innovations by analyzing patents, emphasizing novel and unique technologies. Patents serve as early indicators of emerging technological trends, with advanced tools like machine learning and deep learning enhancing the ability to detect disruptive innovations [30–35]. Additionally, metrics such as technological disruptiveness, originality, and marketability provide a nuanced understanding of disruptive potential [36, 37].
3. **Literature-based discovery model:** This model uses text mining techniques, including topic modeling and keyword network analysis, to extract insights from extensive scientific and technical literature. By clustering and visualizing keyword distributions, it identifies emerging research trends and technical disciplines with disruptive potential. For instance, integrating methods like LDA2Vec enhances predictive capabilities across fields like energy technology and AI-driven systems [38–50].
4. **Situational models:** Also referred to as scenario analysis, situational models advocate for a customized approach to understanding and adapting to specific industry contexts and market dynamics. This framework emphasizes Contextual Analysis, Performance Driver Identification, and Strategic Alignment. It also highlights the importance of adaptability and proactive responses to emerging trends. Recent research demonstrates the value of these models in navigating disruptions, such as those caused by the COVID-19 pandemic, by fostering strategic flexibility [51–55].
5. **Keyword network analysis methods:** These methods focus on clustering and mapping keywords to predict and visualize research trends. By understanding the relationships and distributions of keywords, this approach aids in identifying advancements in emerging technologies. Visualization tools play a critical role in capturing the dynamics of technological evolution and market disruptions [38, 39, 44, 49, 50].
6. **Scoring models:** Scoring models employ a structured approach to assess the disruptive potential of innovations. Using predefined criteria, such as contribution factors, these models evaluate the

likelihood and impact of innovations disrupting existing markets or creating new ones. Recent studies integrate this approach into innovation management frameworks, enabling organizations to systematically evaluate and prioritize innovations [7, 25, 56–66].

3. Methodology

Our methodology is designed to ensure comprehensive development and robust validation of the framework assessing disruptive potential within the IT industry. This detailed approach encompasses theoretical grounding, empirical testing, and iterative refinement.

3.1. Framework Development

- **Literature Review:** Our initial step involves an extensive review of existing literature to identify and understand the current models and their limitations in predicting IT sector disruptions.
- **Framework Construction:** Based on the literature insights, we construct a comprehensive framework that includes a diverse range of factors like business model innovation, technology evolution, market dynamics, and customer behavior, all identified as key to understanding disruption in the IT context.
- **Innovative Methodology:** Innovative Methodology: We introduce a novel scoring model within the framework, designed to provide a quantifiable measure of disruption potential. This model is distinctive in its incorporation of both qualitative insights and quantitative data, offering a comprehensive assessment tool for the IT sector. The scoring model is further enhanced by the situational model, which focuses specifically on the IT sector's unique characteristics and challenges. By contextualizing disruptive dynamics within specific industry conditions, the situational model allows for a more accurate and relevant analysis of potential disruptions. This dual approach ensures that the framework not only captures the multifaceted nature of disruptive innovation but also aligns with the rapid technological advancements, intense competition, complex ecosystems, and short product life cycles that are typical of the IT industry.

3.2. Framework Validation

- **Structured Interviews:** To validate our framework, we engage in structured interviews with a various IT experts, including decision-makers and experts in various domains. These interviews are conducted in both German and English to accommodate a wider expert base, ensuring diverse and insightful inputs. To systematically analyze the qualitative data from these interviews, we utilize MAXQDA software. This tool aids in efficiently organizing, analyzing, and interpreting the vast qualitative data, thus bolstering the depth and integrity of our analysis.
- **Historical and Contemporary Case Studies:** Our validation process extends to the application of the framework on historical cases like Apple's impact on Nokia and a current case study examining the competitive dynamics between Mondoo and Lacework in the cybersecurity domain. These applications demonstrate the framework's utility in both retrospective analysis and real-time market evaluation.
- **Iterative Feedback Integration:** Insights from expert interviews and case study analyses are iteratively integrated back into the framework, allowing for continuous refinement and enhancement based on practical feedback and observed outcomes.
- **Expert Review and Peer Validation:** The refined framework is presented for peer review within academic and professional circles, ensuring its academic stringency and industry relevance.
- **Validation through Author's Professional Experience:** Additionally, the framework's validity is enriched by the author's personal experience working in a cybersecurity startup in Silicon Valley. This experience offers unique, firsthand insights into the disruptive dynamics within the IT industry, providing a practical perspective that enhances the framework's strength and applicability. The author's

observations of innovation processes, competitive strategies, and market responses within this vibrant technological ecosystem serve as a valuable real-world test, affirming the framework's relevance and effectiveness in capturing the nuances of disruption in the tech industry.

4. Results and Discussion of Findings

4.1. Concluded Framework

Our enhanced framework builds upon the foundational theory of disruptive innovation by Christensen, emphasizing the shift towards business model innovation as a core aspect of disruption, rather than solely technological changes, as highlighted in seminal works by Christensen [5, 25] and Christensen and Anthony [67]. Adapted specifically for the IT industry, our model adeptly handles various types of disruption by integrating insights from significant research [25, 66, 68, 69]. We have implemented a scoring model that works in tandem with a situational analysis approach, utilizing a detailed database of contributing factors. This combination not only enhances the precision and applicability of our framework for assessing 'foothold' and 'main market entry' stages but also equips IT professionals with a robust tool to identify and understand potential disruptive forces within the industry effectively.

4.2. Contribution Factor (Criteria) Development

Our analytical framework integrates 29 theoretical propositions to identify early indicators of disruptive innovation in the IT industry. These propositions span a wide range of factors, informed by the sector's unique dynamics and grounded in comprehensive literature and explained in the following:

1. **Customer adoption costs and network effects:** Evaluation of switching and compatibility costs highlights barriers and facilitators in market disruption [66, 70, 71].
2. **Reduced customer willingness to pay for quality enhancements:** Signals potential market shifts toward disruption [5, 69].
3. **Market complacency among established leaders:** Indicates vulnerability to disruption, particularly when incumbents are slow to adapt to market changes [72–75].
4. **Static market environments:** Dominated by entrenched incumbents, these settings create opportunities for disruptive innovations to emerge [69, 72, 76].
5. **A surge of new market entrants:** Often a precursor to disruption, aligning with Industry Life Cycle theory [77, 78].
6. **Market share shifts:** Movements toward low-end or high-end offerings signal potential disruptive dynamics [69, 79].
7. **Value chain enhancements:** Improved value propositions and streamlined operations often facilitate the success of disruptive innovations [80–82].
8. **High entry barriers:** These can inspire novel and unique approaches to market entry, often leading to disruptive outcomes [68, 70, 75, 83–86].
9. **Customer loyalty:** Established loyalty can impede disruptors, necessitating strategic approaches to overcome this barrier [29].
10. **Price increases coupled with declining sales:** This dynamic often indicates markets ripe for low-end disruption [69].
11. **Radical sustaining innovations:** Incumbents focusing on these may overlook emerging disruptive trends, creating market gaps for new entrants [69, 74, 87].
12. **Simpler, more affordable products:** A hallmark of disruptive innovation, these products cater to underserved or price-sensitive market segments [5, 88, 89].

13. **Lower-cost products with reduced profit margins:** Indicative of a focus on underserved markets with high disruptive potential [90–92].
14. **Distinct business structures:** Unique organizational or operational models can signal innovative, potentially disruptive approaches [81, 93].
15. **Cloud computing:** Reflects a shift in IT service models, exemplifying the disruptive potential of as-a-service offerings [94].
16. **Financial technology advancements:** Demonstrates the disruptive impact of innovation on traditional IT business models [95].
17. **Brand reputation and public perception changes:** These shifts influence market dynamics and the viability of disruptive innovations [96].
18. **Cross-industry innovations:** Unique value propositions emerging from intersections of industries disrupt multiple sectors simultaneously [97–100].
19. **Workforce dynamics:** Trends like remote work reflect shifts in business model needs, signaling potential disruption [89, 101, 102].
20. **Consumer empowerment in innovation processes:** Highlights evolving landscapes in business model innovation [103].
21. **Agile development and adaptability:** Signals strategic flexibility among potential disruptors [104].
22. **Platform-based models:** Challenge traditional linear business structures, reflecting disruptive innovation [105].
23. **Regulatory changes:** Alterations to market structures often catalyze disruptive innovations [82, 106].
24. **Globalization and collaboration:** Cross-border interactions enhance innovation ecosystems, fostering disruption [107].
25. **Environmental sustainability focus:** Green IT solutions disrupt markets increasingly attentive to eco-friendly technologies [108–110].
26. **Cybersecurity advancements:** Represent critical areas for disruptive innovation within IT [82, 111].
27. **Data-driven decision-making:** Adoption of data analytics transforms competitive landscapes, indicating disruption potential [85, 102, 112].
28. **Emerging technologies:** Integration of innovations like AI, IoT, and blockchain creates vectors for disruption in IT [36, 87, 113, 114].
29. **Advances in health technologies:** Disruptions extend to medical fields through innovations like mRNA vaccines and gene editing [115, 116].

The contributing factors are categorized into foothold and main market groups, which are depicted in the following two tables: Table 1 and Table 2.

Table 1. Contributing factors (criteria) for foothold market.

Contributing factors
High Number of Firms Entering the Market: An influx of new companies suggests a fertile ground for innovative and competitive dynamics. **Market Shifts Toward Affordable and Premium Offerings:** Tracking shifts towards both low-end and high-end offerings reflects evolving consumer preferences and potential market disruption opportunities.

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Table 1. (continued)

Contributing factors
Value Chain Improvements: Emphasize the role of advancements across the entire value chain, including production, distribution, and service delivery, in enhancing market efficiency and innovation.
Barriers to Market Entry: Expand to include not just financial and supply chain barriers, but also technological, regulatory, and strategic challenges that affect market entry and dynamics.
Innovative and Accessible Products: Highlight the importance of products that balance innovation, affordability, convenience, and reliability.
Transformation in Business Models: Focus on how radically different business models can disrupt traditional market structures.
Basic Functionality at Lower Costs: Emphasize the significance of offering essential functionalities at more accessible price points, serving to price-sensitive segments.
Adapting to Changing Consumer Preferences: Reflect the dynamic nature of consumer demands in terms of product features, performance, and usability.
Balancing Technology Complexity: Address the need to balance advanced technological features with accessibility and ease of use for a broader consumer base.
New Market Structures: Include how disruptive business structures redefine market norms and competitive landscapes.
Unaddressed Needs and New Demands: Highlight innovations that create new market demands or address previously unmet needs of non-consumers.
Enhanced Product Value: Focus on how innovations increase product utility, appeal, or performance, thereby offering greater value to customers.
User Experience Focus: Innovations that significantly improve user experience can be disruptive. For instance, Uber's success was partly due to its focus on user convenience, offering a simple, mobile-app-based solution for transportation, which was more accessible and often more affordable than traditional taxis.
Digital Transformation: The move towards digitalization in various industries, including the use of cryptocurrencies, has shown the potential for disruptive innovation. Cryptocurrencies, for example, represent a major shift in the financial sector, introducing a completely digital form of currency.
Sustaining vs. Disruptive Innovation: Understanding the difference between sustaining and disruptive innovation is critical. In many cases, what is needed is a sustaining innovation that improves upon existing technologies or systems rather than completely replacing them. This distinction is crucial for identifying true disruptive potential.
Adaptability to Market Changes: The ability of a firm or technology to adapt to changing market conditions can be a strong indicator of its disruptive potential. Adaptability reflects a responsiveness to consumer needs and market dynamics.
Integration with Existing Ecosystems: The degree to which a new technology or business model can integrate with or disrupt existing ecosystems and value chains can be a sign of its disruptive capacity.
Regulatory Landscape: The impact of regulatory changes or the ability of a new technology to navigate complex regulatory environments can play a significant role in determining its success and disruptive potential.

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Table 1. (continued)

Contributing factors
Cost Efficiency: Innovations that significantly reduce costs while maintaining or improving performance can be disruptive, especially if they make products or services more accessible to a larger segment of the market.
Scalability and Global Reach: The potential for scalability and global reach of a product or service can indicate its ability to disrupt on a larger scale.
Ethical AI and Responsible Innovation: Emphasizing ethical AI and responsible innovation is increasingly important in gaining public trust and ensuring sustainable, disruptive advancements in IT.
Cross-Functional Teams and Diversity: Diversity in teams fosters innovative thinking, essential for creating disruptive IT solutions that address a wide range of challenges and opportunities.
Virtual and Augmented Reality: VR and AR technologies are creating new opportunities for disruptive applications in training, education, entertainment, and more.
E-commerce and Digital Payment Solutions: Innovations in these areas are transforming the retail and finance sectors, with significant implications for consumer behavior and business models.
Remote Work Technologies: The rise in remote working drives demand for innovative technologies that enable effective collaboration and productivity remotely.
IoT and Smart Technologies: Innovations in IoT and smart technologies are leading to more interconnected and intelligent systems, capable of disrupting various IT domains.
Data-Driven Customization: Utilizing data analytics for customization allows companies to identify unique market needs and create innovative solutions that disrupt standard offerings.
Collaborative Ecosystems: The emergence of collaborative ecosystems accelerates innovation, combining diverse expertise to create novel IT solutions that can disrupt existing markets.
Rapid Prototyping and Agile Development: These methodologies enable faster iteration and adaptation of IT products, allowing companies to quickly refine and launch disruptive innovations.
Cloud-Based Solutions and SaaS: The shift towards cloud computing and SaaS models represents a significant disruption in traditional IT service delivery, offering scalability and accessibility.
Mobile-First Strategies: With the ubiquity of mobile devices, a mobile-first approach in IT solution development can be a key disruptor, reaching a wider and more engaged audience.
Open Source Contributions and Community Engagement: Engaging with the community through open source can establish a strong foundation in a niche market.
Collaborations and Partnerships: Strategic alliances can help new entrants gain credibility and a foothold in specialized market segments.

A comparable methodology was used to classify the contributing factors for the main market. The results of this classification are concisely presented in Table 2.

Table 2. Contributing factors (criteria) for main market.

Contributing factors
Switching Costs: The expenses customers incur when changing products or services. High switching costs can deter customers from adopting new solutions.
Adherence to Established Standards: Compliance with industry norms and standards. Meeting established standards is crucial for gaining market acceptance and trust.
Need for New Costly Infrastructure: Investments required for new infrastructure. High costs can be a barrier to market entry for new players.
Reduced Willingness to Pay for Quality Upgrades: Customers hesitant to pay more for quality improvements. This can limit the market for premium products.
Over-Satisfaction Among Some Customers: A segment of customers being more than satisfied with current offerings. This can create resistance to new entrants.
Prolonged Market Dominance: Firms dominating the market for an extended period. Long-term dominance can stifle innovation and create complacency.
Substantial Market Share: Companies holding a large portion of the market. This can act as a barrier to entry for new competitors.
High Market Concentration: Few firms controlling a significant market share. High concentration can lead to reduced competition and innovation.
Steady Competition: Regular presence of familiar competitors. Consistent competition can drive ongoing innovation and improvement.
Static Market Induced by Incumbents: Incumbents leading to a lack of market dynamism. Static markets are more susceptible to disruption.
Numerous New Market Entrants: High influx of new firms into the market. This can indicate a dynamic and competitive market environment.
Market Shift Towards Low-End Offerings: A turn towards more affordable products/services. This shift can open opportunities for cost-effective innovations.
Market Shift Towards High-End Offerings: A trend towards premium products/services. High-end markets can be lucrative but also competitive.
Value Chain Improvements: Enhancements in the production or distribution process. Improvements can lead to increased efficiency and reduced costs.
Protective Patents and Licenses: Intellectual property rights guarding market entry. Patents and licenses can create barriers to entry for new competitors.
Challenges in Supplier and Channel Access: Difficulties in establishing supply chains and distribution networks. These challenges can hinder market entry and expansion.
Significant Initial Investment Capital: High capital requirements for market entry. Large investments are necessary for competing in the main market.
Elevated Market Entry Barriers: Various obstacles to entering the market. High barriers can protect incumbents but also limit innovation.
Customer Loyalty: Strong allegiance of customers to current providers. High loyalty can make it difficult for new entrants to gain market share.
Availability of Low-End Offers: Presence of budget-friendly options in the market. These offers can cater to price-sensitive segments and create new market opportunities.

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Table 2. (continued)

Contributing factors
Viability of Previously Unprofitable Low-End Markets: New opportunities in formerly unprofitable segments. Innovations can make these markets profitable.
Radical Sustaining Innovation: Intense focus on enhancing existing products/services. This can maintain market position but also create openings for disruptive innovations.
Gap in Matching New Entrants' Products: Lack of comparable products to those offered by new entrants. This gap can be an opportunity for disruptors.
Simpler, More Convenient, Affordable, Reliable Products: Emphasis on user-friendly and value-for-money products. These attributes can attract a broad customer base.
Distinct Business Model: Significant differences in how businesses operate. Unique business models can differentiate new entrants from incumbents.
Lower Performance, Lower Cost Products/Services: Focus on basic functionality with affordability. These products can disrupt premium market segments.
Changing Performance Expectations: Evolving consumer expectations regarding product features. Adapting to these changes is crucial for maintaining relevance.
Over-Engineered Products: Products with more features than necessary. Simplifying these can reduce costs and increase appeal.
User-Friendly Design and Application: Focus on ease of use. User-friendly designs can enhance customer satisfaction and adoption.
Balancing Complexity and Accessibility: Ensuring complex products remain user-friendly. This balance is key for attracting a wide range of users.
Unique Business Structure (Model): New organizational and operational approaches. Innovative structures can support disruptive strategies.
Creation of New Demands/Needs: Products/services addressing new market segments or unmet needs. Identifying and fulfilling these needs can drive market growth.
Presence of Over-Satisfied Customers: Customers whose needs are excessively met. This can lead to resistance to new products.
Existence of Unsatisfied Customers: Segments that current market offerings don't satisfy. These segments represent opportunities for innovation.
Enhanced Value in Products/Services: Offering greater utility or performance. Enhanced value can differentiate products in a crowded market.
Lack of Match for Newcomers' Offerings: Absence of equivalent alternatives to what new entrants propose. This can provide a competitive edge for disruptors.
Brand Influence in the Market: How new brands are leveraging digital marketing to rapidly build a strong market presence. Strong branding can attract customers and build trust.
Immersive Technologies: The role of virtual and augmented reality in creating new user experiences and market opportunities. These technologies can drive significant market changes.
Edge Computing: The shift towards decentralized data processing and its impact on market structures. Edge computing can enhance efficiency and reduce latency.
Blockchain Technology: Beyond cryptocurrencies, its role in creating new business models and trust mechanisms in various IT sectors. Blockchain can revolutionize transactions and data security.

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Table 2. (continued)

Contributing factors
Quantum Computing: Its potential disruptive impact on data processing, security, and problem-solving capabilities in IT. Quantum computing can solve complex problems faster than traditional methods.
Impact of Artificial Intelligence: How AI is driving significant changes in product development, customer service, and business operations. AI can automate processes and provide insights from large datasets.
Collaborative Consumption Models: The rise of sharing economy principles in IT, such as shared software platforms. These models can reduce costs and increase accessibility.
Consumer Data Utilization: The role of big data in understanding market trends and driving product development. Data analytics can provide a competitive edge.
Globalization of IT Talent: How the global distribution of talent affects innovation dynamics and competitive advantage. Access to a global talent pool can enhance innovation.
Sustainability and Green IT: The increasing importance of environmental sustainability as a factor in innovation and market appeal. Green IT can attract environmentally conscious consumers.
Data Privacy and Security Concerns: How these concerns can both hinder and drive innovation in the IT industry. Addressing these concerns is crucial for gaining consumer trust.
Cross-Industry Disruption: New entrants from different industries bringing innovation and challenging established IT players. Cross-industry innovation can lead to unexpected competition.
Investment in R&D: Significant R&D investment can lead to breakthroughs that reshape the main market landscape. Continuous innovation is key to maintaining a competitive edge.
Regulatory Compliance and Innovation: Excelling in regulatory innovation can set new standards, influencing the main market. Compliance can be a competitive advantage in regulated industries.

4.3. Measurement Development

Our assessment framework uses a strategic tool for measuring disruptive innovation potential across market stages, equipping managers with critical insights for strategic planning and threat adaptation. Although it is not a forecasting instrument, it serves to enhance strategic analysis and decision-making. As shown in Figure 1, the framework uses a five-point scale ranging from highly negative (-2) to highly positive (+2), akin to the methodology of Rafii et al. [66], allowing managers to assess the impact of various factors on potential disruptions. This scaling process not only aids in understanding market dynamics but also in refining strategies and responses to emerging threats, thus facilitating a more informed approach to strategic decisions.

The Disruption Impact Rating Scale serves as a strategic tool to assess the influence of various factors on the potential for market disruption. The scale is structured to reflect the degree of influence, ranging from -2, signifying a significant hindrance to disruption, to +2, indicating a considerable facilitation of disruption:

- -2 = Significantly Hinders Disruption
- -1 = Slightly Hinders Disruption
- 0 = Neutral Impact on Disruption

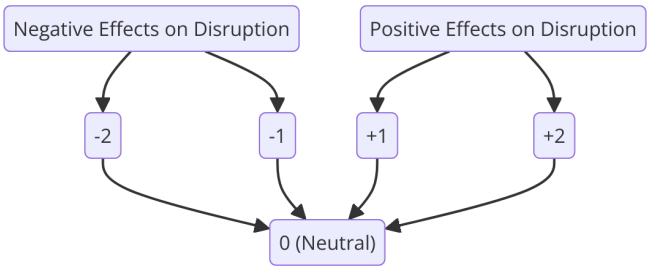

Figure 1. Effects on disruption with a criteria scale

- +1 = Slightly Facilitates Disruption
- +2 = Significantly Facilitates Disruption

Utilizing this framework, managers can undertake a systematic analysis of the disruption process across both the main and foothold market stages by:

1. Identifying: Acknowledging each contributing factor's presence.
2. Rating: Assigning a numerical value to measure each factor's potential impact on disruption.
3. Weighting: Establishing the relative importance of each factor in the disruption context.

As outlined in following, our evaluation framework spatially organizes these factors to reflect their impact on market disruption. Negative influences are placed on the left, while positive influences are on the right, providing a clear visual guide for assessing market dynamics.

In the assessment of disruptive innovation, our weighted scoring model refines the evaluation of contributing factors. Weights signify the level of influence, with '1' indicating low influence and '2' indicating high influence. The score for each factor (W_i) is derived by multiplying its rating (R_i) by its weight (w_i), and the stage score (S) is the mean of these weighted scores. This stage score is then normalized to a -2 to +2 scale by dividing it by the average weight ($\bar{w}$), ensuring comparability. This process allows for a quantitatively structured analysis, aligning with scholarly practices across diverse fields for objective and strategic insights into market dynamics.

Weighted Score Calculation for Each Factor:

$$W_i = R_i \times w_i, \tag{1}$$

where:

- W_i = Weighted Score of the i^{th} Factor
- R_i = Rating of the i^{th} Factor
- w_i = Weight of the i^{th} Factor

Overall Stage Score Calculation:

$$S = \frac{\sum_{i=1}^{N} W_i}{N}, \tag{2}$$

where:

- S = Overall Stage Score
- N = Total Number of Factors

Normalization of the Stage Score:

$$NS = \frac{S}{\bar{w}}, \tag{3}$$

where:

- NS = Normalized Stage Score
- $\bar{w}$ = Average Weight = $\frac{\sum_{i=1}^{N} w_i}{N}$

4.4. Analyzing the Measurement

To effectively leverage the analytical framework, a systematic approach involving several key steps is recommended:

1. **Project Leadership:** Assign a project leader to steer the framework's application.
2. **Evaluation Team Formation:** Create a diverse team of 10-15 members from different departments with IT expertise, customer insight, business model knowledge, and competitive awareness to enhance multifaceted evaluation.
3. **Disruptor Analysis:** Define and analyze the potential disruptor, examining its strengths, market position, business model, and other relevant aspects.
4. **Timing Assessment:** Evaluate the disruptor's development stage and potential market impact timeline, considering market readiness and external factors.
5. **Case Study Review:** Engage the team with relevant case studies to deepen their understanding of the framework and build analytical skills.
6. **Factor Customization:** Tailor the contributing factors to address the specific nuances of the IT industry, ensuring relevance and precision.
7. **Rating and Weighting:** Conduct a thorough team consensus process on each factor's rating and weighting to ensure a balanced and informed evaluation.
8. **Outcome Interpretation:** Analyze the evaluation results to identify potential disruption profiles, guiding strategic responses:

    - Scores Near +2 in Both Main and Foothold Markets: Strong enabling factors in both markets indicate a high likelihood of disruption.
    - Scores Near -2 in Both Main and Foothold Markets: Predominance of disabling factors suggests that disruption is unlikely at present, but the situation could evolve.
    - Scores Near 0 in Both Main and Foothold Markets: A balanced mix of enabling and disabling factors indicates potential for disruption, but it's not certain.
    - Score Near +2 in Foothold Market, Negative in Main Market: The disruptor is strong in the foothold market with potential to move to the main market, despite current barriers.
    - Score Near +2 in the Main Market, Negative in the Foothold: This rare scenario might occur if the disruptor has created a new market and is already influencing the main market.

The framework serves as a dynamic tool for ongoing market analysis and strategic adaptation, offering a structured pathway for organizations to identify and respond to disruptive threats and opportunities effectively. Continuous market monitoring and strategic flexibility remain essential, regardless of the initial assessment outcomes.

4.5. Applying the Prediction Framework - Historical Case-Study

Until the late 2000s, Nokia was a global leader in the mobile phone and operating system (OS) markets. Originally established in 1871 as a rubber boot manufacturer, Nokia had evolved significantly over the years [117]. By the end of 2007, the company was responsible for producing over half of the world's mobile phones. Additionally, its mobile OS, Symbiafn, held a dominant position in the market, boasting nearly 70% of the global share. However, Nokia's dominance in the smartphone market fell sharply within ten years, as competitors like Apple and Samsung emerged [118]. In a significant turn of events, Nokia agreed to sell its mobile phone business to Microsoft in 2013 for approximately $7 billion. Reflecting on this downfall, it's often said that "Nokia killed Nokia," suggesting that internal factors rather than external competitors were primarily responsible for the company's decline in the smartphone market [119]. This case serves as a classic example of an industry leader failing to adapt to rapidly changing market dynamics and technological innovations.

Apple's rise in the mobile phone industry was initially understated; the company had not sold a single mobile phone prior to 2007. However, by the first quarter of 2013, Apple had made a remarkable leap, securing almost 40% of the U.S. smartphone market and claiming over 50% of the global handset industry's operating profits. In the fiscal year 2013, Apple's sales of iPhones reached a staggering 150 million units, quintupling Nokia's sales of 30 million smartphones during the same period [120].

Unlike Nokia, Apple recognized early on that the appeal of a mobile device was not solely in its hardware. The company focused on leveraging software to create enriching mobile experiences and innovating across various applications, including music, movies, and computing. A key element of Apple's strategy was the development of a unique business model, exemplified by the App Store. This platform not only facilitated business opportunities for third-party developers and partners but also fostered a dynamic ecosystem that continuously expanded the iPhone's feature set.

This approach led to multiple product life cycles and significantly enhanced the device's appeal to customers. Apple's strategy demonstrated a keen understanding of the evolving needs and preferences of mobile users, ultimately leading to the creation of an integrated and continually evolving user experience. This strategy not only set Apple apart from competitors like Nokia but also redefined consumer expectations and usage patterns in the smartphone market.

Apple's rapid climb from the foothold market to a dominant player in the main market can be attributed to a strategic approach centered on several key factors:

- Introducing New Innovations in Technology: Apple consistently introduced groundbreaking technological innovations. The company's focus on R&D led to the development of advanced and user-friendly devices, setting new standards in the industry.
- Unique Business Model: Apple's business model was distinctive and played a pivotal role in its success. This included controlling both hardware and software aspects of its products, ensuring a seamless user experience. The introduction of the App Store created a new revenue stream and a platform for third-party developers, fostering a robust ecosystem around Apple products.
- Creating New Customer Demand and Experience: Apple was expert at identifying and creating new customer needs. Through its product design and functionality, Apple not only met existing demands but also cultivated new ones, particularly emphasizing user experience and design stylish. The iPhone, for example, revolutionized the concept of a smartphone, transforming user expectations and experiences.

- The Network Effect: Apple leveraged the network effect to its advantage, particularly through its iOS ecosystem. As more users adopted Apple products, the value of being part of the Apple ecosystem increased, attracting even more users. This effect was further amplified by the App Store, which grew exponentially in terms of the number and variety of apps, drawing in more developers and users.

4.5.1. Applying the Framework

The initial step in applying the proposed framework to a case study involves selecting relevant contributing factors from the established database, as discussed in previous chapters. In a real-world scenario, this process would be led by an assessment team and a project leader, who would conduct brainstorming sessions to identify the most suitable contributing factors for both the Main and Foothold markets. In this case, the appropriate factors have been independently selected and weights assigned based on the specifics of the case study. It's important to note that not every disruptive innovation begins in a foothold market. Disruptions can also occur through insurgents that directly enter the main market, either as new entrants or as existing players who significantly change their business model, products, or services. In this case study, Apple acts as the insurgent. Apple initially entered the foothold market and then moved into the main market by launching the iPhone in June 2007.

For the purpose of this analysis, the framework has been applied with the hypothetical assumption that the data is from late 2007 or early 2008. This timing aligns with the period immediately following the introduction of the iPhone, a critical moment in the mobile phone industry that marked the beginning of significant market shifts. By applying the framework to this specific point in time, we aim to evaluate its effectiveness in identifying and understanding the disruptive impact that Apple had on the market and on established players like Nokia.

In assessing the foothold market for disruptive innovation, various contributing factors (criteria) are categorized based on their influence, either as low or high. Each factor is assigned a weight that reflects its relative importance or impact in the context of the market.

Table 3. Contributing factors (criteria) for foothold market categorized by its weight.

Weight	Contributing factor
1	Increased Market Entry by New Firms
1	Market Shift to Low-End Offerings: Companies are increasingly targeting the lower end of the market by providing alternative products/services that are more budget-friendly.
1	Market Shift to High-End Offerings: A trend where firms focus on the higher end of the market, offering advanced, premium products/services.
1	Challenges in Supplier and Channel Access: Difficulties in securing reliable suppliers and efficient distribution channels, crucial for market penetration.
1	Substantial Initial Investment Requirements
1	Market Entry Barriers (Patents, Licenses, etc.)
1	Simpler, More User-Friendly, Affordable, and Reliable Products
1	Products and Services with Lower Performance and Cost: Offering solutions that might have lower performance specifications but are more affordable, catering to a different market segment.
1	Complexity and Availability of Support Services: The degree of complexity in providing customer support and its availability, which can impact customer satisfaction and loyalty.

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Table 3. (continued)

Weight	Contributing factor
2	Distinctive Business Models: Adoption of business models that significantly diverge from the norm in the mobile industry.
2	Redundant Features in Products: Addressing the issue of excess functionalities in products that may not be necessary for all users.
2	User-Friendly Interface and Applications
2	Enhanced Value in Products and Services
2	Value Chain Improvements: Enhancements in the value chain, from production to customer delivery, to increase efficiency and reduce costs.
2	Changing Established Performance Metrics: Shift in the industry's benchmark performance attributes, reflecting evolving technological and market trends.
2	Creation of New Market Demands or Addressing Non-Consumers
2	Existence of Over-Satisfied or Under-Served Customers
2	Disruptor Products Unappreciated by Mainstream Segments
2	Strong Market Presence: Establishing a significant presence in the market, essential for brand recognition and trust-building in the mobile sector.

Adopting a similar methodology as used for the foothold market, the contributing factors for the main market were also categorized based on their influence levels. This approach ensures a consistent and comparative analysis across different market segments.

Table 4. Contributing factors (criteria) for main market categorized by its weight.

Weight	Contributing factor
1	Adherence to Established Standards: Compliance with industry standards and regulations, which is critical for gaining customer trust and market acceptance.
1	Limited Willingness to Pay for Quality Upgrades: A trend where customers are reluctant to pay extra for improved quality.
1	Long-Term Market Dominance as a Barrier to Disruption: The presence of established competitors who have dominated the market for an extended period, potentially stifling innovation.
1	Significant Market Share: The extent to which leading companies control a large portion of the market.
1	High Market Concentration: A market characterized by a few companies holding a large market share, leading to reduced competition.
1	Customer Loyalty: The strength of customer allegiance towards incumbent brands, which can be a significant barrier to new entrants.
1	Static Market Created by Incumbents: A scenario where the existing market leaders maintain the status quo, hindering innovation and disruption.
1	Increasing Number of Market Entrants: New firms entering the market, indicating a growing and potentially saturated market.

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Table 4. (continued)

Weight	Contributing factor
1	Strong Brand Presence: The impact of well-established brand names in the market, influencing customer choices and market dynamics.
2	Switching Costs: The financial and logistical challenges customers face when changing from one provider to another.
2	Need for New, Costly Infrastructure: The requirement for substantial investment in new infrastructure to stay competitive in the market.
2	Over-Satisfaction of Some Customers: Some segments of the market being excessively served, leading to a lack of demand for new offerings.
2	Market Shifts to Lower-End Offerings: Companies targeting the lower end of the market with more affordable products/services.
2	Market Shifts to Higher-End Offerings: A trend towards premium, high-end solutions.
2	Value Chain Improvements: Enhancements in production, delivery, and customer service processes that increase efficiency and reduce costs.
2	Protective Patents and Licenses
2	Challenges in Accessing Suppliers and Distribution Channels: Difficulties faced by new entrants in establishing a reliable supply chain and distribution network.
2	High Initial Investment Requirements
2	High Barriers to Market Entry: Regulatory and market-based hurdles that new entrants must overcome to compete.
2	Presence of Low-End Market Offers: Availability of basic, more affordable solutions catering to a different market segment.
2	Previously Unprofitable Low-End Markets: Market segments that were once not lucrative but may now present new opportunities.
2	Radical Sustaining Innovation: Significant improvements within existing products and services that do not disrupt the market but enhance the current offerings.
2	Mismatch of Products to New Entrants' Offerings: A gap in the market where incumbent products do not align with the innovative offerings of new entrants.
2	Simpler, User-Friendly, and Economical Products: Focus on developing products that are straightforward, easy to use, cost-effective, and reliable.
2	Distinctive Business Models: Adoption of innovative business models that differ significantly from the traditional approaches in the industry.
2	Flexibility to Modify Business Models: The ability of existing companies to adapt and change their business models in response to new market entrants or shifts.
2	Lower Performance yet Cost-Effective Products and Services: Offering solutions that might have lower performance but are more affordable, appealing to a different market segment.
2	Evolution of Established Performance Metrics: Shift in industry benchmark performance attributes, reflecting changing technology and market trends.
2	Experience with Software Platforms: The extent of expertise and familiarity companies have with developing and managing software platforms in the mobile domain.
2	Redundant Features in Products: Addressing the issue of excess functionalities in products that may not be necessary for all users.

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Table 4. (continued)

Weight	Contributing factor
2	User-Friendly Interface and Applications
2	Complexity and Availability of Support Services: The degree of complexity in providing customer support and its availability, which can impact customer satisfaction and loyalty.
2	Creation of New Market Demands or Addressing Non-Consumers: Products or services that either create new demands/needs or cater to previously unaddressed segments of the market.
2	Existence of Over-Satisfied Customers: Identifying customer segments that are too well-served (over-satisfied) by existing solutions.
2	Existence of Under-Served Customers: Identifying customer segments that are not adequately served (under-served) by existing solutions.
2	Lack of Product/Service Alignment with Newcomers' Offering
2	Necessity for Incumbents to Discontinue Popular Products: Incumbent firms may face the tough decision to phase out well-received products in favor of more innovative or market-relevant solutions, to stay competitive or adapt to changing market demands.
2	Strategic Partnerships with Established Market Leaders: Forming alliances with credible, well-established incumbents can provide new entrants or smaller firms with critical market insights, technological support, and enhanced credibility, essential for growing in the main market and thriving in the competitive mobile market.

The evaluation process involves selecting key factors, assigning weights and scores ranging from -2 (disabling) to +2 (enabling), to quantify their impact on market disruption. The evaluation should be conducted with the involvement of a diverse group of experts to capture a comprehensive view of market dynamics and ensure a balanced assessment. This collaborative effort is essential for achieving a robust and nuanced analysis.

The weights assigned to each factor signify their level of influence, with '1' for low influence and '2' for high influence. The scores are derived by multiplying each factor's rating by its assigned weight, and the overall stage score is calculated as the mean of these weighted scores. This stage score is then normalized to a -2 to +2 scale by dividing it by the average weight, ensuring comparability across different evaluations.

In Tables 5 and 6, we will go through the detailed calculations for both the foothold market and the main market. These tables will illustrate how the framework can be utilized for evaluation, providing a structured approach to understanding the potential for market disruption.

Timing is a crucial aspect of this evaluation process. Determining the immediacy of potential disruptions helps in prioritizing strategic responses. Factors that indicate imminent disruption require more immediate action, while those indicating long-term potential allow for more gradual strategic planning.

Table 5. Foothold Market Entry (smart-phone market).

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
Insurgent has the same Business model					X	Insurgent has significantly different Business model	2	2	4	Business Model: Apple's introduction of a unique ecosystem, contrasting with the existing business models in the smartphone market, was a significant enabler, scoring the maximum (+4).
Insurgent products has less functionality					X	Insurgent products has more functionality	2	2	4	Product Functionality: Apple's products offered more functionality, making them a strong force for disruption, also scoring a maximum (+4).
Insurgent products are harder to use in terms of user experience					X	Insurgent products are more user friendly and easier to use	2	2	4	User Experience: The user-friendly and easy-to-use nature of Apple's products, particularly the iPhone, contributed positively to its market entry (+4).

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Table 5. (continued)

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
It is difficult to access suppliers and channels	X					It is quite easy to access suppliers and channels	-2	1	-2	Access to Suppliers and Channels: This was a challenge, as indicated by a negative score (-2), reflecting difficulties in establishing supply chain and distribution networks.
Market has no interest in high-end products and not interested in different offers					X	Market has huge interest in high-end products and interested in different offers	2	1	2	Market Interest in High-End Products: Apple's focus on high-end products and its ability to offer different products were positively received in the market (+2).
There are not many companies trying to find their ways in foothold market					X	There are many companies trying to find their ways in foothold market	2	1	2	Number of Companies in Foothold Market: The presence of many companies trying to enter the smartphone market also worked in Apple's favor (+2).
There are no non-satisfied customer exist and all users needs are met in the market				X		There are many non-satisfied customer exist which their needs not discovered or not satisfied	1	2	2	Non-Satisfied Customers: The existence of many non-satisfied customers in the market, whose needs were either undiscovered or unsatisfied, was an opportunity for Apple (+2).

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Table 5. (continued)

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
Insurgent has no presence in the foothold market so far					X	Insurgent has already established a strong presence in the foothold market	2	2	4	Market Presence of Insurgent: Apple's established presence in the music industry with the iPod contributed positively to its foothold in the smartphone market (+4).
Insurgent has no improvement in value chain				X		Insurgent already improved the value chain by delivering some products	1	2	2	Improvement in Value Chain: Apple's improvement in the value chain by delivering innovative products contributed positively (+2).
Insurgent products and services do not create any new demands and needs				X		Insurgent managed to offer some products which are addressing even non-consumer and create totally new demand	1	2	2	Creation of New Demand: Apple's products addressed non-consumers and created new demand, which was a significant enabler (+2).

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Table 5. (continued)

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
Insurgent are not facing any entry barriers to the market such as patent and license					X	Insurgent is facing many barriers for market entry as Nokia use a unique mobile operating system and use lots of patent and license	2	2	4	Market Entry Barriers: Apple faced significant entry barriers, including Nokia's unique operating system and patents, which necessitated innovative approaches from Apple (+4).
				Average	1.45	Average Weight: 1.54			Average Score: 2.50	
Overall Average: 1.65										

- The average weight of 1.54 and average score of 1.65 indicate that the majority of the factors had a high influence and were enabling for Apple's market entry.
- The analysis suggests that Apple faced relatively few disabling factors in the foothold market, with the primary challenge being access to suppliers and channels. This factor received a negative score, indicating it as a potential barrier to Apple's market entry.
- However, Apple effectively addressed this challenge over the years. As [121] noted, Apple tackled the issue by partnering with overseas manufacturing specialists. This strategic move allowed Apple to navigate the complexities of manufacturing operations while benefiting both the company and its suppliers.
  - The suppliers gained from the increased business brought on by their association with Apple, and Apple, in turn, was relieved of the burdens of managing labor-intensive manufacturing processes.
  - This approach by Apple highlights the importance of strategic partnerships and outsourcing in overcoming market entry barriers. By leveraging the strengths of its manufacturing partners, Apple was able to focus on its core competencies - innovation in product design, software development, and creating a compelling user experience.
- The rest of the factors analyzed predominantly favored Apple's market entry, with high scores indicating their enabling influence. Apple's different business model, enhanced product functionality, user-friendly design, and ability to create new demand were particularly significant in establishing its foothold in the market.
- Apple's strategy of appealing to non-satisfied customers, improving its value chain, and navigating the initial challenges of market entry barriers played a crucial role in its successful disruption of the smartphone market.

- The average weight and score in the analysis reflect Apple's overall effective approach in entering and disrupting the smartphone market. Despite the initial challenges in accessing suppliers and channels, Apple's strengths in other areas, such as innovation and understanding customer needs, more than compensated for these challenges.

Table 6. Main Market Entry (smart-phone market).

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
There is huge willingness to pay for sustaining innovation by increasing the quality of the products					X	There is less willingness to pay only for increasing the quality of current product	2	1	2	Willingness to Pay for Innovation: Apple focused on radical innovation rather than just improving current products, aligning with market trends towards transformative changes (+2).
Partnership between insurgent and other major incumbent is very unlikely					X	Partnership between insurgent and other major incumbent quite likely	2	2	4	Partnerships: Apple's likelihood of forming partnerships with incumbents and other major players was high, aiding in its market penetration (+4).
Apple has no brand presence in the covering market and is unknown brand to the market					X	Apple has already a strong brand presence in the covering market	2	1	2	Brand Presence: Apple already had a strong brand presence in the market, which facilitated its entry (+2).

Continued on next page

Table 6. (continued)

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
Apple has limited access to channels, suppliers and distributors in the market					X	Apple already established a strong access to channels, suppliers and distributors in the market	2	2	4	Access to Channels and Distributors: Apple established strong access to channels, suppliers, and distributors, which was crucial for its market success (+4).
Incumbent is not dominating the market for a long time					X	Incumbents dominating the market for a long time and usually focusing on sustaining innovation	2	1	2	Market Dominance by Incumbents: Nokia's long-term market dominance and focus on sustaining innovation were seen as enabling factors for disruption, as it may lead to complacency (+2).
Insurgent has complicated product which is hard to use and not reliable					X	Insurgent offers more simpler, more convenient, and more reliable products	2	2	4	Product Usability and Reliability: Apple's products were simpler, more convenient, and more reliable, appealing to a broader customer base (+4).
Insurgent has the same Business model					X	Insurgent is using totally different Business model	2	2	4	Business Model Innovation: Apple's different business model was a key enabler for its market entry (+4).

Continued on next page

Table 6. (continued)

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
Insurgent has limited software and mobile OS experience					X	Insurgent has extensive software experience	2	2	4	Software Experience: Apple's extensive software and mobile OS experience was a significant advantage (+4).
There is huge switching cost for customers by using the insurgent's products					X	There is no switching cost for customers by using the insurgent's products	2	2	4	Switching Costs: The low switching cost for customers to Apple's products was a strong enabling factor (+4).
Incumbent (Nokia) do not have high market concentration and are not creating a static market					X	Incumbent (Nokia) has high market concentration and creating a static market	2	2	4	Market Concentration: Nokia's high market concentration and tendency to create a static market were seen as enabling disruption (+4).
Incumbent (Nokia) has many products matching the Apple offering				X		Incumbent (Nokia) lacks any products matching the the Apple offering	1	2	2	Matching Products: Nokia lacked products that matched Apple's offerings (+2).

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Table 6. (continued)

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
Incumbent (Nokia) has the ability to change the Business model and strike back on insurgent		X				Incumbent (Nokia) do not have enough resources and knowledge to change the Business model and retaliate	-1	2	-2	Ability to Retaliate: Nokia had resources to change its business model but failed to do so in a timely and radical manner (-2).
Insurgent needs a new costly infrastructure				X		Insurgent does not need a new costly infrastructure	1	2	2	Need for New Infrastructure: Apple did not require costly new infrastructure to enter the market (+2).
Incumbent created very well loyal customer		X				Incumbent does not have very loyal customers in the market	-1	1	-1	Customer Loyalty: Nokia' had some loyal customers in the market which was considered a disabling factor for Apple (-1).
Average					1.45	Average Weight: 1.71			Average Score: 2.50	
Overall Average: 1.46										

Overall Scores and Implications:

- **Average Weight:** 1.71, indicating that the selected factors were considered quite significant in influencing market disruption.
- **Average Score:** 2.5, suggesting that the majority of these factors were enabling for Apple's disruptive entry into the smartphone market.
- **Total Average:** 1.46, reflecting a generally favorable environment for Apple's disruptive market entry.

The results indicate that Apple, as an emerging player, had a high chance of disrupting Nokia, the established market leader. Apple's strike into the music industry with iTunes effectively established a foothold from which it expanded into the smartphone market, offering a device with diverse functionalities. This initial success in the music industry was particularly advantageous given the smartphone market's variety of customer needs and its rapid evolution with new offerings. A significant factor in Apple's triumph was its distinctive operating system and the development of a unique ecosystem. The score of 1.46 for the foothold market underscores that Nokia, despite its established position, was slow to respond to Apple's strategic advancements in this area. This delay in reaction allowed Apple to solidify its position and set the stage for its disruptive entry into the smartphone market.

Overall Interpretation for Main and Foothold Smartphone Markets

Foothold Market Entry:

- **Leveraging the Music Industry:** Apple effectively used its success in the music industry, particularly with iTunes, as a stepping stone into the smartphone market. This strategy provided valuable market insight and customer base expansion.
- **Meeting Diverse Needs:** The smartphone industry's varied customer requirements and the quick pace of innovation aligned well with Apple's strengths, allowing it to meet a wide range of consumer needs.
- **Unique Operating System and Ecosystem:** Apple's success in the foothold market was significantly driven by its unique operating system and the development of a special ecosystem, which resonated well with consumers.
- **Nokia's Delayed Reaction:** Nokia's slow response to Apple's strategic moves in the foothold market, as indicated by the score of 1.65, suggests a missed opportunity to counter Apple's growing influence.

Main Market Entry:

- **Probability of Disruption:** The analysis reveals that Apple was highly likely to disrupt Nokia's established dominance in the smartphone market. This was primarily due to Apple's innovative strategies and its distinct approach to technology and market engagement.
- **Innovative Versus Incremental:** Contrary to Nokia's incremental innovation approach, Apple introduced radical changes, particularly with its unique operating system and a holistic ecosystem encompassing hardware, software, and services.
- **Nokia's Market Dominance and Complacency:** Nokia's longstanding dominance led to a degree of market complacency. This, coupled with its slower response to emerging market trends, created an opportunity for Apple to introduce disruptive innovations.
- **Market Concentration:** Nokia's high market concentration, perceived as creating a static market environment, further facilitated Apple's entry as a disruptor.

In summary, Apple's disruption of both the main and foothold smartphone markets illustrates the impact of innovative business models, a deep understanding of customer needs, and the importance of agility in responding to market changes. Apple's approach challenged existing market norms and set new standards in technology and user experience, while Nokia's slower response contributed to its diminished position in the face of Apple's ascent.

4.6. Applying the Prediction Framework - Current Case-Study

The Cloud-Native Application Protection Platforms (CNAPP) market, central to cloud data and application security, includes leading firms like Wiz, Tenable, Trend Micro, Lacework, and Crowstrike [122]. This study examines Silicon Valley startup Mondoo's role within this competitive landscape, particularly its potential to disrupt Lacework's market position. The main author, associated with Mondoo as Cyber Security Engineer, leverage a framework to evaluate Mondoo's innovative impact in the CNAPP sector, focusing on its strategies to challenge established entities like Lacework.

Lacework is established in cloud security with its automated defenses, whereas Mondoo introduces innovative, developer-centric CNAPP solutions. However, Mondoo needs to match Lacework's prowess in behavioral analytics and automated remediation. The effectiveness of Lacework's AI and machine learning in behavioral analytics remains to be fully validated.

To effectively compare Mondoo and Lacework, both recognized for their continuous innovation and technical advancements, it's essential to focus on key areas aligned with our framework, such as Business Model Innovation, Customer Demand and Experience, and Network Effects.

Lacework uses a subscription-based model, aligning with growing consumer preference for such services, while Mondoo opts for a consumption-based model, emphasizing cost alignment with use, showcasing diverse strategies to capture market interest. Mondoo's pivot to an open-source approach addresses specific market demands for transparency and collaboration in security, contrasting with Lacework's AI-driven, automated solutions that cater to a broader industry shift towards integrated security ecosystems. Lacework benefits from strong partnerships enhancing its ecosystem, whereas Mondoo relies on community-driven knowledge and collaborative problem-solving, reflecting different strategies to leverage network effects.

4.6.1. Applying the Framework

Utilizing the proposed framework, contributing factors are identified and evaluated for both companies in the CNAPP market. Each factor is rated and weighted, offering a structured analysis to ascertain Mondoo's disruptive potential against Lacework.

When analyzing contributing factors in the foothold market for the cybersecurity sector, it's essential to consider industry-specific elements. These factors, adapted to the cybersecurity industry, provide a comprehensive view of the dynamics at play in the foothold market, highlighting the various strategic considerations for companies aiming to establish or expand their market presence.

The following table lists the contributing factors for the foothold market, categorized by their weight, to reflect their significance in the cybersecurity and cloud business contexts. These factors help in understanding the strategic landscape and potential for disruption in this specific market segment.

Table 7. Contributing factors (criteria) for foothold market categorized by its weight.

Weight	Contributing factor
1	Increased Market Entry by New Firms: Reflects the competitive pressure and innovation driven by new entrants in the cybersecurity and cloud markets.
1	Market Shift to Low-End Offerings: Companies are increasingly targeting the lower end of the market by providing alternative products/services that are more budget-friendly.
1	Market Shift to High-End Offerings: A trend where firms focus on the higher end of the market, offering advanced, premium products/services.
1	Challenges in Supplier and Channel Access: Difficulties in securing reliable suppliers and efficient distribution channels, crucial for market penetration in cybersecurity and cloud services.
1	Substantial Initial Investment Requirements: High initial costs that can be a barrier to entry but necessary for establishing a foothold in the market.
1	Market Entry Barriers (Patents, Licenses, etc.): Legal and regulatory barriers that can impede new entrants.
1	Simpler, More User-Friendly, Affordable, and Reliable Products: The need for cybersecurity solutions that are easy to use and reliable.
1	Products and Services with Lower Performance and Cost: Offering solutions that might have lower performance specifications but are more affordable, catering to a different market segment.
1	Complexity and Availability of Support Services: The degree of complexity in providing customer support and its availability, which can impact customer satisfaction and loyalty.
2	Distinctive Business Models: Adoption of business models that significantly diverge from the norm in the cybersecurity industry, potentially leading to market disruption.
2	Redundant Features in Products: Addressing the issue of excess functionalities in products that may not be necessary for all users, focusing on streamlined, efficient solutions.
2	User-Friendly Interface and Applications: Importance of intuitive interfaces in cybersecurity tools to enhance user adoption and satisfaction.
2	Enhanced Value in Products and Services: Delivering high-value cybersecurity solutions that address critical needs effectively.
2	Value Chain Improvements: Enhancements in the value chain, from production to customer delivery, to increase efficiency and reduce costs.
2	Changing Established Performance Metrics: Shift in the industry's benchmark performance attributes, reflecting evolving technological and market trends.
2	Creation of New Market Demands or Addressing Non-Consumers: Innovations that create new demand or cater to previously underserved market segments.
2	Existence of Over-Satisfied or Under-Served Customers: Identifying market gaps where customers' needs are either overly met or not sufficiently addressed.
2	Disruptor Products Unappreciated by Mainstream Segments: Innovations that may not initially be valued by the mainstream but have potential for significant impact.
2	Strong Market Presence: Establishing a significant presence in the market, essential for brand recognition and trust-building in the cybersecurity sector.

A similar approach was chosen for the categorization of contributing factors for the main market. Enhancing and refining the list of contributing factors for the main market in the Cybersecurity area involves a deeper understanding of market dynamics, consumer behavior, and technological trends.

Table 8. Contributing factors (criteria) for main market categorized by its weight.

Weight	Contributing factor
1	Adherence to Established Standards: Compliance with industry standards and regulations, which is critical for gaining customer trust and market acceptance.
1	Limited Willingness to Pay for Quality Upgrades: A trend where customers are reluctant to pay extra for improved quality in cybersecurity solutions.
1	Long-Term Market Dominance as a Barrier to Disruption: The presence of established competitors who have dominated the market for an extended period, potentially stifling innovation.
1	Significant Market Share: The extent to which leading companies control a large portion of the market.
1	High Market Concentration: A market characterized by a few companies holding a large market share, leading to reduced competition.
1	Customer Loyalty: The strength of customer allegiance towards incumbent brands, which can be a significant barrier to new entrants.
1	Static Market Created by Incumbents: A scenario where the existing market leaders maintain the status quo, hindering innovation and disruption.
1	Increasing Number of Market Entrants: New firms entering the market, indicating a growing and potentially saturated market.
1	Strong Brand Presence: The impact of well-established brand names in the market, influencing customer choices and market dynamics.
2	Switching Costs: The financial and logistical challenges customers face when changing from one cybersecurity provider to another.
2	Need for New, Costly Infrastructure: The requirement for substantial investment in new infrastructure to stay competitive in the market.
2	Over-Satisfaction of Some Customers: Some segments of the market being excessively served, leading to a lack of demand for new offerings.
2	Market Shifts to Lower-End Offerings: Companies targeting the lower end of the market with more affordable products/services.
2	Market Shifts to Higher-End Offerings: A trend towards premium, high-end cybersecurity solutions.
2	Value Chain Improvements: Enhancements in production, delivery, and customer service processes that increase efficiency and reduce costs.
2	Protective Patents and Licenses
2	Challenges in Accessing Suppliers and Distribution Channels: Difficulties faced by new entrants in establishing a reliable supply chain and distribution network.
2	High Initial Investment Requirements
2	High Barriers to Market Entry: Regulatory and market-based hurdles that new entrants must overcome to compete.

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Table 8. (continued)

Weight	Contributing factor
2	Presence of Low-End Market Offers: Availability of basic, more affordable cybersecurity solutions catering to a different market segment.
2	Previously Unprofitable Low-End Markets: Market segments that were once not lucrative but may now present new opportunities.
2	Radical Sustaining Innovation: Significant improvements within existing products and services that do not disrupt the market but enhance the current offerings.
2	Mismatch of Products to New Entrants' Offerings: A gap in the market where incumbent products do not align with the innovative offerings of new entrants.
2	Simpler, User-Friendly, and Economical Products: Focus on developing products that are straightforward, easy to use, cost-effective, and reliable.
2	Distinctive Business Models: Adoption of innovative business models that differ significantly from the traditional approaches in the industry.
2	Flexibility to Modify Business Models: The ability of existing companies to adapt and change their business models in response to new market entrants or shifts.
2	Lower Performance yet Cost-Effective Products and Services: Offering solutions that might have lower performance but are more affordable, appealing to a different market segment.
2	Evolution of Established Performance Metrics: Shift in industry benchmark performance attributes, reflecting changing technology and market trends.
2	Experience with Software Platforms: The extent of expertise and familiarity companies have with developing and managing software platforms in the cybersecurity domain.
2	Redundant Features in Products: Addressing the issue of excess functionalities in products that may not be necessary for all users.
2	User-Friendly Interface and Applications
2	Complexity and Availability of Support Services: The degree of complexity in providing customer support and its availability, which can impact customer satisfaction and loyalty.
2	Creation of New Market Demands or Addressing Non-Consumers: Products or services that either create new demands/needs or cater to previously unaddressed segments of the market.
2	Existence of Over-Satisfied Customers: Identifying customer segments that are too well-served (over-satisfied) by existing solutions.
2	Existence of Under-Served Customers: Identifying customer segments that are not adequately served (under-served) by existing solutions.
2	Lack of Product/Service Alignment with Newcomers' Offering
2	Necessity for Incumbents to Discontinue Popular Products: Incumbent firms may face the tough decision to phase out well-received products in favor of more innovative or market-relevant solutions, to stay competitive or adapt to changing market demands.
2	Strategic Partnerships with Established Market Leaders: Forming alliances with credible, well-established incumbents can provide new entrants or smaller firms with critical market insights, technological support, and enhanced credibility, essential for growing in the main market and thriving in the competitive cybersecurity market.

The evaluation process involves selecting key factors, assigning weights and scores ranging from -2 (disabling) to +2 (enabling), to quantify their impact on market disruption. Timing is crucial to determine

the immediacy of potential disruptions. Ideally, this scoring should be a collaborative effort with input from a diverse group of experts to capture a comprehensive view of market dynamics and ensure a balanced assessment reflective of various expert opinions.

Table 9. Foothold Market Entry (CNAPP market).

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
Insurgent products have less functionality		X				Insurgent products have more functionality	-1	2	-2	Functionality (Score: -2): Mondoo needs to enhance product functionality, particularly in areas like automatic remediation and AI integration.
Insurgent products are harder to use in terms of user experience			X			Insurgent products are more user friendly and easier to use	0	2	0	User Experience (Score: 0): The product's user-friendliness is neutral, neither a strong enabler nor disabler.
It is difficult to access suppliers and channels			X			It is quite easy to access suppliers and channels	0	1	0	Access to Suppliers and Channels (Score: 0): Access is currently not a significant issue, but neither is it a strong enabling factor.
Market has no interest in high-end products and not interested in different offers					X	Market has huge interest in high-end products and interested in different offers	2	1	2	Market Interest in High-End Products (Score: 2): The market shows significant interest in high-end products and offerings.

Continued on next page

Table 9. (continued)

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
There are not many companies trying to find their ways in foothold market					X	There are many companies trying to find their ways in foothold market	2	1	2	Market Entry (Score: 2): There is active interest and participation by various companies, suggesting a dynamic and potentially disruptive environment.
There are no non-satisfied customer exist and all users needs are met in the market				X		There are many non-satisfied customer exist which their needs not discovered or not satisfied	1	2	2	Unmet Customer Needs (Score: 2): Existence of many non-satisfied customers indicates opportunities for disruption.
Insurgent has no presence in the foothold market so far					X	Insurgent has already established a strong presence in the foothold market	2	2	4	Market Presence (Score: 4): Mondoo has established a strong foothold market presence.
Insurgent has no improvement in value chain			X			Insurgent already improved the value chain by delivering some products	0	2	0	Value Chain Improvement (Score: 0): Neutral impact, suggesting room for improvement.

Continued on next page

Table 9. (continued)

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
Insurgent products and services do not create any new demands and needs			X			Insurgent managed to offer some products which are addressing even non-consumer and create totally new demand	0	2	0	Creation of New Demand (Score: 0): Mondoo is not significantly creating new demands or addressing non-consumers.
Insurgent are not facing any entry barriers to the market such as patent and license				X		Insurgent is facing many barriers for market entry as Lacework uses patent and license	1	2	2	Market Entry Barriers (Score: 2): Facing barriers like patents and licenses used by competitors like Lacework, which could necessitate innovative approaches for successful market entry.
Average					0.63	Average Weight: 1.54			Average Score: 1.09	
Overall Average: 0.7										

Mondoo has a strong foothold in the market, which is a significant enabling factor for its potential disruption, particularly against competitors like Lacework. While Mondoo's current disruptive potential scores at 0.70, indicating moderate likelihood, focusing on underdeveloped areas like AI integration and new market demands could enhance its disruptive capacity. To maximize its impact, Mondoo should deepen its market presence and innovate to meet emerging customer needs, thus strengthening its position and expanding into broader markets.

Table 10. Main Market Entry (CNAPP market).

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
There is huge willingness to pay for sustaining innovation by increasing the quality of the products	X					There is less willingness to pay only for increasing the quality of current product	-2	1	-2	Willingness to Pay for Innovation (Score: -2): The market still shows a significant willingness to pay for sustaining innovations from incumbents like Lacework, indicating a challenge for Mondoo to disrupt based solely on innovation.
Partnership between insurgent and other major incumbent is very unlikely				X		Partnership between insurgent and other major incumbent quite likely	1	2	2	Partnerships (Score: 2): Mondoo has established partnerships, similar to Lacework, which can aid its market entry.
Mondoo has no brand presence in the covering market and is unknown brand to the market				X		Mondoo has already a strong brand presence in the covering market	1	1	1	Brand Presence (Score: 1): Mondoo has some brand presence in the market but needs to strengthen it further.
Mondoo has limited access to channels, suppliers and distributors in the market				X		Mondoo already established a strong access to channels, suppliers and distributors in the market	1	2	2	Access to Channels (Score: 2): Mondoo has established access to channels, suppliers, and distributors, aiding its market entry.

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Table 10. (continued)

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
Incumbent is not dominating the market for a long time			X			Incumbents dominating the market for a long time and usually focusing on sustaining innovation	0	1	0	Market Dominance (Score: 0): Lacework's long-term market dominance is seen as neither an enabling nor a disabling factor for Mondoo.
Insurgent has complicated product which is hard to use and not reliable			X			Insurgent offers more simpler, more convenient, and more reliable products	0	2	0	Mondoo's user-friendly products level the field with Lacework.
Insurgent has the same Business model				X		Insurgent is using totally different Business model	1	2	2	Mondoo's different business model provides competitive edge.
Insurgent has limited software experience				X		Insurgent has extensive software experience	1	2	2	Mondoo's software experience enhances its market position.
There is huge switching cost for customers by using the insurgent's products					X	There is no switching cost for customers by using the insurgent's products	2	2	4	No significant switching costs facilitate Mondoo's adoption.

Continued on next page

Table 10. (continued)

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
Incumbent (Lacework) do not have high market concentration and are not creating a static market			X			Incumbent (Lacework) has high market concentration and creating a static market	0	2	0	Market Concentration (Score: 0): Lacework's market concentration does not significantly enable or disable Mondoo's market entry.
Incumbent (Lacework) has many products matching the Mondoo offering		X				Incumbent (Lacework) lacks any products matching the Mondoo offering	-1	2	-2	Product Match (Score: -2): Lacework has some products matching Mondoo's offerings, which is disabling factor for Mondoo.
Incumbent (Lacework) has the ability to change the Business model and strike back on insurgent	X					Incumbent (Lacework) do not have enough resources and knowledge to change the Business model and retaliate	-2	2	-4	Ability to Retaliate (Score: -4): Lacework has the resources to change their business model and respond to Mondoo, presenting a significant challenge.
Insurgent needs a new costly infrastructure		X				Insurgent does not need a new costly infrastructure	-1	2	-2	Costly infrastructure slightly hinders Mondoo.
Incumbent created very well loyal customer			X			Incumbent does not have very loyal customers in the market	0	1	0	Lacework's loyal customer base does not deter Mondoo's entry.

Continued on next page

Table 10. (continued)

Forces disabling disruption	-2	-1	0	+1	+2	**Forces enabling disruption**	**Rating**	**Weight**	**Score**	**Comments**
Average					0.07	Average Weight: 1.78			Average Score: 0.21	
Overall Average: 0.11										

Mondoo's moderate main market score highlights both opportunities and challenges in CNAPP. Its strengths, including willingness to innovate, strong partnerships, and robust brand presence, are promising for disruption. However, barriers to market entry must be addressed. Mondoo's focus should be on overcoming these barriers and enhancing its innovation integration to increase its disruption potential.

5. Conclusion

Our study introduces an innovative framework to assess disruption in the IT industry, combining scoring and situational models for comprehensive market analysis. The framework, validated through historical and current case studies, identifies key factors enabling and inhibiting disruption. Specifically, the historical case study examines Apple's disruption of Nokia in the smartphone market, highlighting the significance of business model innovation and user experience. The contemporary case study on Mondoo and Lacework in the CNAPP market illustrates the framework's application in assessing current competitive dynamics and strategic responses.

Our research explores disruptive innovation in the IT industry, focusing on evaluating a company's potential to disrupt or be disrupted. We reviewed existing literature and frameworks, identifying criteria such as business model innovation, customer demand, network effects, technological advancements, and market dynamics. This led to the development of a situational model and scoring framework for identifying disruptive innovation, supported by a comprehensive database of contributing factors.

We refined our framework through expert interviews and applied it to case studies, including a detailed comparison of Mondoo versus Lacework. Our findings highlight the multifaceted nature of disruption and the need for continuous strategic analysis and adaptability. As the IT sector evolves, so must the methodologies to identify and lead disruptions, ensuring businesses can maintain competitive advantages.

For practical implementation, the framework provides IT professionals with actionable insights to navigate market dynamics and respond to emerging threats and opportunities effectively. By applying the framework to both historical and current case studies, we demonstrate its utility in both retrospective analysis and real-time market evaluation, offering strategic insights for IT professionals, strategists, and policymakers to effectively navigate and leverage disruption opportunities. The practical applications of this framework extend beyond academic discussion, providing actionable guidance for identifying and addressing potential disruptions in the IT landscape.

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