4 Congrés d'Economia i Empresa de Catalunya 2025
Cap a una economia més digital i sostenible

EIX6 | El sistema de ciència i innovació i el repte de la transformació digital

Col·legi d'Economistes de Catalunya
Al servei dels professionals de l'economia i de l'empresa

Characterizing technologic disruption: a business-oriented analytical model

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ABSTRACT

Technological disruption, a significant alteration in competitive industry standards, impacts all stakeholders within the value chain, redefining business models, collaborative and competitive relationships, value propositions, and prevailing product/service standards. Historically technological at its core, disruption arises either from the adoption of emerging technologies or the innovation on existing ones. Given the accelerated pace and increased frequency of technological disruption in recent decades, understanding its dynamics is crucial, yet challenging due to the shortening of disruptive cycles and the complex recombination of technologies.

Despite numerous analyses from various perspectives, particularly technological, a holistic conceptual model interpreting this phenomenon from a competitive strategy standpoint is lacking. This paper aims to bridge this gap by proposing a theoretical analytical framework that enables researchers, managers, and analysts to characterize and anticipate technological disruptions in competitive environments.

The genesis of disruptive processes usually involves a technological component that manifests in two primary forms: cost impact, where the cost-performance ratio of emerging technologies massively alters key competitive processes, leading to business model obsolescence; and revenue impact, where the application of new technologies generates new markets, reshaping industry size and connections with adjacent sectors.

This study introduces the concept of a "competitive paradigm" of an industry, referring to the prevailing competition rules within a certain timeframe from a multidimensional perspective. A disruption signifies a break from these rules, and therefore, from the competitive paradigm itself. The framework outlined in this paper focuses on four competitive dimensions crucial for characterizing potential disruptions: dominant business model characteristics, customer behavior in relation to the prevailing value proposition, the industry's value chain configuration, and the distribution of generated profits among stakeholders.

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For instance, the shift towards digital platforms in the music industry and the rise of electric vehicles are clear examples of how new business models can redefine competitive landscapes. These models often emerge from non-traditional industry participants and drastically alter the competitive dynamics, making anticipation of such changes more complex yet vital for sustaining competitive advantage.

The analytical model provided herein sets the groundwork for identifying industry disruptions based on changes induced by new technological competitive models. It offers specific criteria for analysis across the described dimensions, thus facilitating the anticipation of disruptive shifts.

This paper contributes to the literature by detailing a structured approach to understanding and predicting technological disruptions, reinforcing the strategic implications of such shifts and providing a robust tool for both academic research and practical application in business strategy development.

Key words: Technological Disruption, Competitive Strategy, Types and structure of digital, Transformation Processes.

1. Introduction

Disruption within an industry is characterized by a substantial shift in its competitive standards (Christensen, 2016). By definition, this process exerts a broad and profound impact on all stakeholders across the value chain and key competitive dimensions—such as business models, relationships between collaborators and competitors, value propositions, and prevailing product or service standards. In most cases, competitive disruption originates from technological advancements, whether through the adoption of emerging technologies or the innovation of existing solutions. This intrinsic connection between disruption and technology compels industry participants to closely monitor the evolution of potentially disruptive technologies. It also underscores the need for these stakeholders to anticipate both the direction and scale of impending changes.

While technological disruption is not unique to the 21st century, its pace has accelerated significantly in recent decades. The rapid shortening of disruptive cycles has been well-documented and is often linked to the recombination of technologies that exhibit exponential growth patterns (Bughin & Van Zeebroeck, 2020). These trends result in more frequent, and sometimes abrupt, impacts on industry standards, increasing the difficulty of forecasting disruptive changes and reducing the strategic flexibility of industry participants.

Although competitive disruption has been analyzed from various angles—primarily technological—there remains a gap in the literature regarding a comprehensive, strategic model for interpreting these shifts. This paper aims to strengthen the theoretical understanding of technology-driven industry disruption by proposing an analytical framework that enables researchers, managers, and analysts to characterize and anticipate such transformative processes in competitive environments.

1.1 Theoretical context: the disruption of the competitive paradigm

At the core of most disruptive processes lies a technological element (Gans, 2016), which typically manifests in two distinct ways:

1. Cost Impact: The cost-performance ratio of an emerging technology—or a related

set of technologies—can fundamentally alter the key operational processes of competing firms. This shift often results in the obsolescence of existing business models, as it necessitates a redefinition of cost structures and competitive dynamics.

2. Revenue Impact: The application of new technologies, often through the introduction of innovative products or services, can create entirely new markets. This expansion incorporates new customer segments and value propositions, leading to a significant reconfiguration of market size and establishing new links with adjacent industries (e.g., the interplay between travel, hospitality, and electric vehicles).

However, it is essential to note that not all technologies or innovations have disruptive potential. Many innovations take an incremental approach, focusing on optimizing the current competitive model rather than revolutionizing the existing customer-product or service dynamic.

Incremental innovation	Disruptive innovation	
Objectives	Improved operating margin (increased revenues, reduced costs). Efficiency	New competition rules in the industry. Growth
Effects	Generates short-range competitive advantages, quickly adopted by the rest of the competitors. It does not require a change in the business model that drives and exploits innovation.	Competitive disruption leads to a fundamental break with the prevailing competitive paradigm, necessitating significant changes to existing business models to foster and capitalize on innovation. This shift often results in the emergence and consolidation of new market segments, characterized by a recalibration of the price-to-performance ratio. Such disruptions typically drive the introduction of both advanced, higher-performance products or services, as well as simplified offerings with reduced performance, targeting different customer needs and price sensitivities.
Examples	Hybrid engines in conventional cars	Autonomous, electric, connected cars.
Technology	Evolution of a previous technology	New, or applied in a way that has never been done before.
Impeller	Large, consolidated, and native companies	Startups or new non-native competitors.

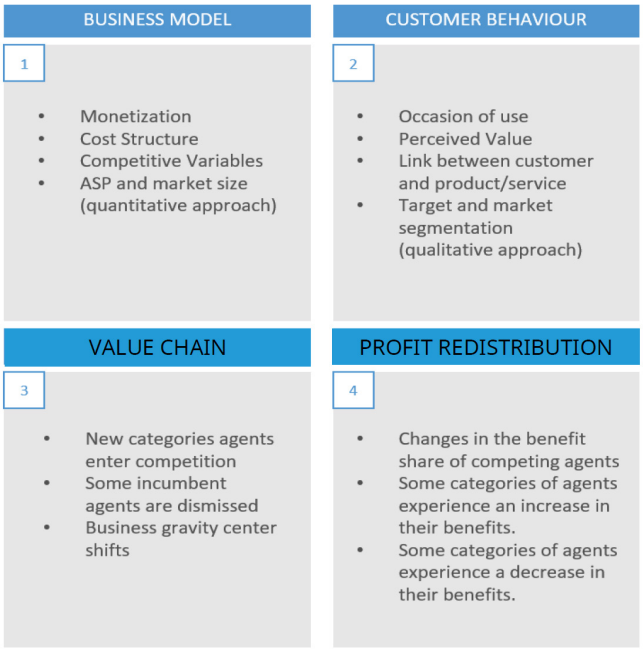
To accurately characterize the impact of technological disruption within an industry, it is essential to adopt a holistic perspective that encompasses various dimensions of competition. We propose the concept of an industry's competitive paradigm to describe how competition operates within a given time frame, taking into account multiple facets of the industry's competitive rules. A disruption signifies a break in these competitive rules (Schilling, 2017) and consequently, a break in the industry's competitive paradigm.

Competitive rules are inherently multidimensional and cannot be explained by a single metric or criterion. Therefore, the competitive paradigm is divided into four distinct dimensions, each of which must be analyzed independently to assess the potential for disruption:

- The characteristics of the dominant business model employed by companies within the industry
- Customer behavior in relation to the prevailing value proposition
- The configuration of the industry's value chain, including key agents and their interrelationships
- The distribution of the benefits generated among participating agents

The proposed analytical framework establishes the foundation for identifying disruptions within an industry by examining the changes brought about by a new, technology-based competitive model. Examples include the emergence of streaming platforms in the audiovisual or music sectors, the rise of the smartphone ecosystem in contrast to conventional mobile telephony, and the digital video game model versus traditional children's games. By analyzing these shifts across the four competitive dimensions, this framework facilitates the anticipation of disruptions by defining specific criteria for analysis.

Figure 1. The dimensions of a competitive paradigm



2. Business model obsolescence: the breakdown of the first dimension of the competitive paradigm.

The progressive consolidation of competitive disruption within an industry typically coincides with the emergence of a new dominant business model across various value chain stages, often introduced by non-native industry players (Sanso, 2020). The adoption of emerging technologies leads to a profound transformation in business models, reshaping how these technologies are implemented across the industry (Christensen, 2016). These transformations generally manifest in four key areas:

First, **monetization strategies** experience significant shifts. For example, in the music industry, digital platforms transformed monetization from a product-based approach (e.g., selling songs in physical or digital formats) to a service-based model (e.g., subscription-based streaming platforms).

Second, there is a **substantial modification in cost structures**, both qualitatively (the type and nature of costs) and quantitatively (changes in gross and operating margins, cost items, and the shift from margin-driven to turnover- driven models, or vice versa). This evolution complicates competition between legacy players and new entrants, as illustrated by the contrasting cost structures of traditional newspapers and their online counterparts.

Third, **competitive variables** shift focus, altering strategic priorities and resource allocation. For instance, following technological disruption in the mobile telephony sector post-2007, Apple prioritized innovation and service, whereas the previously dominant model in the voice phone industry emphasized flexibility, cost, and quality (Sansó, 2013).

Fourth, there is a **shift in the average selling price** of products and services. This can occur in an upward direction, as seen in mobile telephony and electric vehicles, where high-segment disruptions elevate prices (Christensen). Alternatively, prices may decrease, as observed in low-cost airlines and the digital distribution of encyclopedic content.

Finally, the combination of price fluctuations and the adoption of a churn or margin-driven model often leads to a **redefinition of the target market size**. This can be observed in the expansion of the music market or the shift from conventional to electric vehicle markets.

These transformations particularly affect agents at the industry's **center of gravity**—those stages in the value chain responsible for the most significant value generation—forcing them to adapt through a process that is frequently slow, complex, and, at times, unsustainable. This can result in disinvestment

or, in some cases, the eventual exit of these players from the industry.

2.1 Redefining customer behavior and the value proposition: breaking the second dimension of the competitive paradigm.

Competitive disruption processes within an industry also have a clear impact on customer behavior and the qualitative definition of the market in that industry (Kavadias, Ladas & Loch, 2016). On the one hand, this is reflected in the customer's perception of value, which can be incremental (disruption in a high-end segment that results in an aspirational perception, as seen with the disruption caused by the smartphone paradigm in the mobile phone industry) or decremental (disruption in a low-end segment, resulting in a perception of convenience, as is the case with low-cost airlines). Additionally, it affects factors such as the occasion for use of new products or services (for example, autonomous cars represent a radical change in how users relate to the concept of a car), and even the redefinition of the target audience (as seen when the consolidation of the low-cost model leads to the emergence of a new type of customer, focused on cost and, for the first time, considering frequent travel for various reasons). This dimension is closely interrelated with the first, as the creation of a new business model responds to the needs of a new market, while simultaneously contributing to its redefinition through its most evident attributes (such as average price or monetization strategy).

2.2 Reconfiguring an industry's value chain: the breakdown of the third definition of the competitive paradigm

We understand the value chain of an industry as the sequence of agents that participate in it, add value to intermediate products and services, and are aligned around an economic flow that serves one or more customers. The disruption of an industry leads to the reconfiguration of its value chain (Nylund et al., 2022). This is reflected, on the one hand, in the disappearance of certain categories of agents (understood, at a minimum, as a significant loss of their relative importance or even their complete removal from the value chain) and the emergence of new competitors, and on the other hand, in the creation of new centers of gravity within the industry and the consequent repositioning of competing agents around them. Such processes often provide a clear and intuitive way to identify disruptive changes for any type of observer, although there is a risk of mistaking them for isolated cases in their initial phases.

In the case of digital disruption, with its traditional emphasis on the servitization of industries, this has largely resulted in the emergence of new distribution channels (as seen in audiovisual content, information, or retail, for example) and/or the creation of ecosystems built around the software that enables these services (as exemplified by the mobile phone industry).

2.3 Profit redistribution in the industry and new dominant players: the breakdown of the fourth dimension of the competitive paradigm.

The emergence of new competitors with new business models and different relative positions within the value chain, along with the creation of new customer relationships in the context of a market redefined in terms of size and value, inevitably leads to a redistribution of the profits generated within the industry (Teece, 2020). Identifying how this redistribution occurs—specifically, which agents benefit from the

disruptive process and, by occupying a dominant position in the value chain, can capture a larger share of the profits, as opposed to those that are disadvantaged—represents the final part of the proposed conceptual analysis framework.

The table below outlines the effects of competitive disruption on each dimension of the existing paradigm.

Competitive dimension	Characterization	Disruptive effect
Business Model	- Monetization - Competitive variables - Cost structure - Potential revenues	• New standard in cost structure (e.g., cost variability, more representative items in terms of volume and nature), along with shifts in the competitive variables of the new core paradigm (e.g., from quality/cost to innovation/service) (Sansó, 2020). • The monetization model undergoes fundamental changes (e.g., shifting from product-based to service-based models). • The new cost and monetization structure results in a larger potential revenue volume. In high-end disruption (e.g., Apple's creation of the smartphone category), this is reflected in a margin-driven model. Conversely, in low-segment disruption, the model typically shifts to a volume-driven approach (e.g., low-cost airlines). • Significant changes in Average Selling Price, either upward (e.g., smartphones compared to feature phones) or downward (e.g., low-cost airlines compared to traditional airlines).
Customer behavior	- Occasion of use - Underlying need - Perceived value - Potential market	• The perceived value is altered, and with it, the occasion for use. The potential market is vast, as disruption consolidates only when it seeks to become the new benchmark in the core market segment. • The relationship with the customer changes as they assume a different role concerning the product or service (e.g., platforms like Uber, where the customer acts as both a demander and provider) (Sanso, 2020). This change can occur in a more transactional context (e.g., low-cost airlines) or a more relational one (e.g., smartphones, where the customer-product-service link is strengthened).
Industry Value Chain	- Appearance of agents - Disappearance of agents - Shifting of the industry's center of gravity - New roles	• Agents from disrupted phases are the first to disappear from the value chain, whether in distribution (e.g., physical product retail in content industries like music or audiovisual), manufacturing (e.g., transportation as a service (TaaS) versus conventional automotive), or suppliers (e.g., gas stations in the electric vehicle/autonomous driving industry). • Emergence of new categories of agents aligned with the value concept in the resulting industry. Examples include prescribers like TripAdvisor or aggregators such as Skyscanner in the transportation and tourism sectors. • New roles emerge within the context of a redefined value stream (e.g., writer-reader on Wikipedia, traveler-travel planner in a new transport-tourism context). • Shift in the center of gravity, reflecting changes in the relative importance of value contributions at different stages of the chain: for example, the textile-fashion industry shifting from supplier dominance (fabrics) to distribution (physical or online retail), or the smartphone industry shifting from hardware producers to software and application developers.
Distribution of profits	- Gross/operating margins - Relationships between competing agents -Increases/decreases in profits according to agent	• Changes in average operating margins, either upward (e.g., smartphones) or downward (e.g., low-cost airlines). • New relationships of dependence between agents regarding profit generation (e.g., mobile operators no longer acting as the primary sales channel for device manufacturers following Apple's disruption). • Increased profits captured by certain agents (e.g., customers and distribution channels in low-cost airlines) and reduced profits for others (e.g., record labels in the digital music industry).
Managerial Implications The analytical model presented in this paper offers valuable insights for practitioners and managers seeking to navigate and anticipate technological disruptions within their industries. By systematically analyzing the four dimensions of the competitive paradigm—business model, customer behavior, value chain configuration, and profit distribution—this framework provides a structured approach for identifying early signs of disruptive change.		

From a managerial perspective, the ability to correctly forecast disruption is paramount for sustaining competitive advantage in increasingly volatile markets. The model highlights how shifts in cost structures, monetization strategies, and customer relationships can signal emerging threats or opportunities. Managers must focus on early detection of these shifts to adjust their business models proactively (Li & Liu, 2021), whether that involves adopting innovative technologies, revising value propositions, or redefining their positioning within the value chain. Furthermore, understanding how profit distribution evolves in response to disruption can help companies realign their strategies to capture greater value in a changing competitive landscape.

The strategic importance of this framework lies in its holistic approach. Unlike traditional analyses that often focus narrowly on technological trends, this model connects three critical but often disconnected points: the evolution of technology, the competitive reconfiguration of industries, and the early detection of signals that predict disruptive change (McGrath, 2019). By bridging these areas, the model equips managers not only to respond to disruption but also to foresee it, allowing for more agile and informed decision-making.

From an academic and theoretical standpoint, this paper contributes to the ongoing discourse on disruption by offering a comprehensive tool that synthesizes key aspects of competitive strategy with technological foresight. It moves beyond the purely technological perspective by incorporating a multidimensional view of competition, emphasizing the need for integrated analysis to capture the full scope of disruptive processes.

In conclusion, the framework developed here is essential for both academic researchers and business practitioners. It provides a robust foundation for further study while offering actionable insights for managers tasked with steering their organizations through the complexities of technological disruption. By leveraging this model, companies can better position themselves to thrive in an era where competitive landscapes are being redefined at unprecedented speeds.

3. Conclusions and Future Research

This paper has provided an in-depth exploration of how technological disruption impacts various dimensions of competition within industries. By offering a structured analytical model, we have demonstrated how shifts in business models, customer behavior, value chains, and profit distribution can be identified and characterized. This model aims to support both academic researchers and industry practitioners in their efforts to forecast and manage disruptive changes. However, as technological evolution continues to accelerate, especially with the advent of "deep tech" innovations, there are several areas that warrant further investigation.

Looking ahead, one of the most critical areas for future research will be the ongoing monitoring of deep tech categories such as artificial intelligence (Bartolacci et al., 2022), blockchain, the Internet of Things (IoT), and quantum computing (Von Krogh, Netland & Wörter, 2021). These technologies have a profound capacity for recombination, where their integration into various industries could significantly accelerate the pace of disruption. The unique convergence of these technologies may not only shorten the traditional disruptive cycles but also create entirely new paradigms of competition at a

faster rate than previously observed. Such rapid shifts could challenge the assumptions embedded in the current model, particularly concerning the predictability and duration of competitive disruption cycles. Revisiting and refining this framework to account for these potential accelerations will be essential as these deep tech innovations mature and integrate into mainstream industries.

In addition to the need for theoretical refinement, empirical research will play a pivotal role in validating and adapting the competitive paradigm model. Collecting data from a wide range of industries—spanning both B2B and B2C sectors—will provide critical insights into how this model operates in different contexts. For example, B2B industries, often characterized by complex, long-term value chains and specialized customer relationships, may experience disruption in distinct ways compared to B2C industries, where consumer behavior and market dynamics tend to shift more rapidly. These differences could reveal important nuances in how technological disruption plays out, necessitating adjustments in the framework to better reflect industry-specific realities.

Empirical studies that investigate how disruption affects industries like manufacturing, logistics, or financial services in a B2B setting, compared to consumer-driven sectors like retail, entertainment, or healthcare in a B2C setting, would be invaluable. Such studies could help clarify whether the competitive paradigm model can be applied universally or if modifications are needed to account for sector-specific factors such as regulatory environments, capital intensity, or the nature of customer relationships. By collecting and analyzing data across a spectrum of industries, researchers will be better equipped to understand whether the model holds across varying economic landscapes or requires fine- tuning to capture the intricacies of different sectors.

Moreover, future research could explore how the emergence of ecosystems around deep tech technologies alters the traditional roles of value chain participants. For instance, the rise of platforms and software ecosystems in industries disrupted by AI or blockchain may lead to new forms of collaboration or competition between traditional players and new entrants. Understanding how these ecosystems reshape industry dynamics and how they fit within the proposed model of competitive disruption will be crucial for ensuring the framework remains relevant and robust.

Finally, an important area for further exploration is the identification of early warning signals of disruption across industries (McGrath, 2019). While the current model offers criteria for anticipating disruptive shifts, the rapid evolution of deep tech may necessitate the development of more sophisticated tools or metrics for detecting early signs of disruption. Incorporating real-time data analytics, machine learning models, and other predictive technologies could enhance the ability of managers and researchers to foresee impending changes more accurately. These advancements could make the difference between a company adapting successfully to disruption or becoming obsolete in the face of rapid industry transformations.

In conclusion, the analytical model presented in this paper serves as a foundational tool for understanding and anticipating technological disruption. However, its future utility will depend on our ability to adapt it to the accelerating pace of change driven by deep tech innovations. By refining the model through theoretical advances and empirical validation, we can ensure that it remains a powerful resource for academics and practitioners alike, helping businesses navigate an increasingly unpredictable competitive landscape.

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