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By re-architecting markets, digital platforms can significantly disrupt incumbents' businesses. We identify three characteristics of markets that digital platforms exploit to gain a foothold in existing markets: inefficiencies caused by asymmetric, fragmented and complex information; the modular nature of offerings; and unaddressed heterogeneous customer preferences. We provide a tool that incumbents can use not only to assess the risk of digital platform disruption, but also to identify digital platform-related opportunities.[1,2,3]

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Incumbent Firms Need to Understand the Nature of Digital Platform Market Disruption

Digital platforms are a new and potent disruptive force for incumbent companies in traditional industries. These platforms facilitate new ways of organizing business value chains and interfirm relationships and have transformed how markets work by providing new ways for incumbents' offerings to be delivered to and accessed and consumed by customers. They use digital technologies and connectivity to exploit and control digitized resources that reside beyond the scope of the firm and generate value for platform users by enabling direct interactions and transactions across multiple user groups (or sides of the market), thus creating new, fully functional marketplaces.[4] The value of platform business models is now well known and has ushered in a "platform revolution"[5] era. Indeed, as of January 2022, five of the top six companies by market value in the S&P 500 Index—Apple, Microsoft, Amazon, Alphabet

1 Varun Grover and Kalle Lyytinen are the accepting senior editor for this article.
2 We are very grateful to Kalle Lyytinen and two anonymous reviewers for the valuable and constructive feedback provided on earlier versions of the manuscript.
3 This research project was conducted thanks to the support of the over 30 companies that participate in the Digital Enterprise Value and Organization (DEVO) Lab at SDA Bocconi School of Management in Italy. The DEVO Lab researches, explores and monitors the impacts of digital technologies on enterprises.
4 Cennamo, C. "Competing in Digital Markets: A Platform-Based Perspective," *Academy of Management Perspectives*, (35:2), May 2021, pp. 265-291.
5 Parker, G. G., Van Alstyne, M. W. and Choudary, S. P. *Platform Revolution: How Networked Markets Are Transforming the Economy and How to Make Them Work for You.* W. W. Norton & Company, 2016.

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and Facebook[6]—base their business models largely on digital multisided platforms.

Digital platforms provide incumbent firms in traditional industries with an opportunity to upgrade their existing business models and evolve their value creation mechanisms. However, digital platforms also pose a threat to incumbents. Digital platforms entering traditional industries can undermine incumbents' value capture ability by disrupting the structure of the economic relationships in which they are embedded, especially relationships with customers in downstream sale channels.

The disruption caused by digital platforms is different from the traditional disruption faced by incumbents, which involves threats to their established technologies and offerings from the introduction of innovative products or services. Instead, digital platforms disrupt the markets in which incumbents operate, disturbing their established linkages along the value chain, extending beyond the current market structure and industry boundaries and transforming markets entirely. In this context, disruption means a "substantial decline in the sales, market share or profitability of established incumbents, resulting from actions taken by firms that are not initially direct rivals of the incumbent(s)."[7]

Unlike traditional disruptive product innovations as originally conceived by Christensen et al.,[8] digital multisided platforms re-architect the market space, rendering some of the incumbents' assets no longer valuable in the new market structure, and thus undermining their ability to capture value from these assets. By re-architecting markets—i.e., redesigning the way buyers and sellers connect, interact and conduct transactions—digital platform firms can influence to a large extent how value is exchanged in the new market structure. As a result, they can profoundly change the capacity of an incumbent to capture value from its innovations in the new market space.

Consider, for example, the impact of Craigslist on the ability of incumbent newspapers to capture value from classified advertisements in their traditional sales channels. By directly connecting users searching for local items and services provided by other users, Craigslist has created a new marketplace for classified ads, resulting in the newspaper industry losing $5 billion of revenue between 2000 and 2007.[9] Similarly, Airbnb has created a new lodging market for travelers, expanding the existing capacity for lodging and thus preventing hotels from capturing more value by selling their rooms at higher rates during peak periods. One study estimated that in the 10 U.S. cities with the largest Airbnb presence, Airbnb's alternative marketplace reduced "variable hotel profits from accommodations by up to 3.7%."[10]

These examples show that digital platforms can severely disrupt incumbents' businesses. Incumbents therefore need to understand *how* such disruption unfolds and can be identified in an industry and *when* the risk of disruption is high. Our research was designed to address these two issues. We used an explorative qualitative research design to examine several digital platform cases across multiple industries, focusing, in particular, on traditional and business-to-business (B2B) sectors, such as energy, IT services, transportation and mobility, banking and insurance (among others). We cross-validated the findings from this analysis by conducting in-depth semistructured interviews with key individuals directly involved in the design, launch or management of digital platform-based solutions in 12 companies across a range of industries, including energy, automobiles, IT services, banking and insurance.

We found that, in general, digital platforms establish a foothold in preexisting markets by exploiting inefficiencies and bottlenecks and designing new market architectures that resolve or mitigate these issues. Our research identified three critical characteristics of markets historically dominated by incumbent firms that digital platforms exploit to re-architect the

6 *Market Capitalization of Largest Companies in S&P 500 Index as of January 31, 2022*, Statista, available at https://www.statista.com/statistics/1181188/sandp500-largest-companies-market-cap/.

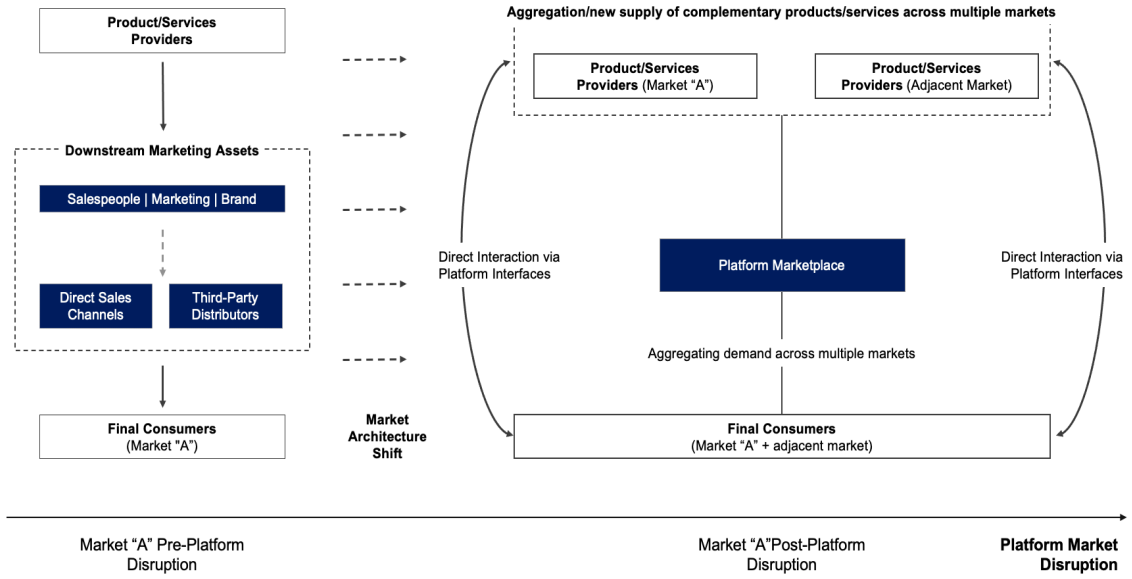
7 Adner, R. and Lieberman, M. "Disruption through Complements," Strategy Science (6:1), February 2021, pp. 91-109.

8 Christensen, C. M., Raynor, M. E. and McDonald, R. "What Is Disruptive Innovation," *Harvard Business Review* (93:12), December 2015, pp. 44-53.

9 Seamans, R. and Zhu, F. "Responses to Entry in Multi-Sided Markets: The Impact of Craigslist on Local Newspapers," *Management Science* (60:2), February 2014, pp. 476-493.

10 Farronato, C. and Fradkin, A. "The Welfare Effects of Peer Entry in the Accommodation Market: The Case of Airbnb," *National Bureau of Economic Research*, February 2018.

Figure 1: Old-Style Market Disruption (Left) vs. Digital Marketplace Disruption (Right)



market space and therefore make digital platform market disruption more likely:

1. Market inefficiencies caused by three types of information problems¬—asymmetry, fragmentation and complexity
2. Market offerings that can be decomposed and provided as combinable modular components
3. Unaddressed heterogeneous customer preferences.

In this article, we describe how, by exploiting these characteristics, digital platform marketplaces disrupt the established position of incumbents and change their potential for capturing value. We also provide a tool that managers in incumbent firms can use to assess the risk that their businesses will be disrupted by digital platforms.

Digital Platforms Cause Significant Market Disruptions for Incumbents

By disrupting incumbents' value chains and established market relationships with customers, digital multisided platforms can undermine the value capture ability of incumbents in two ways.

First, digital platform marketplaces can reduce incumbents' profitability by increasing the level of direct competition they face from traditional competitors because they make the market more efficient and limit the ability of incumbents to leverage their existing downstream marketing assets to offset competition. Historically, incumbent firms have used their downstream marketing assets, such as marketing promotions, sales channels and after-sales support not only to effectively market/promote their products, but also to lock-in consumers by "controlling" their relationship with them. These assets have also helped incumbents fend off the competitive threat of newcomers—by enabling them to maintain control over the gateways to markets while excluding newcomers. However, digital platform marketplaces have rendered these assets ineffective—even obsolete—because the main relationship with customers is controlled by the digital platform firm (see Figure 1).

Consider, for example, Booking.com. This digital platform marketplace is not a substitute for hotels' offerings—in fact, it leverages hotels' offerings and provides them with a new market infrastructure that transcends their traditional sales channels. However, once a digital platform like Booking.com achieves critical mass, the

new market infrastructure largely substitutes for incumbents' downstream marketing assets (such as hotel chains' reservation systems and preferential linkages with travel agencies and other booking operators) with a new way to reach customers via digital platform interfaces.

Digital platform marketplaces are also emerging in traditional industrial sectors like energy and healthcare. In the energy sector, WePower provides a blockchain-based trading platform for renewable energy and functions as a crowdfunding platform for renewable energy projects. As such, it aims to alter the competitive dynamics in traditional corporate energy procurement markets by allowing companies to buy energy directly from renewable producers. Another example from the energy sector is Mobile Energy,[11] a platform-based solution that enables energy roaming by exploiting the existing public and private electricity grid. A director of Mobile Energy's parent company told us: "Through the Mobile Energy platform, a bar owner could sell value-added services such as charging stations for mobile phones for a fixed time and price or third-party providers could easily sell vehicle charging services." Again, these platforms do not substitute incumbents' offerings (energy supply) but rather their downstream marketing assets (by providing new ways to access and exchange energy services). These platforms therefore pose a threat to incumbents' existing grid and distribution infrastructures.

Similar developments are occurring in the healthcare sector, where digital platforms are connecting different parts of the fragmented healthcare market (patients, hospitals, clinics, labs, pharmacies and millions of individual practitioners). For example, MDLive, launched in alliance with drug retailer Walgreens, offers patients web-based consultations by connecting them with certified doctors. Large healthcare incumbents such as Philips Healthcare have also entered the digital platform business. The Philips Engage platform is used by healthcare providers to connect with patients in their care networks, offer remote monitoring, engage patients in their treatment and offer health and care programs.

Although these kinds of digital platform marketplaces do not substitute incumbents' product/service offerings, they have a significant adverse impact on incumbents by displacing their stronghold market positions and their associated sources of competitive advantages. Once a digital platform has assumed a gatekeeper market role and is defining and controlling the market structure and the rules of market participation and exchange, it can then redefine the concept of quality for the whole industry.

For example, Booking.com now provides consumers with a better understanding of the value represented by a particular hotel in the market. This means that the digital platform's norms have replaced established industry norms and market segmentation, usually in a way that enhances the customer experience. In the past, a hotel's star rating was determined by an industry body. When choosing which hotel to book on Booking.com, consumers continue to assess a hotel's quality based on star ratings, but the stars now represent how guests have rated the hotel's service quality and experience using the platform's rating systems. The digital platform thus becomes the "quality guarantor,"[12] with its transaction norms and rules increasingly supplanting the industry's norms traditionally used by established players as the basis for their competitive positioning.

The second way that digital platforms can disrupt the value capture ability of incumbents is through leveraging and pooling service providers from adjacent markets (as depicted on the right-hand side of Figure 1), and thus enlarging the overall market. By introducing new offers that compete with existing offerings, digital platforms can provide alternatives that address underserved segments of the market or meet heterogeneous customer preferences, and thus increase the competitive pressure on incumbents' core offerings. Platforms can also enable the provision of entirely new product categories in the market, further undermining incumbents' offerings. Airbnb, for example, offers travelers access to a new class of offering—stays in private homes—which both widens the market and presents an unexpected challenge to the core of hotels' services (their hotel rooms, facilities and the accommodation itself).

11 Mobile Energy is a spinoff of Engineering, one of the companies in our study with which we conducted in-depth interviews.

12 Jacobides, M. G and MacDuffie, J. P. "How to Drive Value Your Way," *Harvard Business Review* (91:7), July-August 2013, pp. 92-100.

Table 1: Two Ways in Which Platforms Disrupt Incumbents

New Marketplace Infrastructure	Alternative Marketplace of New Offerings
Enhances transaction efficiency	New market channels for new product/service categories
Substitutes incumbents' downstream marketing assets	Substitutes incumbents' core services and downstream marketing assets
Heightens competition among incumbents	Competitive pressure on incumbents from nontraditional sources and service providers
Displaces incumbents' role as integrators and quality guarantors	Displaces incumbents' role as integrators and quality guarantors
Supplants industry norms via new transaction rules and norms	Alters the way consumers define value and assess consumption options
Unsettles incumbents' established linkages to customers	Redefines market boundaries

New entrants such as Airbnb threaten both the way in which traditional players attract customers and the way their target consumers define value. Thus, although seemingly comparable to Booking.com, the impact of Airbnb on the market is different. Airbnb's new complementary offerings undermine incumbents' ability to capture value because Airbnb increasingly substitutes for the established product/service offerings of incumbents.

Another good example of an industry leader being disrupted by a digital platform is the downfall of Nokia caused by Apple's iPhone App Store. Disruptions from platforms such as Airbnb and the iPhone App Store can erode the direct performance of incumbents in terms of both the sales and profitability of their products that compete with platform offerings and address similar customer preferences.

Incumbents in the financial sector also face competitive pressures from digital platforms. Crowdfunding platforms (e.g., CrowdCube) and peer-to-peer lending platforms (e.g., October) demonstrate how fintech platforms challenge the value of incumbents' products and services (e.g., loans) and downstream marketing assets (e.g., their physical branches) by creating digital marketplaces for accessing funds from non-traditional sources. Crowdfunding platforms thus have the potential to create new market channels for new, alternative products and services to those provided by incumbents, such as cryptocurrencies, which potentially offer alternatives to traditional funding channels. The recent backlash from national authorities about Ant,[13] an emerging giant fintech platform (the Ant Group is an affiliate company of the Chinese Alibaba Group) highlights the perceived threat of digital platform disruption for the entire finance sector and demonstrates how vulnerable it is to new platform entrants. One of the IBM executives we interviewed[14] testified to the increased threat of digital platform disruption for the finance sector and identified "cognitive banking" as a new strategic orientation for traditional banks: "The current 'cognitive' phase is strongly linked to the emergence of modern business platforms, which could change the value creation mechanisms of the industry."

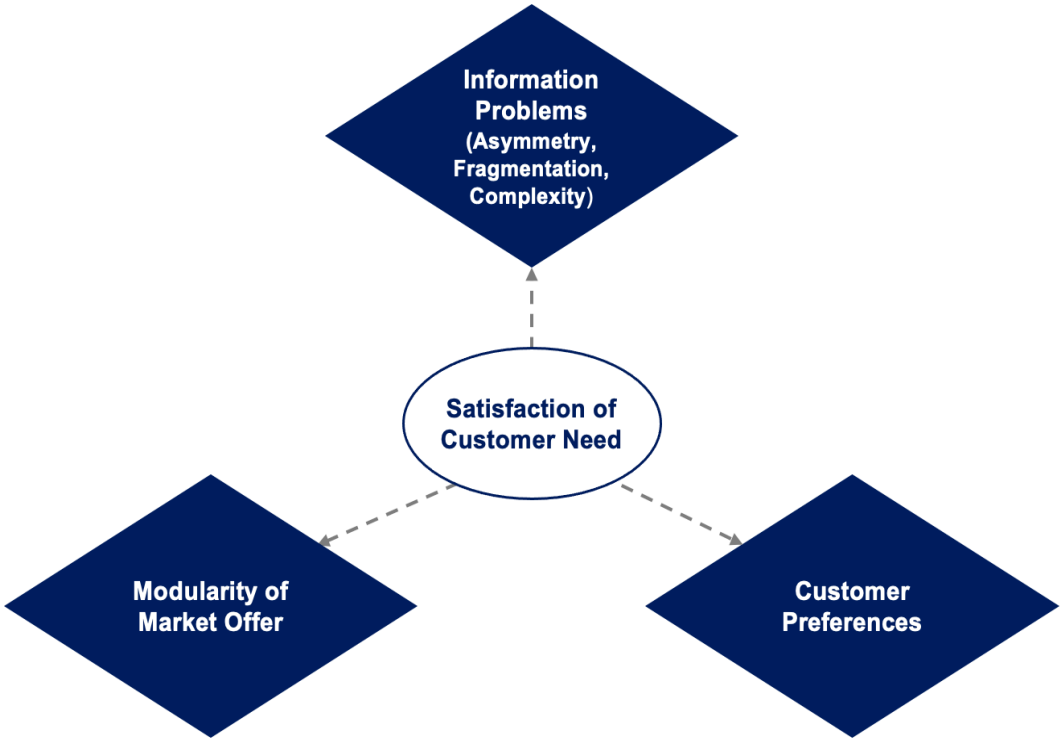
These examples of the two ways that digital platforms can disrupt the value capture ability of incumbents show that established players are having to re-architect the way they do business. They are having to adopt sets of technology-enabled processes that support workflows that do not necessarily start and finish within the boundaries of a single organization but empower interactions with external parties in an open ecosystem (e.g., Open Banking). Table 1 summarizes these two forms of platform disruption.

Below, we identify the key market conditions associated with digital platform disruption,

13 "Fintech Checked by Regulators," *Financial Times* March 3, 2021, available at https://www.ft.com/content/f2260c97-3dd6-4713-9bdb-f815f88b8b04.

14 Financial Services Cluster Leader at IBM Italia.

Figure 2: Critical Market Characteristics Leading to Digital Platform Market Disruption



derived from our analysis of how market-based digital platform disruptions have unfolded in some of the cases outlined above.

Three Key Market Characteristics Exploited by Digital Platforms

When digital platforms enter established industries, they typically do so by exploiting or mitigating inefficiencies that can undermine successful and smooth business interactions or by taking advantage of business opportunities not targeted by current services, products or market structures. In our study, we identified three critical market characteristics that digital platforms exploit (see Figure 2), which can lead to digital platform disruption for incumbents. We now describe each of these characteristics in detail.

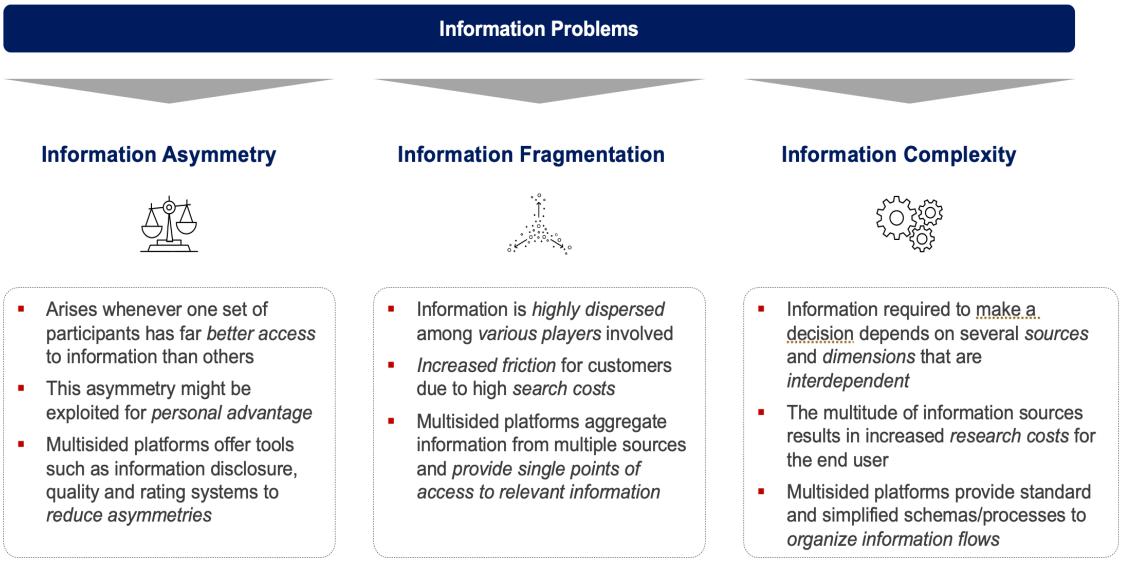
We illustrate these characteristics with examples from the cases we studied (see Table 2, which also includes information relating to the characteristics for three market leading digital platforms). For each case and platform in the table, we show the main platform functionalities that exploited the three critical characteristics that lead to market disruption. These functionalities provide new value propositions to customers (and product/service providers) and re-architect the market space in a way that eventually disrupts the e Exploiting Market Information Asymmetry, Complexity and Fragmentation Problems stablished market.

As indicated in Table 2, we found that most digital platforms exploit the three critical characteristics by introducing specific functionalities that target the inefficiencies and bottlenecks in existing markets. These functionalities are therefore the platforms' key value propositions for their users. Typically, digital platforms aim at designing new market architectures that resolve or mitigate these issues.

Table 2: Platform Functionalities that Exploit the Three Critical Market Characteristics Leading to Digital Platform Market Disruption

	Platform Functionality Examples from Our Study Cases			Functionality Examples from Market-Leading Platforms		
	1. SAP Ariba	2. Yolo	3. WSX BM	4. Airbnb	5. Apple Podcast	6. Hero X
Information Asymmetry	- Integrated portfolio for supplier information, life cycle and performance. - Risk management module for every supplier.	- Micro-insurance options with multiple-choice menus for transparency on details of insurance coverages.	- Auction-based quotation mechanism for transparent pricing.	- Quality and background checks. - Rating system. - Rewards and special badges.	- Rating system. - Special badges.	- Innovators' track record, team memberships and winning history available to companies. - Prescreening to admit partners.
Information Fragmentation	Single view of order status, deviations and delivery updates. - Standard layer to update and share information.	- Single access point for insurance products from multiple providers.	- Digital layer for unification of access to market (providers of waste management services and industrial firms).	- Digital market architecture to aggregate demand and supply. - Aggregation of additional services.	- Single access point to multiple podcasters (both corporates and individuals).	- Single access point to international market of innovation providers.
Information Complexity	- Compliance check with local regulations. - Standard procedures for contract compliance, price checks and validation.		- Standardized way to share information. - Multiservice offer prices for each waste management request.			- Turnkey tools, guides and best practices to manage complex information flows.
Product Modularity	- Separate modules for specific applications can be added to enable new functionalities (e.g., strategic sourcing, spend analysis).	- Disaggregation and re-aggregation of insurance options into custom products. - "Instant" and "micro" on-demand insurance. - Integration with insurers' systems.	- Supply-demand matching functionality to encourage allocation of subcomponents of a waste management task to the most appropriate provider.	- Disaggregation and re-aggregation of value dimensions of travel experiences (e.g., house features, services, experiences).	- Platform layer for new content creation. - Disaggregation and re-aggregation of components of the offering.	- Architecture to decompose an innovation problem into several challenges assigned to different teams.
Customer Preferences	- Support for supplier selection and procurement practices compliant with heterogeneous internal requirements and policies of client companies.	- Insurance products for very specific risks with different levels of coverage. - Easy and repeatable online subscription and subscription cancelation.	- Digital layer to match suppliers' specialization with industrial companies' needs.	- Categorization and segmentation of features to meet diverse customer preferences (e.g., budget house + luxury experiences). - Airbnb Plus service.	- Compatibility with multiple devices. - Customized recommendation system. - Internal structure by genres and categories.	- Single meeting point for companies and innovators from different backgrounds. - Build multiple "crowds" for future challenges.

Figure 3: Three Kinds of Information Problem that Can Be Exploited by Digital Platforms



Before describing each of the three characteristics in detail, we need to provide two caveats. First, the characteristics were identified from our analyses of markets that have been positively impacted by digital platforms and that have gone through the market architecture shift depicted in Figure 1. Although we observed a broad range of cases showing different degrees of platform disruption, we did not contrast them in a systematic way with cases in markets that have not been disrupted. Other industry-specific factors may counteract the three characteristics we identified. Second, and relatedly, although the presence of market inefficiencies and bottlenecks make a market more prone to platform disruption, it does not imply that disruption will definitely occur.[15] Other factors, such as activities by specific firms and strategic interactions between market participants, or more general trends at the societal level, may further catalyze or inhibit the disruption process.

15 For example, Haven, a platform venture backed by three prominent companies, Amazon, Berkshire Hathaway and JPMorgan Chase, to disrupt the healthcare market failed because of governance problems.

1. Exploiting Market Information Asymmetry, Complexity and Fragmentation Problems

The characteristics of the information flow necessary for a successful business transaction are a major symptom of potential market inefficiencies (or failures in extreme cases) and, as a consequence, are an indicator of the benefits that a digital platform marketplace might offer to customers. As summarized in Figure 3, transaction inefficiencies in traditional markets can arise from three kinds of information problems: information asymmetry, fragmentation and complexity. These information problems make a market ripe for disruption by a digital platform.

Information Asymmetry. Information asymmetry is a common issue in many markets and occurs when one party of a transaction possesses more knowledge than the other. For example, the parties might have different levels of information and monitoring power before and/or after the transaction, which could result in different consequences depending on the degree of failure costs connected to an undesirable outcome of the transaction. The greater the obstacles posed by information asymmetry, the greater the benefit and impact that digital

platforms could have on both sides of the business interaction.

Consider the case of SAP Ariba, a cloud-based digital platform for B2B procurement. When companies began to look at sourcing more globally, the problem of information asymmetry between a company's buyers and its suppliers jeopardized efficient procurement. The evaluation of supplier risk requires buyers to make knowledgeable decisions during supplier selection and monitoring. Buyers must proactively monitor risks and compliance for each supplier engagement. SAP Ariba addresses the information asymmetry problem by providing sellers with the ability to manage catalogs, bids, purchases and invoices, and buyers with the ability to search for suppliers, negotiate costs, procure goods and services, and track spending. The Director, Value Advisory for Spend Management, SAP Italia, told us during an interview that *"the SAP Ariba platform mitigates the problem of information asymmetry that is likely to arise because of a lack of awareness about the characteristics and past details of a supplier and allows companies to monitor risks and warning signals before and during the procurement process."*

Similarly, in the business-to-consumer (B2C) hospitality and lodging sector, Airbnb has addressed information asymmetry problems between consumers searching for lodging for short rental periods and owners renting out their properties. When searching for a rental property, guests face significant problems relating to the truthfulness of information about a property's characteristics and the trustworthiness of the owner. Likewise, owners lacks relevant information about guests and the extent to which they can be trustworthy counterparts in the rental transaction.

Airbnb addresses this information asymmetry by carrying out checks on the quality and safety of properties, and includes a quality-rating system, with the ratings being generated and validated by previous users of a property. This rating system and other Airbnb quality signals are based on multiple parameters of relevance for both hosts and guests. Specific tools, such as the "Super Host" qualification, help to certify high-quality offers and make them easily identifiable by guests through a separate, dedicated product category. In terms of safety checks, Airbnb verifies identities to guarantee that the information provided by hosts and guests is both relevant and truthful. It performs a background check on all hosts by accessing relevant databases, criminal records, sex offender registries and terrorist designation data, among other sources. Despite background checks being outsourced to external providers, Airbnb serves as a guarantor in the eyes of both hosts and guests. Moreover, by holding information about hosts and guests and controlling the payment system, Airbnb can also directly sanction misbehavior by either party. The sanctions include charging guests penalty fees for misconduct (including damages to the property) or not disbursing rental fees to hosts if the property information is inaccurate or they fail to comply with Airbnb's rules.

These Airbnb tools and functionalities provide the user community with a high degree of trust, which reduces transaction frictions and makes hosts and guests more prepared to transact with strangers without the need for costly intermediation and contractual services provided by specialized, local intermediaries such as rental and real estate agents. By reducing these market inefficiencies, Airbnb has been able to create a spot market for short-term lodging rentals that not only disintermediates the services of real estate agencies but also creates alternatives to the offerings of hotels, thereby expanding the market offerings in the hospitality sector.

Information Fragmentation. Information fragmentation occurs when the information essential to satisfying customer needs in a business transaction is dispersed among a high number of disconnected players, resulting in high costs for gathering the necessary information. Digital platforms exploit information fragmentation by increasing efficiency and reducing search costs for businesses and individuals looking for goods and services in highly fragmented markets.

For example, both Airbnb and Booking.com act as single access points to a variety of additional complementary service offerings from multiple providers that make information seeking and comparison easy and fast. Booking.com has expanded from hotel bookings into adjacent, ancillary booking services like flights, car rentals

and even leisure activities, and Airbnb aggregates additional services provided by/to hosts, such as "Airbnb Experiences" (events and unique activities proposed by the hosts or local providers connected to the platform) as well as cleaning and property management services. Both Airbnb and Booking.com offer "one-stop-shop" market aggregation, which provides significant benefits to platform users, while disintermediating incumbents' traditional sales channels. The role of key intermediaries such as travel agencies, chain hotels' reservation systems and real estate agencies in the customer purchasing journey has been drastically reduced as customers' default choices for seeking information and comparing offerings have shifted to these digital marketplaces.

Another example of a digital platform exploiting information aggregation inefficiencies is WSX BM, a B2B platform that provides industrial firms with access to different waste management services from a variety of providers (see Table 2). In Europe, industrial firms are obliged to manage waste according to strict European regulations. The waste-management cycle usually involves intermediaries, which act as middlemen, channeling materials from industrial firms to specialized waste-management companies. The past president and special prosecutor of Computer Solutions, one of the main sponsors of WSX BM, told us that:

> *"The current market dynamics are inefficient due to the strong presence of middlemen and a general fragmentation of disposal services, which cause difficulties in the identification of the best capabilities to manage a specific waste product. WSX BM is the first attempt to set up a digital platform that tries to bring order, accessibility and transparency to this market at the European level."*

WSX BM solves the information fragmentation problem that arises from the highly fragmented European market populated by a multitude of companies that offer very specific services, each with a specialized skill set. Industrial companies usually face two options for waste management. The first is to carry out a lengthy and complex process to identify specialized players, gather information in a dispersed market, check compliance with the required regulations and match all information to select the most appropriate player. The second is to select the option they know best, running the risk of choosing suboptimal services and prices.

To address these issues, the WSX BM platform facilitates the matching of the demand side of the market (i.e., industrial companies) and the supply side (i.e., specialized waste management providers). WSX BM leverages several tools and functionalities to reduce information fragmentation. On the demand side, the platform: 1) offers access to multiple specialized providers through a single digital interface, and 2) certifies providers' compliance with European regulations. On the supply side, it allows waste management service providers to access a multitude of industrial clients throughout Europe.

Information Complexity. Information complexity refers to the high level of difficulty encountered by customers in the purchasing decision process because of the large number of interdependent information sources and dimensions that must be assessed in combination to arrive at a final decision. The larger the number of sources and/or dimensions, the higher the level of information interdependence and the greater the complexity for customers in processing the relevant information. Customers often need to use "cognitive decisional cues" to arrive at a specific product/service choice. In these cases, factors such as brand, reputation, popularity of a product and the provider and intermediary experts' advice play a major role in customer decisions—they serve as cues (i.e., signals) to circumvent information complexity and allow customers to focus on a few relevant parameters.

Digital platforms can reduce information complexity and ease the process of assessing information by presenting the information as standardized parameters relevant for the decision and providing a ranking order for choices based on different combinations of these parameters. In this way, platforms reduce complexity to a few relevant parameters for the customer, thus reducing the customer's cognitive effort in assessing complex information.

The WSX BM initiative also provides a good example of how a digital platform can displace incumbents by addressing the information

complexity problem. Traditionally, the challenges of industrial waste management have arisen from the need to exchange complex and bureaucratic information flows. This often makes it difficult for industrial firms to identify the proper technical competencies needed to dispose of specific classes of industrial waste. WSX BM solves this problem by implementing standard modules and procedures to reduce information cluttering and share relevant information, alleviating the previous bureaucracy and speeding up the information flow process.

The HeroX platform (see Table 2) also addresses the information complexity problem. HeroX is a crowdsourcing platform that connects enterprises and innovators to help them find innovative solutions for complex problems. Many companies around the world now engage in open innovation activities, but the kind of information they need to evaluate the expertise, success rates, characteristics and reliability of prospective partners is complex. HeroX provides a new process for gathering and channeling the needed information by simplifying and organizing the complex information flows, thus making it easier for firms on the demand side to assess the needed information. On the demand side, the platform offers companies interested in posting open innovation challenges a turnkey platform with standardized information flows and access to a knowledge base that includes templates, tools and best practices for successfully managing an open innovation challenge call. The knowledge base also includes guidance from innovation challenge experts on how to share crucial information effectively on the platform. On the supply side, HeroX provides innovators with a one-stop shop for hundreds of innovation challenges. They can access standardized forms and procedures that clarify the terms of a challenge, its objectives, timelines, likely benefits, teams involved and resources available.

Digital platforms like HeroX are increasingly emerging in traditional sectors—e.g., energy utilities—as a byproduct of incumbents' digital platforms initiatives aimed at overcoming important bottlenecks to value creation caused by information complexity. An open innovation and artificial intelligence expert at ENI, an Italian energy utility company, told us that:

> *"ENI launched the CallForGrowth project through the GrowITup open innovation platform, leading to the launch of three proof of concepts with the startups Nuvap, Fluxedo and Inglobe Technologies. This process brought many advantages, among which were simplification and [standardization] of complex information."*

Digital platforms are also addressing the information complexity problem in the corporate insurance industry. Four leading insurance companies in the Italian market (AIG, Generali Assicurazioni, UnipolSai and Zurich) and two global insurance broker firms (Aon and Willis Towers Watson) have joined forces with Capgemini, a consulting and technology services provider, to launch a digital insurance marketplace. This platform is based on distributed ledger technology that digitally replicates the entire insurance quotation market and its players, facilitating data exchange and making negotiations smoother and more standardized. The complex coordination of at least three classes of players is needed for corporate risk assessment: businesses seeking to cover their risks, brokers that act as intermediaries in the quotation phase, and insurers. From the initial request for coverage to the actual insurance of corporate risk, a vast amount of complex information needs to be exchanged among several players, increasing the probability of an incorrect or inconsistent risk evaluation. The head of Digital and Data Platforms at Generali Assicurazioni told us:

> *"Our market is not standardized, and this causes long, iterative processes that are highly error-prone. We need to make the management of complex information flows easier and interactions more transparent. For this to work, it is crucial to create a market infrastructure with as many counterparts as possible."*

The aim of the corporate insurance market platform is to mitigate these long-standing problems of the industry by providing a new way of reducing some of the underlying information complexity associated with the market and thus coordinating the economic interactions between industry players and settling transactions.

2. Exploiting the Modularity of Market Offerings

Modularity is the degree to which the components of a system (or product) can be separated, mixed and recombined in different ways.[16] If a product or service made of integrated components can be disintegrated and recombined through independent, separate modules, digital platforms can break up existing value chains by offering stand-alone modules as a core product, creating new value propositions and leading to potential disruption for incumbents. Platforms enable customers on the demand side to choose individual components and create new personalized products or services (e.g., apps that allow the customization of smartphone usage). Thus, the go-to-market business model shifts from a precombined finite number of supply-driven solutions to a much higher (and potentially unlimited) number of *demand-driven personalized solutions*, made possible by the role of the digital platform as a market orchestrator in charge of the core module that allows such choice combinations.

Consider the mobile phone industry. Before today's smartphone app ecosystems existed, this industry was dominated by Nokia and Motorola handsets and BlackBerry devices. These products were designed with specific features to appeal to different customer segments. While Nokia's N-Gage targeted gaming enthusiasts, the BlackBerry was the go-to option for professionals. Both products offered integrated solutions with predesigned, fixed functionalities. At the time, the industry offered "bundled" products, designed to incorporate specific functionalities that were deemed necessary to create a utility market for the target consumers. That all changed when iOS and Android became de facto standards on phones previously used just for a single service (e.g., phone calls, chat services, localization services). The previously dominant products were disaggregated into their individual functionalities, opened up to external providers (apps and app developers), and re-aggregated by users to match their needs and preferences in countless combinations. This disrupted incumbents' value chains and expanded the market from stand-alone, finished products to product systems comprising connected devices and complementary services.

We found a similar dynamic in the retail insurance industry, which is characterized by bundled products: Customers typically buy insurance products that cover a specific set of risks from a single insurer. Yolo (see Table 2), a European startup, offers a platform to create and manage on-demand insurance services, connecting banks, insurers, fintech companies and large firms, and allowing customers to purchase insurance coverage on-demand from different providers under a single umbrella. Yolo disaggregates the bundled insurance products offered by multiple insurers and makes the components available through its digital marketplace. Yolo offers a flexible "insuretech" platform with data management, end-to-end operations and customer engagement modules that allow insurers (e.g., traditional insurers, banks, fintechs) to integrate their systems easily and quickly with the Yolo platform through application programming interfaces (APIs).

Yolo provides a digital marketplace in which the single components of traditional insurance coverage (e.g., car glass insurance) are disaggregated from the typical supply-driven precombined offerings from insurers. The platform enables business and consumer clients to pick their favorite insurance products in the marketplace, personalize them with different levels of coverage, and recombine them to create a variety of demand-driven options. Thus, Yolo, breaks up the bundled services provided by insurance companies and enables users to purchase micro-insurance products in real time, and on a pay-per-use basis. Yolo disintegrates the downstream value chain of the insurance companies and offers the final consumer a single access point to the disaggregated offerings. In this way, the Yolo platform not only provides a more efficient digital market infrastructure for incumbent players, but also, through its modular infrastructure, enables new players to offer alternative insurance coverage to address the

16 Schilling, M. A. "Toward a General Modular Systems Theory and Its Application to Interfirm Product Modularity," *Academy of Management Review* (25:2), April 2000, pp. 312-334.

increasing needs for "instant" and "micro" on-demand insurance products.[17]

3. Exploiting Customer Preferences for Heterogeneous Offerings

When a set of customer needs are unaddressed or there is a demand for heterogeneous offerings, digital platforms can aggregate and combine services and products in ways that offer more personalization—a kind of bespoke bundling. Consider the case of Apple Podcast (see Table 2), which combines entertainment content from third-party producers into broadcasting "channels" according to customer preferences in terms of genres (e.g., fiction, drama), categories and previous choices. The Apple Podcast platform enables viewers to create a personalized experience by specifying their preferences for specific content.

The Apple Podcast platform exploits several mechanisms to meet heterogeneous customer needs. One is a clear categorization of titles based on genres, new trends and authors. There is also a subscription option that keeps users updated about new episodes, and the platform allows users to build a programming schedule and provides them with special suggestions. The platform also allows users to listen to podcasts on multiple devices (e.g., iPhone, Mac, Apple Car Play, iPad).

Apple recognizes that to meet unaddressed and heterogeneous customer preferences, the platform must offer a wide and growing number of different podcast options. Therefore, in addition to collaborating with established broadcasters, Apple incentivizes the creation of new content from individuals and provides a set of tools to promote such initiatives. For instance, its "Best of" tools provide new podcasters with insights on how other successful podcasters overcame the main challenges and issues that arose on their journey.

Customers' preferences can also be specialized and diverse in B2B sectors. In the automotive industry, for example, vehicle manufacturers have highly specialized requirements concerning parts and components, which are developed in collaboration with suppliers and designers. This requires the manufacture of specialized physical artifacts and prototypes, and the exchange of knowledge, making the design and development process expensive and time-consuming.

To address this problem, Dallara, a specialized manufacturer of sports car components, has evolved its role in the market to become a central digital hub that governs the interaction between vehicle manufacturers and component producers.[18] To cater to the different requirements of manufacturers such as Ferrari, Lamborghini and Bugatti, Dallara created an ecosystem based on a simulator. This made the company a focal player because it integrates knowledge generated during the various interactions and allows for the targeting of specialized vehicle manufacturer requirements. When markets are characterized by high levels of unexploited heterogeneous customer requirements, multisided digital platforms can emerge to respond to these needs, leading to market and service innovations.

Recommendations for Assessing Incumbents' Risk of Digital Platform Disruption

The examples described above show that incumbents can experience significant market disruptions from digital platforms. These disruptions can be caused by players from any industry or by new platform providers and are driven by three critical characteristics of existing markets: 1) information problems faced by customers, 2) the ability to disaggregate existing products and make the separate modules available for customized recombinations, and 3) unaddressed heterogeneous customer needs. Some incumbents succumb to digital platform disruptions even when they have anticipated them. They suffer from an incumbent "legacy

17 Similar platform market disruptive effects through modularization are occurring in the media and entertainment industry. Broadcasters traditionally organized their offering around fixed content and schedules, i.e., the offering was typically bundled, and specific radio stations targeted well-defined customer groups with their products. Podcast platforms such as Apple Podcast unbundle the existing offers of the broadcasting companies, disaggregating their components (TV channels), and providing a single platform open to third parties, through which producers can broadcast their own channels and users can access them in an integrated and recombined manner.

18 Aversa, P., Cennamo, C. and Lorenzoni, G. G. "Digital Transformation in Manufacturing Ecosystems: A Case of Integration Decoupling," *Academy of Management Annual Meeting Proceedings*, August 2020.

Box 1: Are You at Risk of a Digital Platform Attack?

1) How severe is the information asymmetry in your market?
In many markets, one party in a transaction possesses more knowledge than the other. The traditional short-term property rental market is a good example because the landlord generally knows much more about the property and its value than the prospective renter. Airbnb unlocked a vast new market by reducing information asymmetry and then integrating tools, access policies and governance rules into its digital marketplace that greatly reduced the natural mistrust that arises when one is renting a property from or to a stranger.

2) How fragmented is knowledge in your market?
Information fragmentation stems from the involvement of a large number of disconnected players in a business transaction, with each player possessing information that is critical to satisfying customer needs. Market aggregation through a digital platform can increase efficiency and reduce search costs for businesses and individuals looking for goods and services in otherwise highly dispersed markets.

3) How complex is it for customers to get the information they need to make a successful transaction?
Information complexity refers to the level of difficulty customers encounter in processing the relevant information they need to make an intelligent purchase. The greater the complexity, the bigger the opportunity for a digital platform to re-architect the market and redefine the basic parameters of competition, starting with quality and other key attributes of product/service value.

4) How modular could your products or services be?
Markets characterized by products or services that could be modularized are ripe for digital platform disruption. Digital platforms can disaggregate these services into multiple interconnected modules and re-aggregate them as complementary offerings that create new value propositions with potentially highly disruptive effects.

5) How unaddressed are heterogeneous customer preferences?
Digital platforms can address a greater range of customer preferences and needs for variety without facing the typical production costs and trade-offs of integrated firms by decomposing integrated products with predefined functionalities into separate modules that can constantly evolve and expand in terms of functionalities through the contribution of complementary products from third-party providers. This process can also work in reverse: When customer needs are heterogeneous, digital platforms can re-aggregate and recombine services and products in ways that offer more personalization—a kind of bespoke bundling.

effect" of excessive inertia as they try to tailor their existing business models and operations and their established economic relationships and linkages with other players along the value chain to the new world of digital platforms.

The market inefficiencies and bottlenecks that digital platforms exploit to enter and re-architect existing markets historically dominated by incumbent firms are often the foundations on which incumbents' success has been built. Breaking free of them would require drastic changes in incumbents' business models, and possibly in operations and competencies. The challenges involved in making these changes might tempt incumbents to ignore the market characteristics that digital platforms can exploit or underestimate the consequences of changes in market architecture and dynamics. This would be a mistake, however, because incumbents would then be more severely exposed to digital platform disruption.

Incumbents therefore need to assess the risk of digital platform disruption and the impact of digital platforms on their hitherto dominant market positions. A good starting point is to address the five questions set out in Box 1. Answering these questions will position the three critical market characteristics that digital platforms can exploit at the center of the organization's strategic agenda and stimulate the active monitoring of market evolution and the changes that may potentially occur in the firm's competitive environment.

Addressing the questions in Box 1 will help incumbents raise awareness of potential disruptions from digital platforms and inform their corporate strategic thinking. However, they offer only a limited first-touch assessment of digital platform disruption risks. A deeper, more analytical assessment of the risks and the key risk drivers requires a more systematic evaluation of the three critical market characteristics described above, examining both the underlying elements of the individual characteristics and their holistic effect in combination. To enable incumbents to carry out the detailed risk assessment, we recommend they use the tool summarized in Table 3 and described below.[19]

Information Asymmetry Risk Assessment Factors

Our case examples show that information problems are a key driver of digital platform disruption. The first type of problem is information asymmetry, when a person on one side of a transaction has access to "private information" that cannot be observed by the other side. This is the case, for example, in the used cars market. Buyers find it difficult to discover the quality of used cars because the attributes that determine vehicle quality are not readily observable or widely documented—this is private information possessed by the dealer, not the customer.[20] In other cases, the qualities of products or services are available or observable, but uncertainty still exists because the user might have to perform due diligence under time pressure or rely on product or service quality information from third-party sources. Moreover, providers can leverage information asymmetry to raise the price of their products or services to more than is justified by their quality. Information asymmetry can also arise when there are different quality certification tools provided by intermediary or third-party experts.

Table 3 lists the three information asymmetry risk factors we recommend that incumbents should assess, rating them using the scales shown in the table.

Information Fragmentation Risk Assessment Factors

One way that a digital platform provides value for users is by aggregating relevant information from multiple sources and providing a "one-stop-shop" access point. Factors indicating the extent to which information is fragmented include: 1) the extent to which relevant information resides in different sources, 2) the degree to which the information required to arrive at a decision is maintained in different formats (making it cumbersome for customers to combine and compare such information), and 3) the number of different information gatekeepers along the value chain who own pieces of relevant information that can influence the customer's decision. For example, the healthcare sector has a high degree of information fragmentation, with information dispersed among hospitals, clinics, labs, pharmacies and millions of individual practitioners, all acting as local information gatekeepers for patients. As shown in Table 3, we recommend using a five-point Likert scale for assessing the platform disruption risks related to Risk Factor 1, whereas binary yes/no indicators are sufficient to assess risks related to Risk Factors 2 and 3.

Information Complexity Risk Assessment Factors

Platform disruption risk factors related to information complexity are the number of information cues required by the customer to arrive at a decision, the volume of information the customer needs to process, and the number and level of interdependence of information components. The larger the number of information cues required to be processed, the greater the task complexity.

For example, when venture capitalists are assessing a prospect for an investment opportunity, they need to consider multiple information cues, including information about the quality of the venture (itself a composite of different information cues about entrepreneurial team quality, experience, etc.), economic

19 Note that this tool focuses only on the three critical market characteristics that digital platforms can exploit. It does not account for other industry- or company-specific factors (including, e.g., capabilities or financial constraints) that might augment the risk of digital platform disruption or reduce its likelihood through, e.g., a company's strategic reaction. Consideration of the strategic options for responding to, or anticipating, platform disruption is outside the scope of this study.

20 Akerlof, G. A. "The Market for 'Lemons': Quality Uncertainty and the Market Mechanism," *The Quarterly Journal of Economics* (84:3), August 1970, pp. 488-500.

Table 3: Factors to Consider When Assessing the Risk of Digital Platform Disruption

Market Characteristics	Risk Factors	Measurement Scale
Information Asymmetry	Do you observe a high price mark-up on products/services in your industry?	Yes = 1; No = 0
	What level of difficulty/uncertainty do customers face in knowing in advance or assessing objectively the underlying quality of the core and ancillary goods or services?	1= not at all; 2 = not really; 3=neutral; 4 = somewhat; 5= very much
	Is quality signaled/certified by intermediaries or experts? (e.g., through quality certification standards such as hotel star ratings, credit scores, insurance, etc.)	Yes = 1; No = 0
Information Fragmentation	Do you need to integrate information from different sources? To what extent is information scattered across different sources?	1= not at all; 2 = not really; 3=neutral; 4 = somewhat; 5= very much
	Are there some players (i.e., information gatekeepers) along the value chain that own different pieces of information relevant for making a purchase decision?	Yes = 1; No = 0
	Is the information required to arrive at a decision maintained in different formats, making it cumbersome to combine?	Yes = 1; No = 0
Information Complexity	How many information cues must be processed to arrive at a purchase decision?	Scale from 1 (few) to 7+ (many)
	What is the volume or the load of information that users need to process (i.e., do they suffer from information overload)?	High=1; Low=0
	Are the relevant information components required to make a decision varied and interdependent, making it hard to decompose and rank order the relevance of the different components?	1= not at all; 2 = not really; 3=neutral; 4 = somewhat; 5= very much
Product Modularity	Separateness: - Can core and ancillary products or services be decomposed into separate modules? - Can we make changes in the key component without redesigning others?	1= not at all; 2 = not really; 3=neutral; 4 = somewhat; 5= very much
	Specificity: - Are there open/standard interfaces for a core component or are they possible? - Can or does each component perform one function? - Are interface components decoupled?	1= not at all; 2 = not really; 3=neutral; 4 = somewhat; 5= very much
	Transferability: - Can components of a product system be reused in various products or another system? - Does the product have a high degree of component carry-over?	1= not at all; 2 = not really; 3=neutral; 4 = somewhat; 5= very much
Customer Preferences	Can our customers' needs not be fully satisfied with a standardized design?	1= not at all; 2 = not really; 3=neutral; 4 = somewhat; 5= very much
	Does the nature of competition vary widely in different market segments?	1=Strongly disagree; 2= Disagree; 3= Undecided; 4=Agree; 5=Strongly agree
	Do we need diverse production methods and marketing assets to cater to different customers and properly address their needs?	[over past 5-years period] 1=No diversity at all; 2=somewhat decreased; 3=neutral; 4=somewhat increased; 5=diversity has dramatically increased

information (financial projections, business model sustainability, etc.) and social information (the prospective market readiness for the venture's products, level of customers' awareness, etc.). Unsurprisingly, given the different information cues and how they relate, venture capitalists often arrive at different assessments of a given venture project. Crowdfunding platforms invert this process by reducing the number of information cues to a few relevant parameters and directly involving customers and multiple backers (i.e., investors) in the process to arrive at a consensus on the prospects of a venture and to validate its prospective value. Nonetheless, information complexity might still constrain investors. A study[21] examining venture projects on Kickstarter, the leading crowdfunding platform, shows that an overload of information complicates backers' capacity to understand crowdfunding projects, thus discouraging backers and reducing the rate of success of crowdfunding projects.

Our recommendation for assessing platform disruption risks related to information complexity (see Table 3) uses Miller's proposed scale for measuring information complexity, [22] which is based on the number of information cues available. According to Miller, information complexity ranges from low (less than five information cues) to moderate (five or six information cues) to high (seven or more cues). Furthermore, we recommend using a five-point Likert scale to assess the risks arising from the level of interdependence among the different information components relevant for customer decision-making and to determine the difficulty of decomposing and ranking the relevance of the different components. However, binary high/low indicators are sufficient to assess the information overload faced by users.

Product Modularity Risk Assessment Factors

We recommend that platform disruption risks related to product modularity be assessed on the three key dimensions of modularity: separateness, specificity and transferability, using the measurement scales shown in Table 3.[23]

Separateness refers to the degree to which a product can be disassembled and recombined into new product configurations without loss of functionality.[24] Modular product systems have separate modules with well-specified interfaces across the modules, such as those found in personal computers. Conversely, for products with low product modularity (i.e., integrated product design), the product components are highly interlinked without well-specified interfaces across the components.

Specificity refers to the degree to which a product component has a clear, unique and definite product function with its interfaces in the product system.[25] Standard interfaces allow modules to be designed independently and, as a consequence, "mixed and matched" to create a complete product system. Thus, the larger the number of interfaces or closed interfaces, the lower the level of modularity. In the banking industry, for instance, thanks to standard interfaces, a growing number of new players can enter the market specializing in the production of single elements of the banking system (for example, digital banking, digital payments).

Transferability refers to the degree to which product components in a product system can be reused by another system.[26] This indicates that the components can be recombined to contain costs and complexity by reusing the same standard component modules across models (component sharing) or model generations (component carry-over).

21 Liang, X., Hu, X. and Jiang, J. "Research on the Effects of Information Description on Crowdfunding Success within a Sustainable Economy: The Perspective of Information Communication," *Sustainability* (12:2), January 2020, Article 650.

22 Miller, G. A. "The Magical Number Seven, Plus or Minus Two: Some Limits on Our Capacity for Processing Information," *Psychological Review* (63:2), 1956, pp. 81-97.

23 These measures and scales are based on: 1) Cabigiosu, A., Zirpoli, F. and Camuffo, A. "Modularity, Interfaces Definition and the Integration of External Sources of Innovation in the Automotive Industry," *Research Policy* (42:3), September 2012, pp. 662-675; 2) Lau, A. K., Yam, R. C. and Tang, E. "The Impact of Product Modularity on New Product Performance: Mediation by Product Innovativeness," *Journal of Product Innovation Management* (28:2), February 2011, pp. 270-284; and 3) Worren, N., Moore, K. and Cardona, P. "Modularity, Strategic Flexibility, and Firm Performance: A Study of the Home Appliance Industry," *Strategic Management Journal* (23:12), December 2002, pp. 1123-1140.

24 Schilling, M. A. "Toward a General Modular Systems Theory and Its Application to Interfirm Product Modularity," *Academy of Management Review* (25:2), April 2000, pp. 312-334.

25 Ulrich, K. "The Role of Product Architecture in the Manufacturing Firm," *Research Policy* (24:3), May 1995, pp. 419-440.

26 Mikkola, J. H. "Capturing the Degree of Modularity Embedded in Product Architectures," *Journal of Product Innovation Management* (23:2), March 2006, pp. 128-146.

Customer Preferences Risk Assessment Factors

Customer preference platform disruption risks arise from the extent to which heterogeneous customer preferences are unaddressed. Incumbent firms often respond to customer heterogeneity via strategic segmentation, targeting and positioning approaches that facilitate appropriate competitive strategies for each targeted market segment. The same applies to digital platforms. The propensity of digital platforms to add new categories to their offerings is mainly driven by customers' desires for heterogeneous offerings and variety. Their need for diversity encourages digital platforms to expand the number of categories offered. Thus, the extent to which customer needs cannot be fully satisfied with a standardized design and the extent to which competition varies in different market segments are good indicators of the presence of heterogeneous customer preferences (see Table 3).

Customer heterogeneity also implies differences in competitive tactics, customer tastes, product lines, channels of distribution etc., across the firm's respective markets. These differences require very different marketing, production and administration practices. For instance, digital platforms offer different content for the different markets in which they operate (e.g., content in regional languages and associated marketing strategies).

To assess platform disruption risks related to customer preferences, we recommend using the risk factor proposed by Miller and Friesen[27] —i.e., the extent to which a company needs diverse production methods and marketing assets to cater to different customers and properly address their needs. This factor should be assessed over the past five-years using a five-point Likert scale (see Table 3) that takes major trends into account as well as changes in methods and tactics.

Understanding the Level of Platform Disruption Risk

Assessing the platform disruption risk factors using the measurement scales shown in Table 3 will enable an incumbent to identify the significance of each factor in the specific industry context. When assessing the information risk factors, a total score of more than 22 would indicate significant information problems in all three areas (asymmetry, fragmentation and complexity), and therefore a high associated risk of potential digital platform disruption. Similarly, a score of more than 12 for the product modularity risk factors would indicate market and technological conditions that enable digital platforms to disrupt incumbents by breaking and opening up existing value chains. Finally, a score ranging between 12 and 15 for customer preference risk factors would indicate moderate to strong heterogeneity in customer preference and thus a higher risk of digital platform disruption.

But which of these risk factors matters most? While this may vary and depend on the specific industry and market, we found some commonalities across the cases we studied. Specifically, we found a moderate to high risk of digital platform disruption in markets characterized by information fragmentation, product modularity and heterogeneous customer preferences. For example, in the Yolo and Booking.com cases, the disruption risk arose from the ability of digital platforms to aggregate market offerings from multiple providers and across multiple market categories, eventually leading to a convergence of markets. This led to the increased commoditization of incumbents' offerings and increased price competition pressure from existing competitors.

We found platform disruption risk to be high or very high in markets characterized by acute levels of information asymmetry and/or complexity, coupled with product modularity (high risk) or heterogeneous customer preferences (very high risk). For example, in the Airbnb and Apple Podcast cases, digital platform disruption risks for incumbents resulted from the entire redefinition of the market caused by a paradigm shift in the type of products/services offered and the degree to which customers appreciated the quality and value attributes of a product. Incumbents found that their traditional products and offerings were being substituted by alternative offerings from nonconventional competitors.

27 Miller, D. J. and Friesen, P. H. "Strategy-Making and Environment: The Third Link," *Strategic Management Journal* (4:3), July 1983, pp. 221-235.

Concluding Comments

Digital platform-based business models are increasingly being deployed in multiple industries and, by transcending the usual industry boundaries and redefining the value mechanisms, are having significant impacts on incumbents in those industries. The success of major platforms such as Amazon, Uber, Airbnb and Google threatens the dominance of established firms in different sectors. But digital platforms can also inspire incumbents to adopt new digital strategies and embark on transformative projects.

In this article, we identify the critical market characteristics that make incumbents vulnerable to digital platform disruption. Where information flows are inefficient and current players do not take full advantage of the modularity of products or heterogeneous customer preferences, digital platforms can introduce new market architectures to exchange value and also enable alternative new offerings capable of challenging the core products and services of traditional players. Our three-characteristics framework and risk-assessment tool can help corporate decision makers formulate strategies to counter the impacts of digital platforms. Addressing the risk-assessment questions we present for each of the three market characteristics will also enable incumbents to identify new opportunities for value creation.

The most important question incumbents need to answer is: What market inefficiencies do you see in your sector? To gain a foothold and grow and thrive in established markets, digital platforms need to exploit inefficiencies and bottlenecks in those markets. Despite their technological advantages, digital platforms ultimately thrive in the same way that entrepreneurs have always thrived: by finding markets in which information flows are inefficient and dominant players have failed to take full advantage of modularized offerings or heterogeneous customer preferences. Digital platforms that identify these gaps and identify new ways to deliver higher value to customers will outcompete dominant players—unless these players anticipate them and beat digital platforms at their own game.

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