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METHODOLOGY FOR INVESTIGATING BUSINESS ADAPTATION TO EMERGING RISK FROM SINGLE INNOVATION DISRUPTING MULTIPLE INDUSTRIES

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Abstract: In the contemporary digital economy, technological innovations often disrupt multiple industries simultaneously, challenging traditional models of competition and risk management. The study aims to explore how businesses adapt strategically to such cross-industry technological disruptions. To achieve this, a mixed-methods approach is applied, combining quantitative diffusion modeling with qualitative case analysis of dynamic capabilities. The results highlight the need for probabilistic, multi-scenario risk frameworks and innovation-oriented cultures that enhance firms' resilience to ongoing technological change.

Keywords: disruptive innovation, risk assessment; technological disruption; organizational adaptation; mixed-methods research; dynamic capabilities; bass diffusion model; organizational resilience

JEL: O31, O33, G32

Introduction

The nature of strategic risk is changing dramatically. Historically, disruptive innovations challenged incumbents within industry boundaries by serving neglected market segments. Today's digital innovations operate differently: a single technology can simultaneously disrupt multiple industries. Smartphones eliminated markets for cameras, GPS devices, and portable music players; cloud computing transformed IT, software, healthcare, and finance; artificial intelligence disrupts transportation and creative industries alike. The latter exemplifies how cognitive, behavioural, and environmental factors of a technology can create value - and disruption - across heterogeneous sectors (Sterev & Biolcheva, 2024).

This revolution signifies a fundamental shift: risks now come not only from traditional rivals but from companies using technology or platforms to rewrite competitive rules across the economy. Existing companies, aligned with classical

competition indicators, face asymmetric risks. New technologies and business models challenge market structures and disrupt professional and social elites. This creates turbulent business environments characterized by extreme dynamism, rapid change, heightened uncertainty, increased complexity, and compressed decision timeframes.

Consequently, multi-dimensional examination of threats to organizational security is crucial for managing this new risk landscape. This article addresses this gap by analyzing managerial implications of cross-industry shocks and designing an integrated risk management framework to guide enterprises in assessing and mitigating risks from breakthrough technologies - essential for sustainable value creation amid technological change.

Classical innovation models, where progress occurs within industry boundaries, are increasingly obsolete. Digital-era innovations - platforms and general-purpose technologies like artificial intelligence, blockchain, and advanced robotics - can simultaneously disrupt multiple industries (Brynjolfsson & McAfee, 2014). This creates incomprehensible risk environments. Conventional risk management models, focused on clearly identifiable uncertainties within established industry contexts, inadequately address threats from distant industries deploying different value propositions and asymmetric business models (Christensen et al., 2015). These risks manifest through competition-driven displacement, value chain disruption, strategic obsolescence, and unforeseen regulatory complications (Molhova & Ivanov, 2023).

Therefore, enterprises require specific approaches to perceive, assess, and respond to these risks. Clarifying this phenomenon demands research designs that track macro-level disruption propagation while examining micro-level organizational responses. This study proposes that rigorous mixed-methods design - combining quantitative diffusion modeling with qualitative investigation of adaptation strategies - bridges this gap, enabling comprehensive understanding of causal relationships between disruptive diffusion and strategic adaptation.

Taking advantage of an innovation created in a different industry: cross-industry innovations

Neglecting disruptive technologies carries multifaceted risks (Coccia & Watts, 2020; Danneels & Vestal, 2018; Faster Capital, 2024): foregone growth opportunities, competitive disadvantage, market irrelevance, unpredictable disruption from startups, and threatened organizational sustainability. These risks can rapidly escalate into organizational crises - "dramatic phenomena and processes in external and/or internal environments that render existing management methods inefficient and threaten organizational viability" (Zafirova & Bachvarova, 2019).

Managing these new risks requires different approaches than conventional methods, including:

enhanced strategic agility and dynamic capabilities: the dynamic capabilities are where the firms have to focus; the opportunities being the reintegration of the major processes, the building up of the hard and soft skills, and changing the overall business model to make it work in a rapidly shifting external environment period (Teece et al., 1997). The areas covered are:

– improved peripheral vision: doing the search for the possible areas of change not only in one's own immediate industry but also several others that might be related.

– strategic agility: becoming accustomed to an existence where one can quickly put a new idea to the test, turn to another if necessary and even have several different plans to choose from.

– ambidexterity: balancing the exploitation of existing businesses while exploring new opportunities that come because of disruption.

These dynamic capabilities enable firms not only to respond to disruption defensively but to transform potential risks into strategic opportunities. Organizations that systematically develop capabilities to apply emerging technologies as risk treatment instruments across their value chains demonstrate superior resilience and adaptability (Biolcheva, 2025).

utilization of open innovation and ecosystem strategy: the ecosystems, rather than the individual companies, are the subjects of the competition. One of the moves that companies must make is to do open innovation. They can collaborate with startups, research institutions, and other industries, including their rivals, so as to gain new skills and knowledge. Being part of an attractive and valuable ecosystem may be a much safer advantage compared to standing out through a product only.

developing an organizational learning and resilience culture: the ability to bounce back from a crisis or huge changes in situations, or recover swiftly, is termed as resilience. One of the ways to create it is by establishing an organization that finds a lesson in every victorious outcome and even failure cases. It also includes changing reaction from crisis response to crisis management, which has been deeply intertwined with strategic management, thus, making it a proactive one. According to Zafirova (2021), strategic management is often the major source of the primary mistakes that lead to crises, thereby causing the two areas to overlap. The first step in stopping organizational crises is when you detect the symptoms of strategic crises.

Schumpeter argued that innovations recombine existing knowledge, traditionally limited to internal company resources or value chain partners. Firms typically organize innovation strategies around single types - product, process, marketing, or organizational – with rare combinations (Tavassoli & Karlsson, 2015). However, technological synthesis, shortened innovation cycles, cross-industry worker mobility, and global knowledge availability now facilitate access to external technologies. Cross-industry innovations increasingly adapt solutions between sectors.

Cross-industry innovations involve creatively adapting solutions from other sectors to address current market needs (Enkel & Gassmann, 2010). Since knowledge transfer occurs between dissimilar industries, defining, assessing, and adapting this knowledge is critical (Bo Lyng & Brun, 2018). Firms must establish structures and processes that enable organizational learning beyond industry boundaries. Henkel, an international leader in the industrial and consumer business, systematically applies cross-sectoral innovations and has created numerous radical innovations through this approach (Bader, 2013).

Innovations systematically created in an inter-sectoral context are a relatively new phenomenon for economic theory, but not for market practice. Cross-industry innovations can be:

Outside-in innovations – these innovations involve adapting solutions available in another sector for one's own sector. For example, BMW used TouchSense technology, invented by the California-based company Immersion for its joysticks. TouchSense was integrated into the iDrive control system of BMW cars to provide the driver with the first intuitive car control device in the industry (Glockner & Neef, 2015).

Cross-industry innovations manifest in three forms: outside-in (adapting external solutions, e.g., BMW's integration of gaming technology into automotive interfaces), inside-out (expanding proprietary solutions to new sectors, e.g., Gore-Tex from apparel to medical implants), and shared innovations (collaborative development across industries, e.g., Google-Novartis smart contact lenses) (Glockner & Neef, 2015; Enkel & Heil, 2014).

Shared innovations between different industries - this type of innovation refers to strategic innovation partnerships in which firms from different industries seek a way to open a new business field from which they can mutually benefit (usually by creating a product with unique characteristics) (Enkel & Heil, 2014). One example of cross-industry innovation in the sense of a linked innovation process is the collaboration between Google and Novartis in the development of smart contact lenses, which, among other things, are claimed to be able to measure the user's blood sugar level. The partnership leverages Google's leading technical position in the field of information technology, while Novartis's subsidiary, Alcon, which specializes in ophthalmology, contributes its medical expertise to the product. Here, it is not about transferring solutions from one company to another, but about new developments involving an exchange of knowledge in both directions. Cross-innovations between the video game industry and the music industry are also extremely popular (Waldner et al., 2011).

Cross-industry innovations are an accepted method not only for product and technological innovations, but innovations affecting the overall business models of firms as well. In theory and practice, the term "business model" is used for a wide range of informal and formal descriptions to present the main aspects of

a business, including goals, business processes, target customers, strategies, infrastructure, organizational structure, supply of materials, trading practices, and operational processes and policies (European Commission, 2014). A business model is an abstract representation of an organization, of all the main interconnected organizational, partnership, and financial arrangements designed and developed by an organization, as well as of all the main products and/or services that the organization offers based on these arrangements, which are necessary to achieve the strategic goals and objectives of the organization. For the purposes of this publication, a business model is defined as a structured and analytical model used by a firm to create, deliver, and capture value; a tool through which the firm is able to simplify the numerous variables that influence the business structure and present them in a consistent and unified form. In cross-industry business model innovations, three phases are passed through:

Abstraction: The process of abstraction defines the problem and its components within the firm's existing business model so that a solution from another industry that could be adapted to solve the existing problem can be more easily identified. Usually, in the abstraction phase, the firm seeks a way to provide higher value to its customers.

Identifying an analogy: The process of identifying an analogy requires the firm to find solutions in other industries that have higher added value for customers in terms of satisfying similar needs;

Adapting the analogy: In the third phase, the firm adapts elements from the business model in another industry that it has assessed as suitable into its own industry and its own business model. These elements can be revenue models, organization of customer interaction, etc.) (Enkel & Gassmann, 2010).

The adoption of business models as a strategic tool is based on the premise that they operate at an intermediary level between strategy and operational processes. In other words, the business model translates strategy into operational definitions, thus becoming a working model of a firm's strategy, including external stakeholders. Over the years, the business model has been viewed primarily as a tool for generating value from technological innovations.[4] But in modern economic theory, the understanding is developing that business models themselves can also be the subject of innovation (Enkel & Gassmann, 2010). Cross-industry innovations in business models represent not simply copying successful business models from one industry to another, but a systematic search for applicable analogies, followed by creative recombination of the different elements of the business model (Enkel & Merzger, 2013). Many of the ideas that have the capacity to create innovative businesses and markets in the future can only be realized through the collaboration of key partners from different industries (Khan et al., 2013).

Quantitative modeling: simulating cross-industry diffusion of disruptive innovations

The first component of the methodology aims to model and forecast the spread of a disruptive innovation across multiple industries. This provides a macro-level view of the risk environment, allowing researchers to identify which industries are vulnerable, the sequence of disruption, and the velocity of change.

Theoretical foundation: enhancing the Bass diffusion model

The Bass Diffusion Model (Bass, 1969) is a cornerstone for modeling the adoption of new products and technologies. Its standard form calculates the number of adopters at time *t* based on coefficients of innovation (*p*) and imitation (*q*). However, its traditional application is limited to a single market and industry. For cross-industry application it requires significant enhancement.

Proposed multi-industry Bass model extension

We propose a system of coupled Bass models, where the diffusion in each industry is represented by its own adoption curve, but the imitation coefficient (*q*) of one industry is influenced by the adoption level in another.

The adoption rate for each industry *i* at time *t* is given by:

$$\frac{dN_i(t)}{dt} = [p_i + q_i(t) \cdot X_i(t)] \cdot [m_i - N_i(t)]$$

Where:

$N_i(t)$: cumulative number of adopters in industry *i* at time *t*.

m_i: Market potential (ceiling of adopters) in industry *i*.

p_i: Coefficient of innovation (external influence) in industry *i*.

$q_i(t)$: Coefficient of imitation (internal influence) in industry *i* at time *t*.

$X_i(t)$: Fraction of the market potential that has already been adopted in industry *i* at time *t*, i.e., $N_i(t)/m_i$

The critical modification is that $q_i(t)$ is no longer a constant but a function of the adoption in other connected industries *j*:

$$q_i(t) = q_{i,base} + \sum_{j \neq i} \alpha_{ij} \cdot X_j(t)$$

Where:

$q_{i,base}$: the base level of imitation within industry *i*.

α_{ij}: the "cross-industry contagion coefficient" from industry *j* to industry *i*. This coefficient quantifies how much adoption in industry *j* influences the imitation process in industry *i*. A positive α_{ij} indicates that disruption in *j* accelerates disruption in *i* (e.g., cloud computing adoption in tech accelerating adoption in healthcare).

Factors and data requirements for the quantitative model

Implementing this model requires careful consideration of several factors:

Defining industry boundaries: industries must be defined with a focus on their functional relationship to the disruptive technology (e.g., "personal transportation" instead of "automotive" to include ride-sharing).

Estimating market potentials (mi) requires careful consideration of both direct and indirect value creation mechanisms. The indirect value effects of disruptive technologies - through network effects, complementary innovations, and ecosystem development - often compound their direct impacts, making traditional market size estimates insufficient (Biolcheva & Sterev, 2024). Therefore, market potential calculations should incorporate: market analysis, expert judgment, and analogies from historical disruptions.

Calibrating coefficients (p_i, $q_{i,base}$): initial values can be estimated from early adoption data within each industry or from analogous technologies.

Estimating contagion coefficients (α_{ij}): this is the most challenging step. It can be approached through:

Expert elicitation: surveys and Delphi studies with industry analysts, technologists, and strategists to rate the strength and direction of cross-industry influence.

Patent and publication analysis: Tracing the flow of knowledge related to the core technology across industry classifications.

Supply-chain data: analyzing input-output tables to understand economic interdependencies that could be pathways for disruption.

Incorporating risk modifiers: the model can be extended to output a "Disruptive Risk Index" for each industry at time *t*, calculated as the rate of change in adoption (dXi(t)/dt) combined with the industry's estimated vulnerability (e.g., based on profit margin concentration, regulatory rigidity, asset specificity).

Steps for quantitative analysis

Case selection: identify a specific disruptive innovation (e.g., generative AI, autonomous vehicles) with clear cross-industry impact.

Industry scoping: Define the set of *n* industries to be included in the model.

Data collection: gather time-series data on early adoption metrics, market sizes, and proxies for contagion (expert surveys, patent data).

Model calibration: use optimization techniques (e.g., Nonlinear Least Squares) to fit the multi-industry Bass model to historical adoption data, estimating the parameters (p_i, $q_{i,base}$, α_{ij}).

Simulation and forecasting: run the calibrated model to simulate future diffusion paths across all industries, identifying tipping points and high-risk periods.

Validation: compare model forecasts with actual adoption data as it becomes available to refine the model.

Qualitative Research: investigating business adaptation processes

The quantitative model illustrates the cross-industry risk environment beyond the firm's boundaries; however, it doesn't show how the company internally navigates the uncertain external landscape. The second component of the methodology relies on qualitative research, which delves into the internal processes concerning adaptation.

Research design: a multiple case study: this design known as a multiple case study (Yin, 2018) is the most suitable option for this "how" question. It confers the possibility of a profound, complete investigation of adaptation strategies' practical usage within their original settings. The unit of analysis can either be the strategic business unit (SBU) or the company altogether that is confronted with the threat of going off the beaten track due to cross, industry disruption.

Sampling strategy: theoretical sampling is used to select the most insightful cases. From the different types of industries (identified quantitatively) that are in different stages of disruption, examples of companies that face the different risk profiles can be chosen (e.g., a disrupted incumbent vs. a native digital player exploiting the disruption). This not only assists the cross-case comparison but also helps in building theories.

Factors to investigate: qualitative inquiry can be guided by a preliminary framework based on dynamic capabilities (Teece et al., 1997) and the phenomenon of strategic agility:

Sensing capabilities: What ways does the firm use to scan the environment outside its traditional industry boundaries? What structures are there to reveal the weakest signals of cross, industry disruption?

Seizing capabilities: Which part of the resources is to be used in the disruption area? What is the decision, making process between building, buying, or partnering in order to gain new capabilities? How the innovation portfolio is managed?

Transforming capabilities: How the business model, company structure, and supply chain of the firm are reconfigured? What the role of leadership during this transition is? How the cultural resistance is dealt with?

Strategic agility: How quickly and flexibly is the strategic decision made? How does the firm keep a balance between exploitation (core business) and exploration (new opportunities)?

Risk perception and assessment: How do the managers internally perceive the disruptive risk? Do they follow formal models or their gut feeling? How is the risk communicated to the board and investors?

Data Collection Methods

Semi-structured interviews: C-suite executives (CEO, CTO, CFO, CRO), the heads of strategy, R&D leads, and board members are interviewed. The interviews should reflect perceptions, decision, making processes, and lessons acquired.

Document analysis: Besides interview data, internal strategy documents, annual

reports, investor presentations, risk management frameworks, and organizational charts are used for cross, reference or validation.

Archival data: Press releases, public announcements, and media coverage are analyzed for creating a timeline of strategic movements in response to the disruption.

Steps for the qualitative analysis

Case selection: through the results of the quantitative model and by means of theoretical sampling.

Data collection: the process of data collection comprises interviews and gathering of documents for each case.

Within-case analysis: comparison between firms of the narrative of the engagement process that is developed along with the coding of the data based on the factors mentioned above (sensing, seizing, etc.) for each one of them.

Cross-Case analysis: the comparison and contrast of the narratives across the cases are done. Examining patterns of both successful and unsuccessful adaptation strategies. Naming the themes of barriers and facilitators that occur in several cases.

Theory building: formulate hypotheses or a mid, range theory that consists of the main organizational and strategic factors that lead to successful adaptation to cross, industry disruptive risk.

Conclusion

Cross-industry disruption from single innovations presents significant challenges for modern businesses. The mixed-methods approach described - combining an enhanced multi-industry Bass diffusion model with multiple-case study design - provides a comprehensive framework to address this complex phenomenon.

The quantitative component offers predictive macro-level risk assessment, while the qualitative component delivers detailed micro-level insights into organizational adaptation. The quantitative model guides qualitative sampling by identifying high-risk contexts for case selection. Integrated findings enable causal explanations: for instance, firms in “fast follower” sectors may demonstrate superior sensing capabilities and exploit first-mover advantages, while firms failing in high-risk industries may exhibit inadequate cross-industry scanning and strategic rigidity. This integration advances beyond correlation to establish causal relationships between external disruption diffusion and internal adaptive responses.

This methodology offers dual contributions. Theoretically, it advances disruptive innovation, risk management, and dynamic capabilities research by explicitly addressing cross-industry effects. Practically, it equips leaders with tools to assess organizational preparedness, benchmark performance, and develop strategies for thriving amid continuous interconnected disruption. Future applications to emerging technologies like quantum computing or synthetic biology could further refine our understanding of business adaptation and exponential change.

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