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DIGITAL BUSINESS MODEL TYPES: UNDERSTANDING THEIR MECHANISMS AS RECIPES TO COMMERCIALISE DIGITAL TECHNOLOGIES

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The increasingly digital business landscape has created manifold novel opportunities as well as threats to traditional business models. In consequence, a broad variety of digital business models emerged. Powerful tools and managerial guidance on how to shape digital strategies in this volatile and uncertain terrain are sought-after, but remain rare. Building on an analysis of the world's top-1.000 venture funded technology startups over the last decade, we identify 49 novel business model types that describe firms as vendors of digitally enabled products and services, as providers of resources and capabilities for digital business, and as facilitators of intermediation. Furthermore, we identify the novelties of these digital business models types in their components, i.e., value proposition as well as their value creation, delivery, and capture processes. The result is a recipe collection of novel mechanisms to guide and inspire other firms when commercialising digital technologies in their business models.

Keywords: Digital business models; business model types; business model patterns; digital technologies; digital transformation; digital strategy; platforms.

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Introduction

Digital technologies have become omnipresent in almost all aspects of life and business—at an unprecedented pace and extent, they offer rising processing power, increasing miniaturisation of hardware, more ubiquitous wireless connectivity, novel data, digital replication opportunities at almost zero marginal cost, and entirely new forms of global interaction and collaboration (El Sawy and Pereira, 2013; Greenstein *et al*., 2013; Fichman *et al*., 2014; Lansiti and Lakhani, 2014; Porter and Heppelmann, 2014; Bogers *et al*., 2018; McGrath, 2020). At the same time, the behaviours of market participants and their interaction preferences have begun to change (Lamberton and Stephen, 2016; Verhoef *et al*., 2017). The World Economic Forum (2018) expects a continuous, two-digit annual growth rate for firms' emphasis on digital technologies in the future. In consequence of these advances and the global, social developments; the rules of competition and collaboration have changed in many industries (Dodgson *et al*., 2015; Pigni *et al*., 2016; Weill and Woerner, 2018). While digital innovation may lead to new wealth for some organisations and societies (Nambisan *et al*., 2017), exploiting the emerging opportunities remains a challenging endeavour. Furthermore, opting out of the digital transformation is no option either (Lucas and Goh, 2009; Svahn *et al*., 2017; Hanelt *et al*., 2021). However, since the range of opportunities is immense, and the developments remain to be novel, volatile, and uncertain; guidance and powerful tools that help managers to shape their digital strategies and transformation agenda are sought-after, but remain rare.

Ever since the emergence of the internet and consequently, the e-commerce market, business models have gained prominence as the linkage between a technology and its commercialisation (Amit and Zott, 2001). A business model describes how a firm creates and delivers value to customers and how the firm thereby captures value (Teece, 2010). A novel technology only becomes economically valuable once enacted in a commercial opportunity through a business model (Chesbrough, 2010; George and Bock, 2011; Kavadias *et al*., 2016). The business model is thereby separable from the technology as it describes the mechanisms that allow the commercial exploitation that the technology provides (Amit and Zott, 2001; Baden-Fuller and Haefliger, 2013). As such, one business model can serve as a recipe and source of inspiration for other firms for how to commercialise a technology (Sabatier *et al*., 2010; Baden-Fuller and Haefliger, 2013). An entire school of thought on business models—the recombination school—looks at the key components and archetypes of business models to identify re-combinable patterns (Gassmann *et al*., 2016). Within this perspective, a wide range of business model patterns for business models in the pre-digital era have been identified, including the business model navigator with its 55 business model innovation patterns (Gassmann *et al*.,

2014) that include generic patterns such as "freemium," "franchising," or "long-tail." Other approaches to categorise business models distinguish generic business model types (such as "creators," "distributors," "landlords," and "brokers" (Weill *et al*., 2005)), and some of them focus particularly on online or mobile business models (Timmers, 1998; Applegate, 2000; Clemons, 2009; Wirtz *et al*., 2010) or on business models for the Internet of Things (Fleisch *et al*., 2014). However, none of these typologies reflect the more recent developments of the rapidly changing digital landscapes (Remane *et al*., 2017). Over the last two decades, technological change and innovations have been a source and driver for the innovation and adaptation of existing business models, as well as for the creation of new business models (Casadesus-Masanell and Ricart, 2010; Smith *et al*., 2010; Wirtz *et al*., 2010; Fitzgerald *et al*., 2014). The development and increasing diffusion of digital technologies, such as additive manufacturing (D'Aveni, 2018), social media (Mandviwalla and Watson, 2014), or artificial intelligence (Garbuio and Lin, 2019) have recently led to a diverse variety of new business models. This has also led to the emergence of novel, "digitally-enabled" business model patterns, which extend the repositories of traditional business model patterns.

This paper's objective is to reduce complexity and lend some structure to foster understanding and utilisation of digital business models. To do this, we aim to identify and explain the digital business models that have emerged over the last decade. To do so, we analysed the world's top-1.000 venture funded technology startups over the last decade, using CrunchBase as our data source. We particularly focused on start-ups as this allows us to capture more disruptive and early-stage developments in often less restricted and complex corporate settings. Gaining an understanding of the various categories and types of digital business models in the market and their novel forms of value offering, creation, delivery and capture enhances our understanding of how firms already commercialise digital technologies today. This not only adds to our understanding of digital business models but also illuminates how digital transformation actually plays out. Furthermore—potentially even more important—this understanding allows us to build a recipe collection of mechanisms to commercialise digital technologies that might serve as a guidance and source of inspiration for the design of the next wave of digital business models.

Background

The term "digital business model" has become a catchword receiving widespread interest and attention, despite little consensus on its meaning, in particular concerning the distinguishing characteristics of digital vs. traditional business models (El Sawy and Pereira, 2013; Bock and Wiener, 2017). There is wide agreement

that digital technologies have a fundamental impact—both as enabler and driver—on how a firm does business, what the business is about, and how the firm captures value (Veit *et al*., 2014; Härting *et al*., 2018; Vendrell-Herrero *et al*., 2018; Kohtamäki *et al*., 2019; Verhoef and Bijmolt, 2019; Kurtz *et al*., 2021; Verhoef *et al*., 2021). Adding digital technologies to traditional business models is seen as a complex endeavour (Caputo *et al*., 2021). Many researchers further agree that we need a perspective that goes beyond the focal firm's boundaries to capture a digital business model's complexity (e.g., Martín-Pena *et al*., 2018; Kohtamäki *et al*., 2019). Therefore, conventional wisdom about how to execute business strategy does not apply anymore to the changing, formerly traditional as well as the newly emerging digital business models (Verhoef and Bijmolt, 2019; Kurtz *et al*., 2021).

Precise definitions of what business models (and what not) remain difficult and also extant definitions of digital business models vary (Martín-Pena *et al*., 2018). In a broad sense, digital business models refer to business models that use digital technologies to create, deliver and capture value (e.g., Weill and Woerner, 2013; Rai and Tang, 2014; Bock and Wiener, 2017). In line with this understanding, Verhoef and Bijmolt (2019, p. 343) defined digital business models as "situations where digital technologies have fundamentally affected the way a firm structures and carries out its business and thereby creates value for customers, the firm itself, and its partners." Similarly, Veit *et al*. (2014, p. 48) argued that "a business model is digital if changes in digital technologies trigger fundamental changes in the way business is carried out and revenues are generated." In contrast, for example Langley *et al*. (2021, p. 4553) recently provided a more granular definition, describing a digital business model as "the mixed utilisation of smart products and digital smart services, the digitisation of internal processes, the operation within an ecosystem, the accessibility of a platform, as well as the utilisation of data analytics." However, all of these attempts to describe and define digital business models provide no satisfying answer to what is different between digital and traditional business models.

Several characteristics of digital business models have been identified so far, that help to shed some light on this debate. Generally, digital business models show less dependency on physical elements (e.g., Erevelles *et al*., 2016; Caputo *et al*., 2021). Many of the products and services are intangible, thereby allowing for fast scalability at low marginal cost (e.g., Yoo, 2010, 2013; Weill and Woerner, 2013; Iansiti and Lakhani, 2014; Bajwa *et al*., 2017). In general, we see more and in parts novel service and solution offerings—many of them with enhanced customer-experience and individualisation features (e.g., Weill and Woerner, 2013; Ross *et al*., 2016; Bock and Wiener, 2017; Härting *et al*., 2018; Sebastian *et al*., 2021). In digital business models, technologies enhance existing functionalities (Gao and Iyer, 2006; Adomavicius *et al*., 2008), in particular by using data analytics (e.g.,

Loebbecke and Picot, 2015; Bock and Wiener, 2017) and through the offer of connectivity and interaction (e.g., Keen and Williams, 2013; Bradley *et al*., 2015; Härting *et al*., 2018; Langley *et al*., 2021; Sebastian *et al*., 2021). Increased connectivity allows for co-creation opportunities—both with business partners and customers (e.g., Adner, 2017; Broekhuizen, Broekhuis, *et al*., 2021; Broekhuizen, Emrich, *et al*., 2021). Often, value is not created before selling, but determined in use (Vargo and Lusch, 2008) and many digital products and services increase in value with increased consumption (Shapiro and Varian, 1999). Further, technologies help firms to increase their efficiency, e.g., by enhancing their resource optimisation or by increasing speed (e.g., Bharadwaj *et al*., 2013; Planing, 2017; Härting *et al*., 2018; Sebastian *et al*., 2021). However, these opportunities and efficiency gains come at a cost: Digital business models tend to be more complex than traditional business models and interdependencies rise (e.g., Nambisan *et al*., 2017; Parida *et al*., 2019; Broekhuizen, Emrich, *et al*., 2021).

Despite the interest in digital business models, the research field remains vague and scattered (Broekhuizen, Broekhuis, *et al*., 2021; Gregersen Trischler and Li-Ying, 2022), and most empirical findings so far stem from the analysis of case studies only (Böttcher and Weking, 2020). Several attempts to provide frameworks that help us capture digital business models have been suggested, particularly focusing at platform business models. This includes for example El Sawy and Pereira's (2013) VISOR framework. The framework consists of five components: Value proposition or customer motivation to pay for a product or service, the interface, the service platforms as the engines to enable delivery of products and services, the organising model, and the revenue model focusing on the distribution of revenues and cost among the ecosystem participants. More generally, Weill *et al*. (2005) distinguished business model archetypes based on the type of rights being sold (creator, distributor, landlord, broker) and the type of asset being involved (financial, physical, intangible, human). With an attempt to summarise what we know about digital business models and their components, Langley *et al*. (2021) recently identified smart products, digital smart services, digitised processes, ecosystems, the platform, and data analytics as elements of a digital business model based on a review of extant literature.

These frameworks, paired with the known characteristics of digital business models and the available attempts to define the term give us a good idea about what digital business models are about. However, approaching the topic from a practice perspective might help to extend and complement our understanding of digital business models, in particular concerning the manifold types that have emerged. This motivates the two primary research questions of this paper: *What novel types of digital business models have emerged? What mechanisms are applied to commercialise digital technologies?*

Research Methodology

To shed light on the differences and novelties of digital business models, we analysed the world's top-1.000 venture funded technology startups over the last decade. Our aim was to identify novel types of business models that reflect the most recent digital technology developments. We therefore particularly focused on recent start-up investments to capture and explore the more disruptive, less restricted and more early-stage digital business activities. Startup business models tend to be more disruptive than those of incumbents are as they face less heritage-related burdens. Second, startups often launch new business models at much earlier stages to get feedback from the market, while incumbents are often reluctant to do as they want to avoid a potentially negative impact on their established business model (Koch, 2015). Third, most startup business models are purer than those of incumbents and thus easier to understand and formalise. Whereas incumbent firms may cross-subsidise innovative business models by revenues from other sources and mix them with their existing operations, startup business models must function by themselves and cannot rely on such support.

We extracted startups for our study from CrunchBase, which is the world's most comprehensive database for high technology startups (Marra *et al*., 2015). Unlike many other databases, CrunchBase also contains startups that are still in the funding phase, which allows identifying early-stage business models and makes the database an attractive source for many research projects (Block and Sandner, 2009; Werth and Boeert, 2013; Marra *et al*., 2015). In CrunchBase, we exclusively focused on venture-funded startups. Young firms receive venture capital from professional investors, who actively engage in the entrepreneurial firm to support its professionalisation and growth further (Hellmann and Puri, 2002). We assumed venture-funded firms to be particularly useful for our analysis, as venture capitalists are experts in identifying the most promising new business model ideas—it is their daily business. Furthermore, venture capitalists select firms for their investments that have the potential to gain a substantial competitive advantage (Fried and Hisrich, 1994), which was particularly important for our investigation. The usefulness of analysing venture-funded firms becomes even more obvious when we look at the two former waves of IT-driven transformation (Porter and Heppelmann, 2014). Many of the most successful companies from these eras have received venture funding, including Apple, Cisco, and Microsoft—all enabled automating individual activities of the value chain in and after the 1970s—as well as Amazon, eBay, and Google—key players in the evolution of the Internet ecosystem in the 1990s.

As our objective was the identification of new business model types and mechanisms, i.e., those that capture most recent digital technology developments, we further decided to focus on investments from the recent decade. A majority of

existing research on technology-driven business model types stems from around the 2000s. Therefore, these collections cannot account for the more recent technological advances, such as the mobile Internet, new opportunities for data processing, and advanced opportunities from connected sensors (Bharadwaj *et al*., 2013).

To address our first research question, we translated the business logics of these venture funded startups into formal business model types and compared them to past collections of business model types. We proceeded in three phases. First, we identified the top-1000 venture funded startups from CrunchBase (by amount raised in a single funding round in USD). Second, we reduced the complexity of this data sample by pre-classifying it according to the business model classification from Weill *et al*. (2005). In contrast to the majority of other business model typologies, which emerged from empirical analysis, this classification scheme with its 14 rather generic, but simple, types builds on conceptual work and provides a generic base for a more fine-grained differentiation. We found this framework to be just on the right level for coping with the complexity of analysing 1,000 firms in parallel and at the same time being able to identify new business model types. To gather information on each startup, we relied on the company website as well as further company information from online research. Third, we analysed this scheme cell by cell and across cells to systematically extract digital business model types. For instance, we summarised SaaS for HR (e.g., Zenfits), SaaS for healthcare (e.g., Intermedix Corporation), SaaS for e-mail marketing (e.g., Campaign Monitor), and many other SaaS startups as digital business model type "Software as a Service." Afterwards, we compared them to the business model types mentioned in existing business model research (see Remane *et al*., 2017 for an exhaustive overview of existing types) and excluded all types, which have been mentioned before. For instance, we saw many startups pursuing a traditional E-retailer business model. We did not include this as a novel type because the concept is well-known and already has been part of various business model collections in the past (e.g., Applegate, 2001; Eisenmann, 2001; Wirtz *et al*., 2010; Wirtz *et al*., 2016). In contrast, the aforementioned digital business model type Software as a Service, has not been part of prior business model type collections before and thus was included. The result comprised of a list of 49 new digital business model types from three broad categories: (i) offering digitally-enabled products and services, _(ii) providing resources and capabilities for digital business, and (iii) facilitating intermediation.

To address our second research question, i.e., the applied mechanisms to commercialise digital technologies, we built on the three aforementioned categories of digital business model types (offering digitally-enabled products and services, providing resources and capabilities for digital business, and facilitating intermediation). For each type we analysed the mechanisms how digital technologies are

embedded in these firms' business models. We structured our approach along four guiding questions derived from the common understanding of business models as models that describe how a firm creates, delivers and captures value (e.g., Teece, 2010): (1) what is novel about the firms' value offering to their customers? How have digital technologies changed the way, (2) how value is created, (3) delivered, and (4) captured? The result was an overview of different mechanisms that have been applied to commercialise digital technologies.

The overall research process lasted over 1.5 years, continuously updating the data sample, enhancing the research method, presenting the results in several international conferences, and discussing them with various experts from academia and practice. The two major results are explained in the next section, where we also provide several examples.

Findings I: What Novel Types of Digital Business Models Have Emerged?

Applying our methodology to the selected data set helped us to identify 49 new digital model types, which we further aggregated into twelve groups from three broad categories: Firms that offer, create, deliver and capture value by (1) creating and selling digital products and services to consumers, (2) delivering digital resources and capabilities that other businesses need for their activities, and (3) facilitating intermediation (see Fig. 1).

Provision of digitally enabled products and services

Provision of digitally enabled products comprises business model types that focus on selling products with features enabled by digital technologies. *Manufacturing of robots/autonomous products* offers products and services that use artificial intelligence to perform complex tasks formerly conducted by humans independently. For example, SoftBank Robotics offers robotic solutions for a wide range of household needs and Anki sells AI-based entertainment robots. *Manufacturing of connected products* offers products connected to the Internet and thus can be complemented by digital services. Ring (now part of amazon), for example, manufactures Internet-enabled security doorbells and cameras for homeowners and Jawbone Health produces a variety of wearable devices that help to guide customers towards a healthier lifestyle. *Manufacturing of connectivity devices for physical products*, such as Nest Labs' home automation or SimpliSafe's home security devices, offers devices that customers can attach to physical products to connect them to the Internet and thereby enable the usage of complementary digital services. In addition, *App developing* focuses on developing and selling applications

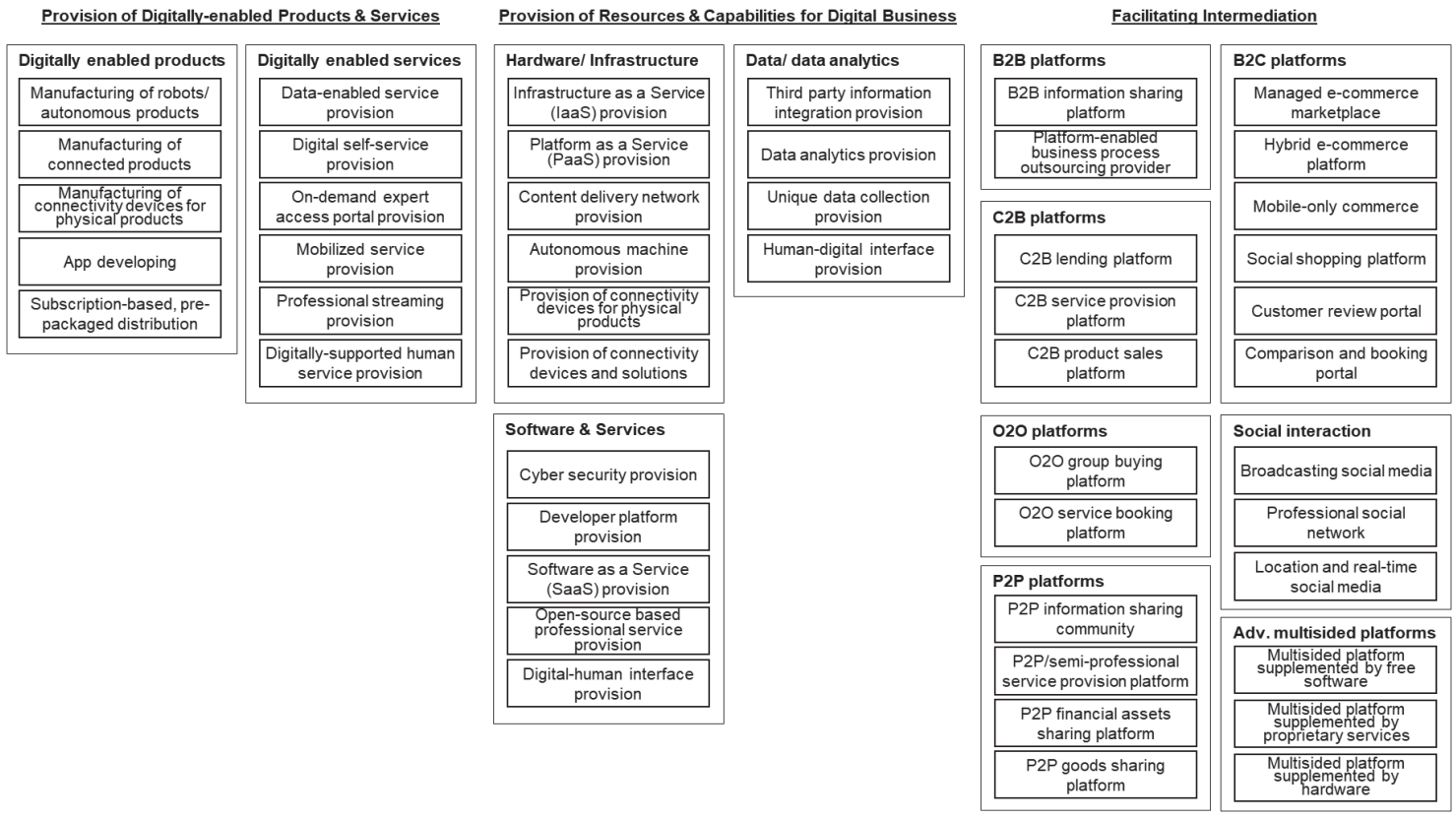

Fig. 1. Overview of digital business model types.

for mobile devices via app stores. Examples include Zynga, which offers social online games or BYJU's, who creates and sells personalised learning programs for primary education students. Another form of digitally enabled products come from *subscription-based, pre-packaged distribution* which comprises an e-commerce shop with physical goods that are home-delivered as pre-assembled packages on a regular basis. Examples include Hello Fresh, a food subscription company that delivers pre-portioned cooking ingredients on a weekly basis to its customers' doorsteps, or PillPack, a full-service pharmacy that delivers a customised medication dose to its customers' homes.

Digitally enabled service provision comprises business model types that offer services, which are enabled by digital technologies. *Data-enabled service provision* uses data to provide completely new or significantly enhanced services. Examples include Fundbox, an innovative B2B payment and credit network, or Metromile, a car insurance company that offers fairer insurance rates based on the data it collects and analyses. *Digital self-service provision* replaces service staff through digital technologies, thus allowing customers to serve themselves. For example, Atom Bank's mobile banking application provides personal and business banking products as to its customers or Betterment's robo advisor offers self-service financial advice and investment services. *On-demand expert access portals* provide a platform that allows customers to consult third party experts on demand through technologies such as video conferencing tools. American Wells offers this service to connect instantly patients with doctors; Avvo offers a similar service for customers seeking legal advice from lawyers. *Mobilised service provision* enables traditionally stationary services at home or on the go through localisation technologies. Edaixi, for example, serves as an "Uber for laundry" by providing an on-demand laundry service. Yangche Diandian uses the technology to offer car wash and painting services. *Professional streaming provision* describes those businesses that provide professional content streaming services, e.g., for movies, sport event or music. Hulu, for example, is such an online video streaming service and Spotify uses the same business model for commercial music streaming. The business model of *digitally supported human service provision* leverages digital technologies that support and guide human activities to increase the quality and/or replace professional service staff by semi-professional or unskilled staff. Examples include the food delivery platform Deliveroo or the ride-sharing provider Uber.

Provision of resources and capabilities for digital value creation

Hardware/Infrastructure-focused business models provide their customers with the hardware and IT-infrastructure for their business. *Infrastructure as a Service*

(IaaS) providers—such as UCloud, a provider of storage and data analytics to online gaming and e-commerce operators, or QuingCloud, a Chinese cloud-computing provider—offer business logic neutral IT infrastructure solutions. Digital content-focused business models support and allow firms to monetise digital content. *Platform as a Service (PaaS)* providers offer online platforms that allow customers to develop and host their own applications. Outsystems, for example, was a pioneer in the low-code market by offering a platform that allows for fast and easy app creation. C3's AI Suite allows its customers to rapidly develop and operate applications based on AI, IoT, or predictive analytics. *Content delivery networks* provide data centres all over the globe that serve to increase the delivery velocity of digital content. Examples of content delivery networks include Fastly and Limelight Networks. *Autonomous machine provision* offers machines and that use artificial intelligence to perform complex tasks formerly conducted by humans independently. For example, Auris Surgical provides robots for medical applications. UBTECH is an example for a provider of enterprise robots such as service or terrain patrol robots. *Provision of connectivity devices for physical products* offers a device attachable to physical goods, thereby connecting the product to the Internet and serving as a platform for complementary digital services. Examples for this type of business model include Gogo, a provider of inflight internet and entertainment solutions, or GridPoint, a clean tech company offering corporate energy management systems. *Provision of connectivity devices and solutions* offers products for connected services. For example, Square produces technological devices for mobile payment solutions and Ubox provides connected vending machines.

Software-focused business models comprise business models that provide specific software offerings as well as those that supply its customers with the tools to develop and use software solutions. One is the business model of *Cybersecurity provision*, which provides software and services to increase customer cybersecurity. For example, Cloudflare helps firms protecting their websites or Lookout is specialised at predicting and preventing harm from mobile attacks. *Developer platforms* provide the developer environment for software programmers. Among those firms, IronSource offers analytical and engagement tools for mobile businesses or Unity Technologies provides a real-time 3D development platform. *Software as a Service (Saas)* providers focus on the online provision of business logic software. For example, Zenefits delivers small and medium sized firms with Human Resource Management software solutions. Intermedix is specialised on offering cloud-based SaaS to healthcare providers. *Open-source based professional service provision* offers complementary services to an existing third party open source software, such as system integration of customisation. Cynagon, for example,

builds on the Android mobile platform to offer an operating system for mobile devices or Mirantis uses only open source software to run Kubernetes on-premises. *Digital-human interface provision* offers implants or prosthetics to influence human functions automatically in a desirable way. Kernel, for example, offers a non-invasive brain interface or MindMaze, runs a mind-machine interface that builds on a neuro-science inspired platform.

Data-focused business models concentrate on the provision of access to novel data and aggregated information as well as data analytics services. *Third party information integration* aggregates information from third parties into one single source of information and make the information accessible for an interested audience. For example, Tabloola, a content discovery platform, connects people with content that they like, but which they did not know about before. ZipRecruiter, an online employment marketplace, collects and aggregates the information of employers and job seekers in a way that matching sides find each other. *Data analytics provision* leverages big data technologies to analyse large amounts of data to extract relevant information or to make predictions about future developments. Civitas Learning, for example, analyses learning data with the aim to help raise the percentage of students graduating in higher education. Turn offers a data and media management platform for marketing data. *Unique data collection* creates a unique source of data that nobody else possesses. 23andMe for example collects genome research data that allows the study of ancestry. Terra Bella offers its collection of high-resolution, commercial satellite imagery. *Human-digital interface provision* offers hardware or software for converting human functions and activities into digital data, thus allowing the provision of novel data-based services. For example, Proteus Digital Health collects and analyses behavioural, physiological and therapeutic metrics through its digital medicines.

Facilitating intermediation

Business-to-Business (B2B) platforms concentrate on the intermediation between businesses for information sharing and process outsourcing. *B2B information sharing platforms* provide a neutral third party platform to share information among multiple, often competing businesses and organisations for mutual benefits. Flatiron for example is such a sharing platform aiming to make the records of cancer patients available for research. Practice Fusion is another cloud-based electronic health records platform for information sharing. *Platform-enabled business process outsourcing* offers a one-stop platform for process outsourcing services by running the platform, combining the offerings of complementary providers

to satisfy the customers' needs, and managing the service provision. Radialpoint (now operating as AppDirect) and SMS Assist operate such services.

Consumer-to-Business (C2B) platforms focus on the intermediation between consumers and businesses. *C2B lending platforms* facilitate the intermediation of private customers borrowing or investing money and companies as the providers or recipients of the funds. For example, Jumubox, a Chinese lending platform, intermediates loans for individuals and small businesses. OurCrowd offers an equity crowdfunding platform for startup investments. *C2B service provision platforms* connect (semi-)professional service providers to individuals and companies. Fiverr is such an online marketplace for freelancers that provide digital services. Another example is Pond5, a video-first content marketplace for creative video services. *C2B product sales platforms* provide a platform for purchasing valuable assets from end customers through automated processes. HYLA Mobile is an example for a mobile device trade-in and reuse solution provider. Opendoor operates a real estate sales platform, with online home-selling services.

Online-to-Online (O2O) platform business models focus on group buying and booking service activities. *O2O group buying platforms* offer online discounts for purchasing products and services from local merchants through multiple customers. Examples for this business model type include Groupon, a mobile marketplace selling discounted vouchers for local businesses such as restaurants of leisure activities, or Meituan-Dianping, a similar shopping platform for the Chinese market. *O2O service booking platforms* provide an integrated online platform for professional services booking from multiple—typically rather small and dispersed—third parties. Taobao Movie (now part of Alibaba Pictures), for example, is such an online ticketing platform. Another example is Thumbtack, an online marketplace for local professional services.

Peer-to-Peer (P2P) platform business models focus on building and leveraging P2P communities. They include *P2P information sharing communities*, in which a platform serves to share content and information among its members. Douyu TV, a Chinese live-sharing platform, is an example of this business model type. Another example is Truecaller, a crowdsourcing platform that allows users to see incoming caller information. *P2P/semi-professional service provision platforms* mediate service provision by non- or semi-professionals to consumers. Examples include BlaBlaCar, a long distance carpooling platform that connects car drivers with empty seats and travellers interested in sharing the travel costs, or 58 Daojia, an online platform that mediates services ranging from cleaning to babysitting, or beauty care. *P2P financial assets sharing platforms* facilitate the lending of money or other financial assets between consumers. Examples include the online P2P loan

marketplaces Auxmoney or Lufax. *P2P goods sharing platforms* intermediate the sharing of physical goods between consumers. Airbnb is one of the most famous examples for a platform that allows the sharing of flats in a P2P context. Another example is ppzuche, a Chinese P2P car-sharing platform.

B2C platforms summarise the various forms of electronic and digital commerce offerings that have emerged over time. Those include the *managed e-commerce marketplaces*, which operate an e-commerce marketplace without engaging in the sales activities, yet support the retailing activities through additional services such as logistics. Examples include Farfetch, a UK-based online luxury fashion retailing platform or Snapdeal, an Indian no-frills online marketplace. *Hybrid e-commerce platforms* operate an own e-commerce shop as a reseller and allow third parties to sell through the shop by using the existing infrastructure and related services. Provides of such hybrid e-commerce offerings comprise the Jumia Group or the China-based online shopping website Flipkart. Other businesses focus on *mobile-only commerce*, by operating an own e-commerce show as a reseller that exclusively leverages mobile devices such as smartphones as its sales interface. Wish, for example, reaches its global customer base solely via a mobile shopping app. Yello Mobile, a Seoul-based mobile media company, runs a mobile commerce offering branded as Coocha. Furthermore, several business model types that emphasise smart features to identify customers' needs, to influence their shopping behaviour, or to match demand and offering have emerged. *Social shopping platforms* provide platforms that integrate social media and professional online shopping. Babytree, for example, is an online platform and community for parents as well as a shopping platform for mother- and child-care products. MOGU operates a similar business model that combines e-commerce with social medial for fashion products. *Customer review portals* provide an opportunity for customers to evaluate third parties and to read their reviews. Examples include Angie's List, a review portal for service providers' ratings ranging from plumbing to housecleaning, or Glassdoor, an online job and career community with employer reviews. *Comparison and booking portals* provide a portal to compare offerings of multiple third parties with an integrated booking and payment functionality. Credit Karma, a provider of free credit score ratings, in an example for this business model type. Similarly, Goji (now part of Holtz Property & Casualty), used data analytics to match client needs with the offerings of home and auto insurance providers.

Social interaction-focused business models foster and monetise the social interaction between humans using digital technologies. *Broadcasting social media* businesses models focus on providing a social media network with different hierarchical

roles, such as contributors and followers. Among this business model type, the social networking platform Twitter is a famous example that allows its users to distribute and read 280-character tweets. SoundCloud, a social sound platform to create and share sounds is another example for this business model type. *Professional social networks* provide a dedicated social media network for a group of professionals to connect, communicate, and share information. Doximity, for example, is such a professional network for medical experts and DXY offers a social medial platform for pharmaceuticals and life sciences specialists. Businesses that focus on *location and real-time social media* integrate this type of data into social media networks to enable to forms of social interaction. Nextdoor, for example, facilitates the connection and exchange of information, goods, or services within a neighbourhood. Another example for a location-based social network is Yik Yak, which connects users to people in their geographical proximity.

Advanced multisided platforms complement their core intermediary role with additional services and products. *Multisided platforms supplemented by free software* operate a multi-sided platform that is complemented by free software to attract more users. For example, 51 Credit Card, a Chile online credit card management platform, provides software for users to manage their credit card bills. Yunmanman is a freight transportation solution that connects truck drivers with cargo owners and supports them with intelligent logistics information and vehicle transportation dispatching software. *Multisided platforms supplemented by propriety services* operate a multi-sided platform and provide key activities of the platform's offering in-house. Instacart applies this model in the US grocery delivery and pick-up service market by running the grocery delivery logistics in-house. Further, Redfin, a US-based real estate broker runs such a platform and runs the activities of the local real estate agents to do virtual house tours and who lead customers through a digital lending process internally. *Multisided platforms supplemented by hardware* operate a multi-sided platform that use connectivity devices to integrate offline infrastructure with the platform. Examples are ETCP, a Chinese platform offering intelligent parking solutions, or iZettle, a point-of-sale system with an app paired with a mini chip card reader.

Findings II: What Mechanisms are Applied To Commercialise Digital Technologies?

Our findings further allow us to reveal the novel aspects in value creation, delivery and capture entailed in the digital business model types identified. Figure 2 summarises the novel mechanisms embedded in our sample of digital business models.

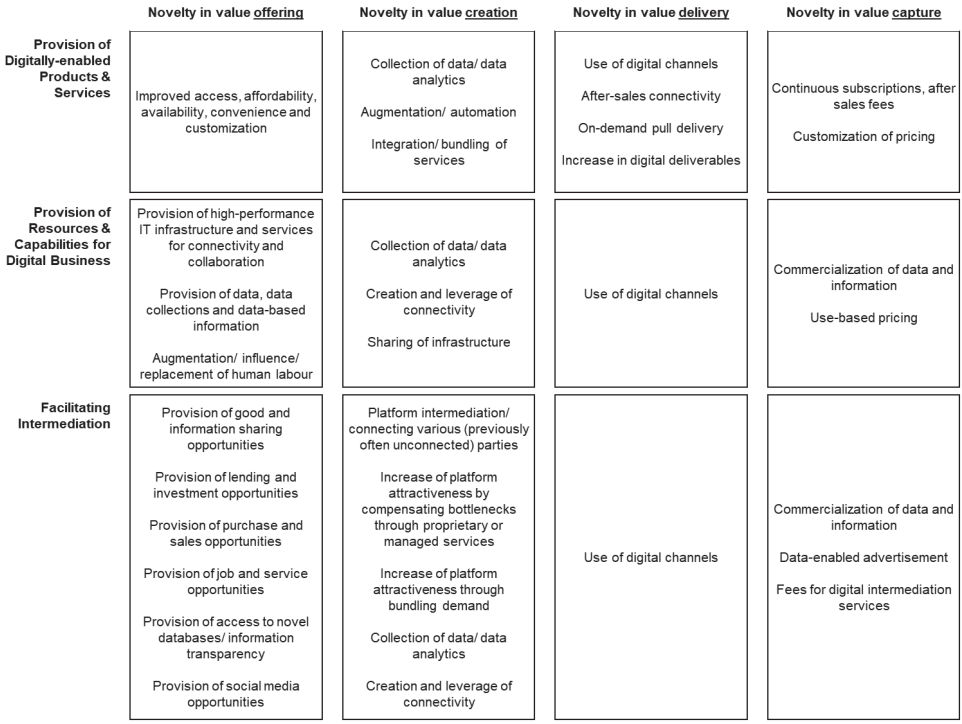

Fig. 2. Overview of mechanisms to commercialise digital technologies.

The business models of providers of novel, digitally enabled products and services

Vendors of digitally enabled products and services focus on producing and selling novel products and services that incorporate features enabled by digital technologies. These business model types target individuals or organisations who use or consume digitally enabled products and services.

Vendors of digitally enabled products and services leverage digital technologies to increase the attractiveness of their offerings to their customers or to attract novel customer groups. Many of these value offerings increase the consumer's convenience, for example by offering pre-assembled product subscriptions packages, customisable online streaming services, or mobile applications for entertainment, learning and communication. In addition, on-demand mobile services of traditionally stationary services or the offering of access to affordable human labour-intense services also aim to increase customer convenience. Other offerings strengthen the customer's position, for example by establishing market transparency. Further offerings deliver novel solutions for potentially unknown needs, such as autonomous household cleaning devices or smart, connected products that for example

allow for remote control over physical devices. Additional novel product and service offerings include data-based solutions and services, such as customised car insurance rates based on one's driving behaviour. In summary, the novelty provided by the inclusion of digital features in the firms' value offering lies in improved accessibility, affordability, availability, convenience, and/or customisation.

To create these offerings, vendors of digitally enabled products and services frequently complement their traditional value creation with data-related activities, in particular the collection and analysis of data. Furthermore, they leverage digital technologies to augment and potentially substitute human workers. A third novel aspect in these firms' value creation lies in their efforts to bundle and integrate external services into their value offering, such as the consulting services of experts. Summing up, the novelty in value creation of vendors of digitally enabled products and services may stem from data-driven processes, the augmentation or automation of human labour, and/or the integration or bundling of services.

From a value delivery aspect, besides using digital channels, we observe an emphasis on after-sales connectivity through digital services. In addition, on-demand pull delivery solutions, such as video streaming services represent novel value delivery aspects. Furthermore, we see an overall increase in digital deliverables, including formerly physical products and services such as online consultancies or robotics-based financial advisory.

In terms of value capture, novel aspects stem from an emphasis on continuous subscription models and after sales fees. Furthermore, enabled by the availability of novel data and data analytics resources, we see first examples of customised pricing, based on actual use and customer behaviour. These two aspects—customised pricing and the emphasis on continuous subscriptions—have emerged as the novel value capture mechanism of vendors of digitally enabled products and services.

The business models of providers of resources and capabilities for digital business

The second category of digital business models summarises business models, where firms act as providers of digital resources and capabilities. Most of the digital business models within this category focus on the provision of IT-related infrastructure/hardware or software, which enable the users to create or enhance their own offering to the customer. A further group of digital business models in this category emphasises the provision of data and data analytics resources.

Providers of resources and capabilities for digital business enable and equip their customers to engage in digital business activities in particular by providing them with the IT infrastructure—both hardware and software—that they need. Novelties

within these IT infrastructure offerings lie in the technological performance, such as delivery velocity for digital content, and the opportunities for connectivity and collaboration provided by the technologies. Furthermore, providers of resources and capabilities often equip their customers with data, data collections, and data-based information. This often includes large collections of relevant information for a particular business purpose that previously was not available or only difficult or resource-intense to gather. In addition, these providers help their customers to use technologies to augment or influence human labour, such as implants and prosthetics, or to replace activities of human workers by increasingly smart machines.

Many providers of resources and capabilities for digital business heavily rely on novel forms of data collection and analysis in their own value creation. Furthermore, they strongly emphasise the creation and usage of connectivity solutions. In addition, in contrast to the traditional sales of IT hardware and software, they create technology sharing or as-a-service solutions.

In terms of value delivery, the novel aspects within their business models are limited to the increased use of digital channels. The novelty within value capture lies on one hand in the commercialisation of data and information. On the other hand, use-based pricing models, in particular for shared/as-a-service service solution represent novel aspects in the firms' value capture logics.

The business models of intermediators

Intermediation refers to the facilitation of interaction between multiples actors. This is the fundamental logic behind any platform-based or social interaction-focused business model. Digital business models facilitate the interaction between a broad range of actors, including C2B, P2P, B2B, or O2O interactions. Similarly, the range of what is intermediated is wide, including service offerings, sharing of goods or information, or social media content.

Facilitators of intermediation provide their multi-sided customers with novel opportunities to share goods and services, to lend or invest money, to sell or purchase goods, to offer or consume services, to contribute and benefit from information transparency, or to share and consume content in social media. For the recipients of the intermediation offering, the facilitation of interaction may increase the access to an attractive product or service offering or a valuable asset for their own value creation. Additionally, intermediation-focused value propositions expand the reach of its users to a global scale. Further, they help reaching a more targeted audience, very often at low transaction costs.

The core novelty in terms of value creation is the platform-based intermediation, which allows them to bring previously often unconnected parties together. Interestingly, some facilitators of intermediation also concentrate on increasing the

attractiveness of the platform for at least one side of their respective markets. They may do so by adding complementary proprietary or managed services that compensate bottlenecks in the market or gaps between physical and virtual worlds that otherwise might prevent customers from using the platform, such as the additional services of human real estate agents for a real estate sales platform. The bundling of demand for a particular offering emerged as another novel form of value creation aiming at increasing the platform's attractiveness. Similar to the providers of resources and capabilities for digital business, the facilitators of intermediation leverage the collection of data and data analytics as well as connectivity solutions to increase the attractiveness of their platforms, for example by integrating real-time parking information in an intermediation offering for parking spaces.

While the novelty in value delivery at a first glance seems to be limited to the expanded use of digital channels, we observed an increased variety of target segments of the underlying platform business models. Put differently, the novelty in value delivery was not the digital channel per se, but the connection established between actors that previously had no direct ties. Furthermore, intermediation facilitators show novel forms of value capture as they commercialise data and information, benefit from data-enabled advertisement, and may charge fees for their intermediation and additional services.

Discussion

Throughout our analysis, we have seen a wide variety and combination of ingredients that firms use to digitise their value offering, as well as their value creation, delivery, and capture processes. Figures 1 and 2 provide a summary of these novel ingredients and show the range of applications of these recipes in the real world. While the analysis revealed many potential combinations of these ingredients, we did not observe clear patterns of ingredient combinations that appeared to be dominant—neither at the industry, nor at the geographical level. Rather, the examples displayed the wide variety of combinations of the underlying mechanisms in a diverse range of environmental contexts. On the one hand, this underlines the broad and far-reaching impact and emerging opportunities that digital technologies may cause for traditional business models. In other words, digital transformation can affect every context and it does so in multiple different ways. The flexibility of digital technologies makes them adaptable to various circumstances as well as a source of diversified innovation across the board. On the other hand, these insights also emphasise that—at least for now—clear managerial guidance on when to apply which set of ingredients is not possible. Rather, the art of designing a suitable digital business model that fits to the particular context remains a crucial managerial accomplishment. To support this art, this study offers a comprehensive

overview of the ingredients that others have used so far. This serves as a source for inspiration, but not as a template that is ready for imitation.

Theoretical implications

This study makes two contributions to our understanding of digital business models. By identifying three categories of digital business models—offering of digitally-enabled products and services, provision of resources and capabilities for digital business, and facilitating intermediation—we provide a complementary perspective to recent attempts to categorise the offerings of digital business models (e.g., Weill *et al*., 2005; Weill and Woerner, 2013; Bock and Wiener, 2017; Langley *et al*., 2021; Staub *et al*., 2021). The categories identified in this study underscore the broad variety of contexts for digital business models. Our analysis further offers a hierarchical categorisation, meaning that we can break down the three categories into 12 groups of related business models and in total, 49 distinct types of business models. Our findings are complementary to the previous results since we identify the same types and groups of business models within the particular focus area of previous studies; however, we provide an overarching framework that allows for a more comprehensive perspective on the manifold types of digital business models. Furthermore, we thereby add specific business model types that, so far, have not received attention in the discussion of digital business models, in particular among the providers of resources and capabilities that enable other firms to engage in digital business.

Additionally, we focus on the discussion of the novelties that distinguish digital from non-digital, traditional business models. So far, despite wide agreement on the fundamental nature of the changes digital technologies are likely to cause (e.g., Härting *et al*., 2018; Kurtz *et al*., 2021; Verhoef *et al*., 2021), capturing the novel and distinguishing characteristics of digital business models remains challenging. Recent findings have shown how diverse the value provided by digital technologies may be, ranging from efficiency gains or cost reductions in operations to increased customer revenues and stickiness and expanded reach through new partnering opportunities (e.g., Planing, 2017; Broekhuizen, Emrich, *et al*., 2021; Sebastian *et al*., 2021). In line with these findings, we show that digital technologies provide novel aspects across all business model dimensions—the value offering, creation, delivery, and capture. More precisely, we show that despite some expected similarities (e.g., the collection and analysis of data within value creation processes), the novel contributions resulting from the use of digital technologies vary across the three categories of digital business models. For example, concerning the novelty in value offering, vendors of digitally-enhanced products and services offer improved accessibility, affordability, availability, convenience, and customisation.

In contrast, providers of resources and capabilities of digital business provide infrastructure and services to enable connectivity, collaboration, data analysis or the augmentation/replacement of human labour. Facilitators of intermediation offer the provision of a broad range of exchanges, including information sharing, lending/investment, or purchase/sale opportunities.

Managerial implications

Business models are necessary for capturing value from digital technologies (Baden-Fuller and Haefliger, 2013). There is not just one simple type of a digital business model. Rather, there is a wide variety of digital business model types, which are combinable in manifold ways. Our study allowed us to identify a broad variety of ways in which start-ups have been leveraging digital technologies in their business models. This revealed the wide range of potential digital ingredients of a firm's business model. Our three categories show how digital technologies can be embedded in business models to (1) provide digital products or services, (2) provide a resource or a capability to create a value offering, and (3) facilitate interaction and exchange between various actors. For corporate practice, the list of 49 novel digital business models types as well as the identified novelties across value offering, creation, delivery and capture provide a toolkit of opportunities for creative combination based on the understanding for whom the digital business model's value propositions services and what value added it provides. This serves primarily as a source for inspiration, rather than as a prescription that is ready for imitation. Identifying the right bundles of digital ingredients remains a managerial art.

Business models are models of "how value is created and how that value is captured or monetised" (Baden-Fuller and Mangematin, 2013, p. 419). This implies that we can use the model to understand and explain the underlying mechanisms and patterns of how a business model works in general—independent from its particular application context. This also applies to the digital environment. Our results illustrating how firms create digital value or how digital technologies contribute to value creation are transferrable across industries. In our data, we did not find any patterns that would limit the novel opportunities within a firm's value proposition, creation, delivery or capture to a particular region or industry. Understanding the underlying mechanisms of a digital business model's value proposition of any industry or geography may reveal transferrable components for one's own context. Understanding whether the business models serve as a facilitator of intermediation, a source of products and services, or a centres on the provision of resources and capabilities is the first step in detecting the attractive, transferrable components of a digital value proposition. However, one needs to remember to adapt the mechanisms to the cultural particularities of the own target market (Wang and Ren, 2012).

Conclusion

Over the last decade, we have seen the emergence of a wide range of novel businesses models, which leverage the rising potential provided by digital technologies. To reduce complexity and lend some structure to foster understanding and utilisation, this paper identifies 49 digital business model types, which can be broadly categorised into the offering of digitally enabled products and services, the provision of resources and capabilities for digital business, and the facilitation of intermediation. This collection represents a reflection of the types of digital business models that have emerged in recent wave of digitalisation and serves to understand the novelties these business models have created in comparison to more traditional business models. However, it is by no means an exhaustive list of what we might see in the future—given the endless number of combinations of the distinct business models types possible and the further development and diffusion of digital technologies. Nevertheless, understanding the structure and variety of existing business model types in combination with the nature of the purposes displayed by their value propositions serve as a powerful source of inspiration for managers to adapt, innovate, and create business models for the increasingly digital business environment.

This study comes with a range of limitations that we need to acknowledge. While we provide a comprehensive overview of the types of digital business models that have emerged, our data does not allow us to make any claims about the relevance or performance of any of these types. Furthermore, the identified types and novelties provide a source of inspiration; however, they do not allow any insights concerning the fit between any of these types and an incumbent firm's traditional business model. Additionally, we need to acknowledge that our data is rich in quantity, but fails to in-depth insides into each of the particular business models. This provides the grounds for promising avenues for future research: We still need to learn more about context-specific factors (such as technologies, industry or market structures) and their impact on a firm's business model design opportunities and corresponding performance implications. Furthermore, analysing the development of digital business models within more digitally advanced industries in more depth might reveal interesting patterns for the future development of so far less digitalised industries.

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