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Offerings That are “Ever-in-the-Making”

How Digital Ventures Continuously Develop Their Products After Launch

Julian Lehmann · Jan Recker

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Abstract Digital ventures are entrepreneurial young firms that introduce new digital artifacts that are “ever-incomplete” and “perpetually-in-the-making” onto the market. The study examines how six digital ventures continued to develop their digital market offerings post launch. Three key designing mechanisms are identified that explain continuous post-launch product development in digital ventures: deploying complementary digital objects, architectural amplification, and porting. The study discusses how these mechanisms advance our understanding of how digital technologies change entrepreneurial processes and outcomes.

Keywords Digital entrepreneurship · Digital innovation · Product development · Late-stage entrepreneurship · Case study · Digital artifacts

1 Introduction

A growing number of entrepreneurial ventures—professionally-funded and privately-owned young firms (Garg and Eisenhardt 2017)—create *digital market offerings*, that is, new products and services that are embodied in

information and communication technologies or enabled by them (von Briel et al. 2018b). Firms such as Google, Facebook, and Tencent, now household names with considerable influence on the world’s economy, all started as digital ventures (Autio et al. 2018; Nambisan 2017), and new digital market offerings brought to the market by digital ventures are now featuring in a wide array of sectors (Autio et al. 2018; Nambisan 2017), from online dating (Davidson and Vaast 2010), to biotechnology (Rothe et al. 2019), IT hardware (von Briel et al. 2018a), and financial services (Gomber et al. 2018; Huang et al. 2017; Kazan et al. 2018).

The material properties of digital market offerings distinguish them from traditional market offerings: they are—at least in theory—inherently malleable (Kallinikos et al. 2013; Yoo et al. 2010), because digital technology is reprogrammable, distributable, and thus generative (Yoo et al. 2010; Zittrain 2008). In consequence, digital market offerings are themselves *ever-incomplete* and *perpetually-in-the-making* (Faulkner and Runde 2019; Garud et al. 2008), presenting digital ventures with a key challenge: how should they develop their products not only at the beginning but throughout the venture, from initiation to launch and post-launch?

This question has not been sufficiently addressed in the emerging digital entrepreneurship literature (Von Briel et al. 2021). While this literature recognizes that digital technology influences entrepreneurial ventures in various ways (Huang et al. 2021; Nambisan 2017), it has primarily focused on digital technologies as enablers of new venturing activity (Autio et al. 2018; von Briel et al. 2018a) or as a means to accommodate the challenges that accompany organizational growth (Huang et al. 2017; Tumbas et al. 2017a). For example, past research asserts that digital technologies, such as miniaturized hardware platforms,

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open-source software, or peer-to-peer lending, can enable the proliferation of digital ventures in specific sectors, like IT hardware (von Briel et al. 2018a), or new ecosystems (Autio and Cao 2019; Nambisan et al. 2019). While authors such as Nambisan (2017, p. 1030) have noted that “*the scope, features, and value of offerings would continue to evolve even after they [products and services] have been introduced to the market*”, there is little systematic knowledge about how digital ventures actually engage in product development after launch. This is problematic, because the time following the initial launch of a product is when digital ventures are traditionally hit by the “valley of death” (Barr et al. 2009, p. 371) as progress and growth become increasingly costly and difficult (Tumbas et al. 2017b).

This gap in understanding presents a theoretical problem: the literature seems to build on the tacit assumption that new ventures transform into established organizations after the successful creation and commercialization of an initial, novel digital offering (Davidsson 2015; Nambisan 2017). This assumption, however, is at odds with the understanding that digital technologies are equipped with ambivalent ontologies, meaning that form, function, or purpose of digital artifacts can change at any point (Kallinikos et al. 2013). And indeed, in practice, digital ventures seldom build sustained success on the singular development and launch of a digital market offering (Nambisan 2017). Instead, most digital ventures enter the market with inherently unfinished products (McDonald and Eisenhardt 2020), often referred to as a minimum viable product (MVP) (Ries 2011). An example is Dropbox, whose MVP was just a video explaining the idea along with a sign-up function, and also the first iPhone, which lacked basic functionality to copy and paste text (let alone pictures and other files) or handle MMS. Moreover, examples such as Uber’s expansion from its match-making offering into areas such as food delivery or bicycle-sharing also illustrate that digital ventures continue to extend and expand beyond their initial market entry (Huang et al. 2021).

As such, when digital ventures initially launch a new product, they need to evaluate and revise once-made assumptions about the design of their products, for instance in the light of customer feedback, with often wide-ranging implications for the functionalities included in the product, as well as establish organizational structures that permit the future growth of the organization. Our aim is thus to unpack how digital ventures continue to develop their products post launch, to better understand how they navigate this challenge. To do so, we use an inductive multiple-case analysis of six digital ventures in the German Rhine-Main startup ecosystem, to study whether, how, and why digital offerings by these ventures evolved post-launch.

Grounded in the data, we develop a model of three theoretical mechanisms (*deploying complementary digital objects*, *architectural amplification*, and *porting*) that describe how digital ventures continuously develop their digital offerings post launch.

We contribute to the literature in three important ways. First, we show that the unique properties of digital offerings continually emerge and evolve through deliberate acts of designing. Second, we demonstrate that digital entrepreneurship is characterized by continuous product development, even after the launch of a digital offering. Third, we connect two largely disjoint streams of literature that relate to the digital entrepreneurship discourse: studies on new product development, and new venture growth.

We start by reviewing research on product development in digital ventures and elaborate why product development is never quite finished. We then describe our research design and then present our case analysis and interpretation. Finally, we discuss the implications that follow from our study.

2 Background

The fundamental idea that digital technologies—man-made artifacts that are made up of layers of material (e.g., hard disks, monitors, smartphones) and nonmaterial (e.g., software, files, binary strings of 0’s and 1’s) objects and bearers (Faulkner and Runde 2009, 2019)—have the potential to shape and even upend traditional ways of organizing is fairly established by now (Baskerville et al. 2020; Nambisan et al. 2017; Yoo et al. 2010, 2012). The starting point for the pivotal influence of digital technologies is rooted in advances in software (including microcode, firmware, software, content, and quantum instruction sets) and hardware (including microprocessors, memory, power management, sensors, and new materials), which have opened up opportunities to add new functionalities and capabilities to traditional economic goods (Yoo 2010).

Several streams of research have begun to explore specifically how digital ventures leverage these properties to develop new products. One stream investigates how digital ventures conceive of and pursue new digital venture ideas (von Briel et al. 2018b). Here, a key insight is that digital technology plays a crucial role in enabling different key tasks in the pursuit of entrepreneurial opportunities (von Briel et al. 2018a). For instance, standardized electronic development platforms (think Arduino mega) allow digital ventures to quickly assemble prototypes of new products like drones (e.g., 3D Robotics), smartwatches (e.g., Pebble), and 3D printers (e.g., Makerbot and RepRap). Similarly, publicly available tools, open-source software repositories, and SaaS solutions aid digital

ventures efforts in the fast development of individual product features. For instance, Spotify, rather than building a new technology from scratch, relied on Google’s TensorFlow platform to develop a recommender system for its streaming service.

Collectively, these developments support the assertion that product development in digital ventures unfolds in an increasingly non-linear and unbounded fashion. Digital technology’s inherent capacity for both planned and unprompted change (Zittrain 2008) drastically reduces the time and effort that is required to conceive and assemble new products. As a consequence, researchers look to better understanding how digital ventures can effectively leverage these opportunities afforded by digital technology.

In this context, primarily practitioner-oriented concepts such as *pivots*, *MVPs*, and *business models* have gained currency among researchers (Kirtley and O’Mahony 2020; McDonald and Gao 2019; McGinn 2012; Ries 2011) to explain how digital ventures develop new products. A key assumption underlying this line of research is that because they heavily draw upon digital technology, digital ventures experience unprecedented levels of flexibility. The possibility to decouple and recombine functional logic from material bearers together with the capability to compute functionality in runtime render digital technologies inherently malleable (Faulkner and Runde 2019; Kallinikos et al. 2013). Malleability fundamentally differentiates digital technology from traditional technology: it allows them to be context specific and to evolve continuously and thus, to adapt to individual users and use cases (Huang et al. 2021; Yoo 2010). Consequently, product development in digital ventures carries the potential to be emergent, fluid, and dynamic, allowing digital ventures to continuously evolve their market offerings in their quest to establish a viable business (not least because competitors, too, can rapidly form and enact product ideas); digital ventures can easily adjust their business model, target customers, and organizational structures in case they run into a dead end.

Collectively, the existing work offers several useful contributions to our understanding of product development in digital ventures. Researchers emphasize that digital ventures’ inherent flexibility allows them to readily pursue new opportunities at minimal costs (von Briel et al. 2018a; Huang et al. 2021). Accordingly, it is no surprise that researchers have focused on how digital ventures identify, and subsequently develop new, often their first, products. However, despite these valuable insights, past work leaves unexplored how digital ventures continue to develop their market offerings once they enter the market.

Exploring this question is important for at least two reasons. First, it is widely accepted that when digital ventures enter the market, they seek to evaluate assumptions

made during the initial design of the offering. Digital ventures typically enter the market with a MVP, which by definition is an unfinished product. Product development in digital ventures, thus does not stop with introducing a new product to the market (Garud et al. 2008). As they revise initial assumptions, digital ventures typically adapt their products as well. Specifically, digital ventures are equipped with a variety of options to further extend and evolve the properties and functionalities of their product in response to novel insights that emerge as they begin to transact with customers and complementors (Sambamurthy et al. 2003; Woodard et al. 2013). For instance, the firm behind the TiVo DVR eventually sought endorsement from relevant market incumbents when faced with adversarial reactions (Ansari et al. 2016), which also had implications for the design of its DVR.

Second, the initial introduction of a market offering marks a turning point for digital ventures: their focus shifts from developing to marketing and selling their product (Wu et al. 2008). This typically means that digital ventures establish more formalized organizational structures that allow for the commercialization of their product, ranging from the formation of new departments, to the formalization of business processes, and hiring of new employees. These organizational changes pose additional challenges to digital ventures as they demand resources that can no longer be vested in continued product development yet are necessary to secure the continued existence of the venture.

Taken together, digital ventures face a key tension upon the introduction of their first product. On the one hand digital ventures need to implement organizational changes that permit growing their user base, such as establishing sales and marketing departments, hiring new employees, and reallocating resources. These actions typically require a more or less complete product so that the focus can shift to exploiting (Bakker and Shepherd 2017). On the other hand, digital ventures also need to adapt their offering to accommodate emerging and changing customer demands, address unforeseen incompatibilities, and manage technical debt. Yet, exactly how digital ventures navigate this situation and what they do with their market offering, in particular, remains unknown at this point. We address this blind spot in the literature through an inductive study of six digital ventures.

3 Method

3.1 Design and Sampling

We engaged in a form of grounded theorizing (Gioia et al. 2013; Strauss and Corbin 1998), drawing on from a multi-case study of six digital ventures (Eisenhardt 1989; Locke

2007). Our objective was to examine how the ventures evolved their digital offerings after their launch to create viable businesses. Our research design aimed at generating novel theoretical interpretations across theoretically replicated cases because this allowed us to develop theory that is better grounded in varied empirical evidence, more accurately defined from multiple cases, and more generalizable (Eisenhardt and Graebner 2007; Yin 2009). We tried to collect data as *representative facts* (Sarker et al. 2018), and our analysis strategy was inductive drawing primarily on the Gioia methodology (Gioia et al. 2013). The theory of mechanisms (e.g., Gross 2009) served as a sensitizing “lens” to support the iterative process between data collection and analysis (Eisenhardt 1989).

Our sampling strategy focused on four aspects. First, timing since initial offering launch: it was important for our study that the sampled ventures were in their post-launch phase and that our cases varied in how long they had been in this phase. By varying how long the sampled ventures were in the post-launch phase, we sought to obtain insights that were representative of digital ventures’ post-launch phase and not just specific periods. The oldest of the ventures we sampled was active for several years when we began our research, while the youngest had only just launched its offering. Second, the nature of the digital offering of the emergent ventures. The constitution of a digital market offering can range from being primarily software-based (think Whatsapp), i.e., with an ephemeral embodiment, to being primarily hardware-based (think Oculus Rift), i.e., with a perpetual embodiment (von Briel et al. 2018b). We sampled ventures that had primarily ephemeral digital offerings, to investigate how they drew on digital technology’s unique properties to evolve their offerings. This was important because ephemeral digital offerings can draw more fully on digital artifacts’ capacity for malleability, change, and evolution without being restricted by the rigidity of physical object characteristics (e.g., size, form, length, or weight of a plastic or metal component). Our third sampling criterion was continued existence. We only sampled ventures that remained operative and independent at the time of writing. We applied this criterion to ensure the selected ventures pursued their own agendas (as opposed to acquired ventures), and to understand which behaviors may be associated with effectively navigating the tension (as opposed to failure). Fourth, we sampled ventures that were located in the same geographical area to ensure they operated under similar conditions. We initially identified ten ventures that were willing to participate in our study. After pilot interviews with each venture, we selected six of those ventures. We excluded two ventures because they reported that their product had not evolved since launch. Another two ventures were unable to participate due to time-constraints. We

continued with the six cases and felt, with time, that they presented rich compelling evidence, a sharp focus on our unit of analysis, continued development of digital offerings, and comparability as well as between-case variance (Eisenhardt and Ott 2017).

3.2 Data Collection

Data collection took place between July 2018 and September 2019. The sampled ventures were on average four years and eight months old and had between 3 and 130 employees. Our unit of analysis were the ventures and the acts through which they continued to develop their offerings post-launch. As is common in digital entrepreneurship research (e.g., Huang et al. 2017, 2021), we collected data using multiple methods covering primary and secondary data, from both formal and informal sources (Table 1).

First, we conducted eleven semi-structured formal interviews and twelve informal interviews with co-founders and employees of the case organizations. Formal interviews were held in German and later professionally transcribed to English. They relied on a set of preplanned questions (see Appendix) but remained open towards emerging themes. Interviewing proceeded in through multiple rounds. Initially, we focused on three key areas: (1) how and why was the venture founded; (2) how did the venture evolve over time; and (3) how did the ventures change, alter, or otherwise adjust their digital offerings post launch and why. At that stage, our goal was to establish a contextually sensitive account of why the ventures were formed, why the initial product had the type and form it had and why and how the ventures made decisions about the offering and how it could change. The interviews yielded rich insights about sequence through which the ventures had evolved their offerings post launch, focusing on such aspects as what were triggers for changes to the product (e.g., a collaboration with an incumbent, novel insights about user behavior, actions by competitors), what were changes to the product, and what was the outcome of these changes. After initial data analysis (which also included archival data), when our focus on the mechanisms underlying post-launch digital product innovation concretized, we returned to the case organizations for a second round of interviews where possible, this time to probe more specifically the emergent concepts (mechanisms) that unfolded through our inductive analysis. Formal interviews lasted between 35 and 90 min (average 53 min), were audio recorded and resulted in 207 pages of transcribed interviews. Informal interviews took place as one-on-one conversations during case visits and communal meetings, did not follow a specific protocol, and relied on note taking and memos instead of recording. These informal interviews

Table 1 Case overview

Case code name	ContentBlock	ScanFeet	RemoteService	EventPromo	TowCar	ContactUpdate
Founding year	2011	2014	2015	2016	2016	2017
Founding Context	The browser extension had existed for several years prior to founding the company. The lead developer was approached by the future CEO of the company with an idea on how to monetize it the software	The founder had experience in the shoe and apparel industry and realized that today's shoes were built with lasts that did not represent the population	Prior to founding RemoteService, the founder had founded a venture that designed wind turbines. Here, he noticed the difficulties with servicing turbines in the field	The founders were festival organizers, and came up with idea in response to difficulties in marketing and selling tickets	One of the founders had his own workshop and thus knew about the industry structure. He saw an opportunity for a low-cost, fast alternative to established services	The founders noted after they graduated university, that they lost track of many fellow students and thus came up with the idea
Scope	Global leader	National reach	National reach	International reach	International reach	Regional reach
Description	Upon founding, ContentBlock adapted the content-blocking functionality to release, among others, several apps, a browser. ContentBlock coopted several publishers to set up a program for whitelisting, which made exempt some forms of content from content blocking. Recently, ContentBlock sought to make content-blocking more widely available, such that the core functionality would be used by IT administrators and as part of other products	A key ambition was to increase scan accuracy and avoid that people would be recommended shoes that did not fit them. As such, ScanFeet began to support a larger variety of scan solutions and asked for feedback from customers. Lately, ScanFeet made available their scan algorithm to third parties. Expanded the solution to other clothing items	RemoteService was driven to better understand how they could enhance remote support teams, and learned that storing and making accessible knowledge played a key role in real-time field support. As such, RemoteService catered its solution to a variety of machines and industries and introduced additional functionality for storing and making available knowledge	Upon launch, EventPromo adapted the offering to also promote consumer products and other services via micro-influencers. Released an API so third parties could easily integrate the functionality into their own products. Tokenized the promotion of these objects and conducted an ICO	Created a white-label version of the platform that car rentals and other companies could use. Collaborated with automotive suppliers to develop an integrated service system around towing	Pivoted from maintaining personal contacts to a b2b solution that ensured customer data is up to date. Integrated a variety of applications that were widely used by potential customers. Designed API so companies could check if (some part of) their data was outdated
Industry	Online advertising (b2b2c)	Apparel (b2b)	Manufacturing (b2b)	Online marketing (b2b2c)	Automotive (b2b2c)	Cloud computing (b2b)
Digital Market Offering	Open-source browser extension for content-filtering and ad blocking	A solution for 3d scanning feet in order to find best-fitting shoes	A solution for secure and reliable communication for remote servicing of industrial machines and equipment	Peer to peer marketing solution through which brands can engage fans to promote services (e.g., apparel, events) in exchange for rewards	Matching platform for broken down cars with road assistance services	Digital platform for contact management to keep contact information always up to date

Table 1 continued

Revenue Model	Charge advertisers for being whitelisted	SaaS	SaaS	SaaS	Fee per transaction	SaaS
Data sources	3 formal interviews and 4 informal interviews (held in Sept. '18, Aug. '19, Sept. '19, w/CEO, CTO, and co-founder), company blog posts (12), software release notes	2 formal interviews, 4 informal interviews (held Aug.–Sept. '18 and Sept. '19 w/CEO, head of development), video and audio material (documentary, interviews, pitches), company blog	2 formal interviews (held in July '18 and Aug '19 with CEO), company blog, video material (2 pitches, 1 panel discussion)	2 formal interviews (held in June '18 and Aug. '19 w/CEO), Secondary interviews, terms and conditions, social media posts, ICO whitepaper	1 formal interview, 3 informal interviews (held in Aug. '18 and Oct. '18 with CEO), company blog posts, industry press	1 formal interview, 1 informal interview (held in Aug. and Sept. '18 w/co-founder & CTO), social media posts (Facebook and Twitter), video material (pitches, roundtables)

provided valuable insights into recent developments (e.g., pending release of new features, status of customer negotiations, hiring plans). They ranged between 21 and 37 min in length.

Second, we complemented this data with archival data on the case organizations to support our theorizing. We felt these additional data sources were important to inform ourselves on further developments that remained unaddressed by our interviews. For instance, many ventures announced new offering features on their company blogs, or through digital channels such as Medium, Twitter or Facebook. These sources thus helped us to complement and enrich the primary data collected through interviews and observation. Overall, we collected company blogs, press releases, published interviews, release notes, audio and video material (e.g., pitches, roundtable discussions, terms and conditions, industry reports), and social media data, oftentimes covering the ventures' entire lifecycle. This added another 65 pages of written material, and approximately 58 min of audiovisual material.

Third, we also drew on communal, informal sources of data (Alvesson and Kärreman 2007; Fiske 2004): we regularly attended start-up events (e.g., pitch events, startup fairs, hackathons) to engage in discussions with the founders and to inform ourselves on recent sectoral and technological developments. This was important for us to understand potential sectoral or technological antecedents that might instill ventures to adjust their digital offering development. A second reason was snowballing: by attending the same communal forums, we got to know several additional digital venture founders and their business models. The talks and discussions we held served as additional informal data sources and provided us a richer view of the context in which the sampled ventures operated.

3.3 Data Analysis

Our data analysis aimed at building explanatory theory about continuous product development in digital ventures. We consequently focused on developing explanations for the unfolding of specific events that characterized product development at the six ventures. To ensure quality in our data-centric, inductive theory building (Sarker et al. 2018), we followed extant guidelines for grounded theorizing (Charmaz 2006; Strauss and Corbin 1994; Urquhart et al. 2010): we constantly compared data with emerging concepts and ensured tight linkages between the data and our conceptualizations thereof. Examples of constant comparison are provided in in Fig. 1 and Table 2. We engaged in theoretical sampling both in our iterative selection of cases based on our specified criteria (e.g., by dropping non-informative cases) and in our data collection within cases (e.g., through follow-up interviews after initial coding rounds). We developed our emerging theoretical model in iterative steps (see Fig. 1), using the Gioia methodology to maintain rigor in conceptualization and scaling (see Table 2).

Our overall analysis process is illustrated with examples in Fig. 1. Broadly, we followed the approach suggested by Gioia et al. (2013), that is, we built a data structure (Table 2) that included the open empirical codes we identified from the raw data and then summarized these in the form of 2nd order theoretical categories. The results from the 1st and 2nd order analyses then served as the basis for generating our main (3rd order) theoretical concepts, drawing on the notion of mechanism (e.g., Gross 2009) as an analytical lens (Strauss and Corbin 1998). We proceeded in five main steps:

First, we started with within-case analysis (Miles et al. 2014) and wrote structured case narratives (Table 1) to gain

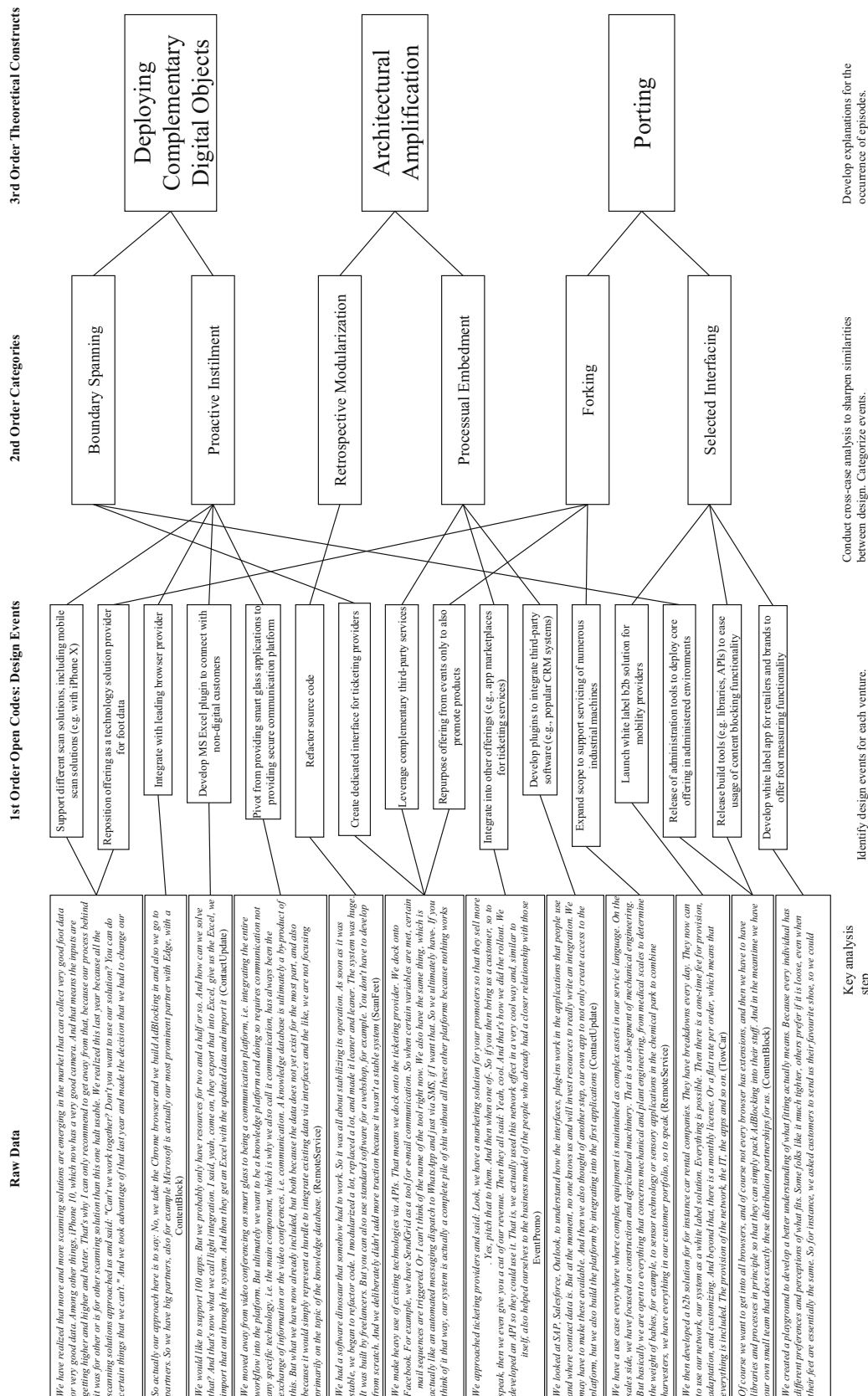


Table 2 Data structure with mappings of 1st order design events to 3rd order mechanisms

Illustrative 1 st order empirical codes (design events)	Case	2nd order theoretical category	3rd order Mechanism
Launch initiative for whitelisting to evade blocking content	ContentBlock	Boundary Spanning	Deploying Complementary Digital Objects
Create dedicated interface for ticketing providers	EventPromo	Boundary Spanning	
Create substantial digital video material and tutorials	TowCar	Boundary Spanning	
Support different scan solutions, including mobile scan solutions (e.g., with iPhone X)	ScanFeet	Proactive Instilment	Architectural amplification
Integrate with leading browser provider	ContentBlock	Proactive Instilment	
Pivot from providing smart glass applications to providing secure communication platform	RemoteService	Proactive Instilment	
Develop MS Excel plugin to connect with non-digital customers	ContactUpdate	Proactive Instilment	
Integrate into other offerings (e.g., app marketplaces for ticketing services)	EventPromo	Processual Embedment	
Develop plugins to integrate third-party software (e.g., popular CRM systems)	ContactUpdate	Processual Embedment	
Release of ad-blocking mobile application for iOS and Android	ContentBlock	Processual Embedment	
Refactor source code	ScanFeet	Retrospective Modularization	
Release of stand-alone mobile browser	ContentBlock	Forking	
Develop b2b version based on core algorithm	ContactUpdate	Forking	
Reposition offering as a technology solution provider for foot data	ScanFeet	Forking	Porting
Expand scope to support servicing of numerous industrial machines	RemoteService	Forking	
Repurpose offering from events only to also promote products	EventPromo	Forking	
Develop white label app for retailers and brands to offer foot measuring functionality	ScanFeet	Selected Interfacing	
Release API to enable use of offering in third party services	TowCar	Selected Interfacing	
Launch white label b2b solution for mobility providers	TowCar	Selected Interfacing	
Release build tools (e.g., libraries, APIs) to ease usage of content blocking functionality	ContentBlock	Selected Interfacing	

a deep contextual understanding of each venture (Gioia et al. 2013).

Second, using a temporal bracketing strategy (Langley 1999), we identified from the raw data for each venture the sequence of salient *design events*, beginning from the moment they first introduced their initial product to the market, to understand how they continued to develop their offerings post launch. We defined a design event as any action or sequence of actions that was palpably related to the development of a digital product as an artifact. Examples include the launch or discontinuance of new features, the revision of existing features, and the branching or forking of the core offering. By contrast, hiring new employees or raising new funds did not qualify as design events in that sense even though they were critical events during the ventures’ trajectories. Figure 2 shows the resulting timeline of salient design events by venture. This step allowed us to develop a comprehensive account of what the temporal and logical occurrence of design events

was through which the ventures evolved their products (Miles et al. 2014), as a complement to our analysis of the designing mechanisms that explain how the design events contributed to the ongoing development of the digital products.

Third, the sequence of design events then formed the basis for cross-case analysis, as we shifted our attention towards developing more abstract and general explanations for why the design events took place and how they unfolded. In so doing, we compared design events across the six cases to gain understanding of what were the triggers and outcomes of these design events and to what extent similarities or differences could be observed in the design events salient for each event. To that end, we generated 2nd level theoretical categories that captured and aggregated similarities experienced across the design events for each venture. For instance, we noticed that some design events targeted at adapting the product to enter adjacent markets (e.g., adding functionality to promote any

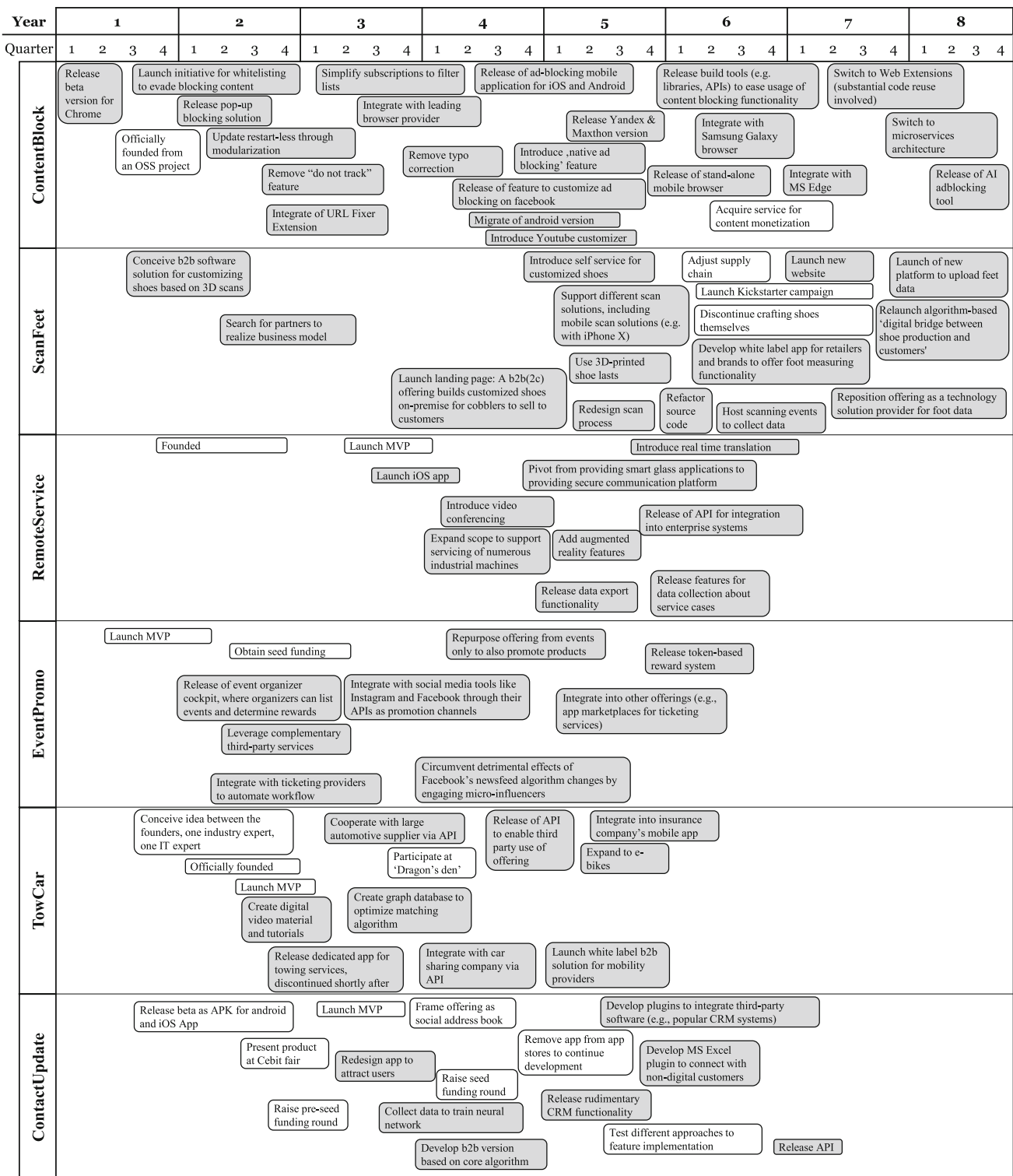


Fig. 2 Timeline of salient design events (light grey) and selected other important events (white), by venture

sort of service/good in the case of EventPromo), while others revised the product architecture to ensure its long-term prosperity (e.g., ScanFeet did substantial refactoring, thereby delaying the development of new features).

Elaborating these similarities and differences, we advanced six 2nd order theoretical categories of design events (Fig. 1) that captured what their main triggers and outcomes were. For instance, we learned that some events

aimed at integrating the products into the surrounding socio-technical environment through the deliberate design of complementary digital objects in response to potential incompatibilities between the product and its environment (boundary spanning), whereas others made core functionality available to third parties to broaden the scope of the offering (selected interfacing).

Fourth, we then sought to cluster as well as to differentiate the categories to analyze what were the overarching mechanisms that generated the observed events and categories. By comparing the categories to analyze if they co-occurred or were independent from each other, we identified three broad themes of product development prevalent at the six ventures: (1) expanding the scope of a digital product with new and revised features, (2) revising the architecture of the digital product, which did not necessarily involve in the introduction of new features, and (3) adapting the product to new use cases. Elaborating the empirical characteristics of these themes, we derived three theoretical mechanisms, namely *deploying complementary digital objects*, *architectural amplification*, and *porting*. In line with other mechanism-based theorizing (Henfridsson and Yoo 2014; Huang et al. 2017), we use the term mechanisms as analytical concept to capture the relationships between causes and effects (Gross 2009). That is, we defined different mechanisms as explanations for the unfolding of design events and how they contributed to the development of the product (Hedström and Ylikoski 2010). For each mechanism, we sought to understand from the data the triggers (what are the circumstances when the mechanism is enacted), the actions (what are the specific activities performed by the ventures that underpin each mechanism), and the outcomes (how does each mechanism contribute to the development of the product), which we aggregated within the label and definition in the mechanisms we propose.

In a fifth and final step, building on the temporal bracketing of design events in step two, we then analyzed the logical-temporal relationships between the mechanisms and how they collectively contributed to continued product development within the ventures. By comparing the sequences of design events (and their conceptual aggregation into 2nd order categories) over time and across the six ventures, we uncovered how the mechanisms sequentially conditioned one another (e.g., the outcome of one mechanism triggered the enactment of another mechanism). For instance, we learned that adapting the product to new use cases typically then required substantial revisions to the product’s architecture. Similarly, the deployment of digital objects then required the ventures to maintain a close look at level of technical debt they accumulated, such that it occasionally triggered architectural amplification.

We captured these relationships in the form of six conceptual connections between our 3rd order mechanisms.

Table 2 summarizes our data structure and illustrates how we arrived from the 1st order empirical codes (i.e., from design events encountered by each digital venture) through summarization and abstraction to the three 3rd order mechanism that explain how which digital ventures evolved their digital products post launch: *deploying complementary digital objects* (the mechanism by which digital ventures deploy a collection of digital data, services, and infrastructure to integrate their offering into its socio-technical environment), *architectural amplification* (the mechanism by which digital ventures leverage their offerings’ malleable and generative potential to facilitate dynamically unfolding interactions between their offerings and other actors), and *porting* (the mechanism by which digital ventures isolate and then deploy core digital technology underlying their product to new use contexts in order to pursue additional innovation trajectories). An example is ScanFeet. ScanFeet initially engaged in *proactive instilment* to expand the range of available scan options. However, this also increased the level of technical debt ScanFeet had to deal with, such that it triggered *retrospective modularization*. This modularization, in turn created opportunities for them to white label the core technology and make it available to third parties, thus leading to selected interfacing.

4 Continuous Product Development in Digital Ventures

Upon the launch of their offering, all the ventures in our study were aware that their entrepreneurial journey had not yet concluded. Instead, the ventures were guided by a broad vision of what they wanted to achieve with their ventures and what they represented, and in that sense viewed the launch of their offering as a means to an end and intermediate step towards realizing their visions. For example, ContentBlock had the vision of putting users in charge of a fair web experience and devised a content blocking software that could block ads and other content on websites, yet encountered countless counter measures by those affected (e.g., publishers) to circumvent the blockade. ContentBlock’s chairman referred to this dynamic as a race that triggered several design decisions related to the offering’s scope, how it is distributed, and accompanying digital initiatives to materialize their vision.

As such, we found that the ventures knew they had to continuously evolve their market offerings after launch. Yet, we also discovered that their design visions evolved over time: new goals emerged as the ventures launched their offerings and learned what could be done with them.

For example, the CEO of RemoteService reflected on the how their digital offering evolved over time:

We evolved from a not really finished to a more finished to a supposedly finished product. So you still can't say it is finished because we still learn and understand better what is necessary and what we have to do differently, better and complete. We know we are 90% on track, but that we are still questioning what we can do better. [...] And our MVP was an educated guess of the product, which we thought our customers would like to have and pay money for. Very limited and definitely not finished. That's how we won first customers. [...] But then of course we realized that we have to dock a lot more. Supporting service staff wherever they are at their machine to solve problems. (CEO RemoteService)

As captured in the quote above, the ventures faced substantial uncertainty in the time following the launch of their offerings, seeking to establish themselves as viable organizations. Our analysis yielded a number of recurring patterns in how the ventures digital ventures dealt with this uncertainty through continuous reenactment of their digital offerings. We captured these patterns through three mechanisms: *deploying complementary digital objects*, *architectural amplification*, and *porting*. Collectively, these mechanisms explain how the digital ventures we studied evolved their market offerings over time.

4.1 Deploying Complementary Digital Objects

Following the launch of their digital offering, the six digital ventures started to deploy dedicated digital objects (e.g., data, services, tools, and/or infrastructure) to integrate their offering into the socio-technical environment for which it was designed. Central to this deployment was the ventures' realization that they were often much more advanced in their use of digital technology than other stakeholders in their environment, which imposed additional effort on them to be able to create envisioned value within that environment. Tapping domain-specific knowledge and synchronizing existing structures through complementary digital objects was thus key for the digital ventures to create a viable business around their offerings once launched. To that end, the digital ventures made a clear distinction between *complementors* that digital ventures coopt to implement their business idea) and *users* (consumers of their offerings). They engaged each stakeholder type through carefully designed digital objects that served to embed their offering into the environment in which the stakeholders operated. For example, the ventures we studied oftentimes were aware that adoption of their offering for both complementors and users posed a burden

that could be lessened by building on available complementary digital objects, such as stablished digital infrastructures like mobile computing or web browsing. We refer to this mechanism as *deploying complementary digital objects*.

We found two distinct activities in which this mechanism manifested: *boundary spanning* and *proactive instilment*. *Boundary spanning* captures the activities by which the digital ventures, through their use of complementary digital objects, were able to engage and onboard *complementors* they required to materialize their business model. Examples of such objects included video material and tutorials, dedicated digital web apps) through which complementors could be on-boarded with minimal effort, or digital infrastructures and tools (such as GPS and social media) that established convenient workflows for complementors around the offering. These objects allowed complementors to actively partake in and benefit from the entrepreneurial initiatives by the ventures. At the same time, the ventures were able to demonstrate to complementors the value partaking would yield, without disrupting the complementors' established organizational structures. Deploying and using these digital objects was crucial because they ensured compatibility between existing ways of working and the novel value proposition of the ventures' offering, thus spanning the boundaries between the old and the new.

For instance, TowCar, with its digital offering that readily connects individuals whose car broke down with towing services, entered a largely non-digitalized industry, where a large portion of business transactions were still arranged via traditional channels such as telephone or fax machines. It proved difficult for TowCar to onboard complementors (i.e., towing service providers), who oftentimes only operated the most basic IT infrastructure and also lacked required skills to readily adopt the digital service offering. The CEO told us:

there are also towing services, they are just a bit-. Let's put it this way, it's a craftsman's business. And accordingly, they are not economically trained or thought. And some simply say: We've always done it that way. (CEO TowCar)

TowCar deployed various complementary digital objects to overcome these difficulties. While TowCar initially developed a dedicated mobile app for towing services ('partner app'), they abandoned further development of the partner app because only very few complementors possessed and used mobile devices in their working environment to begin with. Further, installing the app proved difficult for complementors because the app was not available via app stores because one of the app's core features did not comply with app store review guidelines.

TowCar ultimately focused on offering its services via web browsers, thereby circumventing both of the aforementioned difficulties by leveraging existing and familiar digital infrastructure that yielded a better fit to the complementors even if the technology was considered outdated.

A second activity through which *deploying complementary digital objects* manifested was *proactive instilment*. Through proactive instilment, the digital ventures sought to render their offering accessible to potential users, that is, they attempted to deploy digital objects to remove bottlenecks and barriers to adopting the offering. Proactive instilment thus captures digital ventures’ activities aimed at enabling user adoption through complementary digital objects. To do so, the ventures scrutinized existing user habits, to learn how they could integrate their offering into user routines. For instance, rather than requiring users to visit local scanning spots to scan their feet, ScanFeet leveraged modern smartphones’ sophisticated cameras to simplify the overall process for future users.

Complementary digital objects were key to proactive instilment because the digital ventures could not know in advance how exactly their offering will be appropriated by users. As such, they deliberately exposed their offerings to the environment and sought feedback about obstacles that would hamper their adoption. They then addressed those challenges through the design of digital objects that simplified the adoption. For instance, upon the launch of their offering, RemoteService faced substantial difficulties facilitating adoption of its secure, real-time communication solution for remote support. To ease adoption, RemoteService then released complementary digital tools for logging the contents of the communication and reporting to support user workflows. As the CEO told us:

Some customers used our tool in ways we didn’t even aim for. So they formed workarounds using tool and used our tool for processes that we didn’t even plan to support. So documentation, inspection, quality control, which we hadn’t planned for that at all. For us it was always about solving problems on site as quickly and easily as possible. And of course, feature requests evolved from this. [...] A very concrete example: we never really wanted to support the documentation of cases on mobile devices for technicians on site. But then we made something like this possible, which completely destroyed the UX. And yes, a certain uncontrolled growth has happened. (CEO RemoteService)

Overall, the deployment of complementary digital objects facilitated the integration of the ventures’ offerings into the environment. However, it often also led to what one CEO also referred to as *featuritis*: it created an

architectural challenge because the core offering and features of a digital product had to connect also with a wealth of complementary digital objects. This circumstance led the ventures to renegotiate the architecture of their digital market offerings. We detail this in the following mechanism.

4.2 Architectural Amplification

A second mechanism we uncovered captures digital ventures’ actions by which they leverage their offerings’ malleability to expand the scope of the offering post-launch, for instance by modifying the product architecture such that it can integrate third-party offerings or expand to include complementary, adjacent features. We refer to this mechanism as *architectural amplification*.

The architectural amplification mechanism should be comprehended in light of digital ventures’ awareness that the initial launch of a digital offering merely represented a means to an end, not an end in itself. As such, digital ventures sought to enable their offerings to be enriched with additional functionality. One way to do so was by curating their offerings’ architecture and by integrating (into) third-party offerings. Architectural amplification is thus key to ensure digital ventures’ offering’s long-term viability, fostering its role as a launchpad for future entrepreneurial actions. From the data, we found this mechanism to be constituted by two activities: *retrospective modularization* and *processual embedment*.

Retrospective modularization captures activities through which digital ventures ensure that their offering exhibits typical digital technology traits, such as modularity, malleability, and generativity, but only after an initial product version was launched. This activity was central to secure the ventures’ future prosperity, since the initially launched offerings oftentimes exhibited a monolithic, integrated, and inflexible digital architecture (rather than a modular, flexible digital architecture). An inflexible architecture was the result of time and resource constraints typical for an early market entry, and the ad-hoc decision making style that is typical of early stages of entrepreneurship: during their early days, the digital ventures focused on creating an offering that worked (Ries 2011) and served to evaluate the business idea, rather than creating a fully-fledged, coherent, and modular digital offering. Specifically, the ventures we studied experienced several unforeseen events that led them to diverge from initial plans. Coping with these changes often had wide-ranging implications for the market offerings and required them to adjust it. As a consequence, the digital ventures already had accumulated some level of technical debt that posed a threat to the ventures’ flexibility. In response, many adopted modern, modular

digital design paradigms to reestablish flexibility and ensure the offering’s long-term viability.

To illustrate, consider ScanFeet’s efforts to refactor its core offering after launch. The initial offering was originally developed by a group of contractors. While ScanFeet’s product backlog filled quickly with new feature requests, they decided to stall their implementation and instead shift attention to refactoring the offering’s monolithic digital architecture. As the head of development noted:

The system had grown historically. I know how difficult it is to learn your way around existing code. And the time wasted on this could have been put into developing new features. [...] And the application was way too big. A huge monolith, which didn’t run stable at all. That’s why I didn’t pull any traction on it. [...] We first had to make sure that the infrastructure worked, because nothing was there! [...] We switched rigorously to standard software, and where we had to customize, those parts we developed ourselves. And I used a lot of APIs to handle sensitive things like checkout [in online shops]. And that really wasn’t easy. [But] we wanted to scale, which meant that we also had to get the data clean. [...] And I’ve always been under a lot of pressure to bring new features out, but we needed the infrastructure in place first. [...] And we had an internal project in which we increasingly modularized the entire code. Because contractors brought in a lot of redundancy. And we modularized it very rigorously, such that we would have a set of highly modular building blocks. (CEO ScanFeet)

Processual embedment captures the activities by which digital ventures sought to complement their digital offerings by enabling it to fit into a broader variety of different business processes. Processual embedment requires a deep understanding of the environment in which offerings were meant to be situated in. The ventures viewed their offerings not in isolation but as existing within a larger digital value landscape. As such, the ventures took actions that ensured their offerings could entertain manifold connections to, and interactions with a variety of digital services (e.g., third party services), and subsequently integrated (into) third party digital services that were complementary to their offering. In so doing, the ventures deliberately leveraged their offerings’ malleability to devise processual routines that implicated their offerings. These routines were created by integrating third party services via standardized interfaces and procedure calls, in which their offering could assume an integral role. In turn these actions increased the value their offering delivered to immediately.

For example, ContactUpdate enabled the creation of user workflows around its core offering by identifying potential digital touchpoints that users could have with other complementary services while using ContactUpdate’s offering. To that end, ContactUpdate manually wrote integration scripts in the form of software plug-ins for common CRM software, such that users could also access complementary CRM functionality while using ContactUpdate. As one of the co-founders noted:

We will offer CRM-like functionalities for smaller companies via the web. However, we don’t want to be a CRM. [...] So it’s better for us to use third party services. Either, we’ll integrate with Zoho. Such that we can simply integrate a CRM in the background, without letting customers know, without them having to log into a separate system or even realizing that we use a separate system. We just want access and integrate some CRM features. And then we upload it from our system into this CRM. And then we simply set CRM campaigns. And we always ask ourselves whether we should program such features ourselves? At the moment, we have. But if we now need reminder and tracking possibilities, to determine who clicked on the links we sent, can’t we perhaps somehow do this via a CRM campaign, because these systems already come with such a functionality? Or is there a way in the configurations of CRM systems, because they allow us to define the workflows so that we don’t have to program these functionalities. So, how can we possibly just access and tie together different elements or parts of our flow and integrate them via different interfaces? (CTO ContactUpdate)

Processual embedment not only allowed the ventures to increase their offering’s value creation potential without having to invest resources in developing new features, but also ensured the ventures remained flexible and independent. Processual embedment occurred in an ad-hoc manner and usually did not involve a long-term commitment on the side of the digital venture: The digital ventures did not prescribe and demarcate specific use cases for their offerings. They merely ensured their offerings’ compatibility and compliance with dominant technological standards, such that it could interact with diverse digital resources and be implemented in common digital business processes by third-party providers. Yet, these temporary assemblages could be resolved once obsolete, thereby minimizing the entrepreneurial risk associated with such actions. As such, their digital offerings’ ability to be modified and reenacted with comparably little effort and the venture’ increasing mastery thereof, enabled expansion of the digital market offering and offering beyond its initial scope, which we detail in the following mechanism.

4.3 Porting

The third mechanism we uncovered portrays how digital ventures put core digital technology to new use contexts in order to pursue additional innovation trajectories. We refer to this mechanism as *porting*. Porting represented an important means for ventures to advance their entrepreneurial initiative post launch beyond their initial ambitions.

Porting should be comprehended in light of the competitive dynamics that are typical of digital fields, where competitors (e.g., incumbent organizations or other ventures) can easily copy features once they are released. The digital ventures we studied closely monitored the progress they made with their venturing efforts, and simultaneously searched for additional opportunities to leverage their digital offering's self-referential, distributable nature. Realizing the constant threat posed by uncertain market conditions and strategic moves of competitors, porting allowed digital ventures to increase their reach and strengthen their market position, while reducing the risk falling prey to copycats offering similar offerings. Yet, porting in itself also represented a challenging endeavor, since it required the ventures to invest often scarce resources. Digital ventures navigated this tension by skillfully drawing on already existing digital technology. We found at least two activities supporting the porting mechanism: *forking* and *selected interfacing*.

Forking captures activities through which digital ventures used digital technology that was core to their offerings to pursue additional innovation trajectories that were a variant of the original digital venture idea. Oftentimes, such additional opportunities were discovered in adjacent markets that the ventures had not planned to enter. For instance, opportunities emerged because users made the ventures aware of an added value or expressed the desire to have a similar service but in a different market. In response to such realizations, digital ventures had to make a decision on whether to pursue additional innovation trajectories, while confronting substantial uncertainty and resource constraints.

When pursuing forking, we found that the digital ventures leveraged the knowledge they acquired previously to streamline the launch of additional products. The ventures probed ways to materialize new innovation trajectories by analyzing new contextual conditions in which the offering was to function. Thereby the digital ventures accommodated new use contexts in their digital offerings. They did so by distinguishing and isolating core features from the contextual features. As a result, digital ventures were able to swiftly recondition core digital technology to new use contexts, where a new context was reflected in a set of additional features to complement and contextualize the core.

For instance, RemoteService's core digital technology is a digital platform for secure and reliable communication between locally dispersed individuals to support and improve servicing of complex industrial machines. Once RemoteService had mastered technological details to ensure these qualities (e.g., secure and reliable communication and subsequent documentation), as well as details of onboarding users through the use of digital resources (e.g., video material, and related workflows), they were able to streamline these activities when tapping into new contexts where these qualities were equally important. More specifically, RemoteService's original use context was servicing large and complex land machines. However, soon they realized how other contexts similarly depended on and would benefit from secure and reliable communication, such as servicing medical equipment containing sensitive data. In response to this, RemoteService created a digital platform that ensured these properties, while separating and clustering context-specific functionalities (such as support for proprietary devices) that could be patched in on premise and maintained mostly independently from the core. More specifically, consider how RemoteService, in progressing its entrepreneurial initiative separated core (secure and reliable communication platform) from context (smart glass as tool to carry out communication), only to discover additional opportunities for using core technology.

We initially focused on technology to provide video conferencing with augmented reality on smart glasses, [...] but then discovered what customers really wanted. And they didn't want a video conferencing tool for smart glass, but a communication platform and possibility to have their entire servicing workflows in one platform. And additional features, such as documentation and knowledge capture, are only possible because of the communication services. Our business was always about the exchange of information, be it in the form of video conferences or other. But we have always taken additional aspects into account to create a more coherent workflow. And our target market is mechanical and plant engineering. This includes almost every industrial sector. We have a use case wherever complex devices need to be maintained, from medical scales to sensory applications. And the core features remain the same. We currently individualize the topics of documentation, i.e., according to which logic cases are stored and filtered. (CEO RemoteService)

Forking allowed the digital ventures to pursue additional innovation trajectories, while minimizing the effort required to do so. The quick reenactment of context-specific features enabled the ventures to speed up their

launch and leverage existing knowledge to reduce and cope with uncertainty.

EventPromo is another case in point: initially, EventPromo focused on promoting events (e.g., concerts, festival, and sports events), to *boost conversion, ticket sales, and reach* by engaging ambassadors (so called ‘nano influencers’) who actively promoted an event by performing pre-defined promoting activities (e.g., share a post on Facebook or Snapchat). However, realizing that mechanisms for promoting events through ambassadors likewise applied to consumer goods and other services as well, EventPromo relaunched their offering under a new name, marketing it as a digital solution for promoting all sorts of artifacts (e.g., shoes, consumer products), along with context-specific bundles of additional functionality. For instance, promotion of events involved integrating with ticketing providers’ IT systems, while promoting consumer products required integration of shop systems. Collectively, these activities allowed digital ventures to pursue additional innovation trajectories in a lean way while minimizing associated risk and costs and avoiding pitfalls.

The other activity we unearthed from the data that manifested porting was *selected interfacing*, which captures how digital ventures opened their core digital technology, such that third parties could connect and employ the functionality for their own purposes.¹ Central to this was digital ventures’ ability to bundle digital technology functionality (e.g., software features) into modularized subsets that were made available via APIs. Selected interfacing allowed digital ventures to establish themselves as a “go-to provider” for a particular service. Further, selected interfacing presented a means for ventures to defend against copy-cats imitating their business model.

For instance, ContentBlock bundled its core functionality, namely blocking ads, by providing dedicated build tools that third parties could use to produce builds of the content blocking solution. Further, ContentBlock actively promoted this way of accessing its functionality by providing dedicated application programming interfaces and by signing strategic deals. Reflecting on the strategic importance of one such deal, the chairman noted:

Once you install this browser, a dialog box appears that says, “You can now block ads with ContentBlock”. It’s our logo, it’s our trade mark, and the user only has to click yes and he’s good. And that is of course something completely different than installing an extension. [...] To simply click ‘yes’ in a

process that you go through anyway, is of course much easier. And in this case, [the web browser developer] approached us and we put together a team that does just this sort of thing. Because we see it as strategic growth path: Of course we want to get into all browsers and of course not every browser has extensions and then we just have to provide libraries and processes so that they can simply integrate our adblocking functionality. (Question: And what prevents them from doing that themselves?) They could do that. That’s legit. In the end they also know that it’s not quite as complex and [the browser developer] could put a lot of resources on it. [But] doing adblocking properly is also not that easy. Adblocking isn’t as trivial as it used to be because countermeasures become more complex. [And they] get it for free from us. We don’t want any money for that. For us, it means growth. We increase our reach and they get the feature always perfectly maintained, always updated libraries, well documented adblocking libraries, and APIs. What more could you want? (CEO ContentBlock)

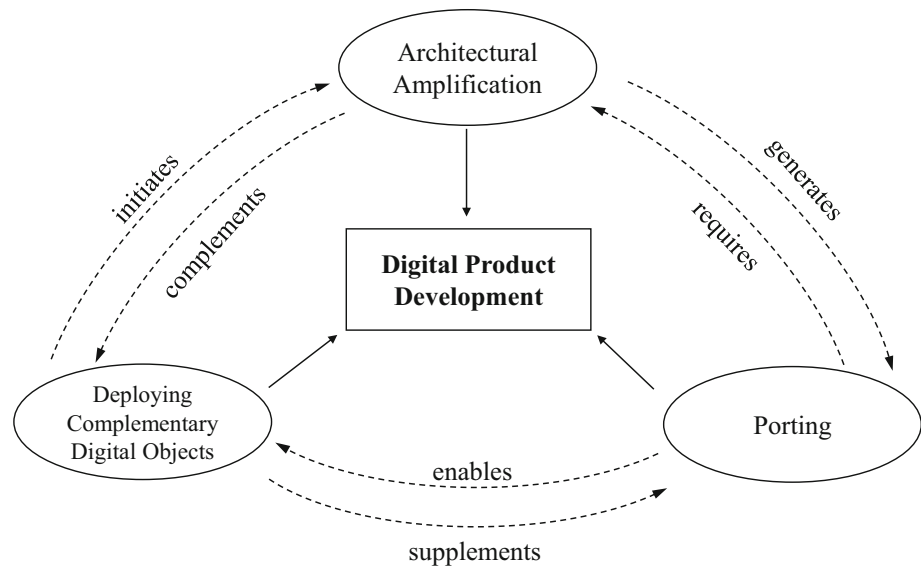
Selected interfacing thus allowed the ventures to progress their venturing efforts and offering, while increasing reach and improving market position. Yet, selected interfacing varied in scope, ranging from interfacing just a limited set of selected core features as in the example above, to interfacing almost the entire offering. For instance, in addition to the b2c solution TowCar entered the market with, TowCar later decided to also release a b2b solution of its digital offering as a white-label solution, that third parties could adopt, such as car rental and car sharing providers:

With our b2b version, which we also call white label solution, we try to win car sharing companies and car rental companies, as customers. This means that even if end users call the car sharing company because their rental car broke down, this gets forwarded to us. And we approached them saying we grant you access to our network, we have the system, we could integrate [this feature] into the app or we integrate your call center, they can just report incidents to us, or they get a portal or a white label solution. Or an interface. We work a lot with interfaces, so we have an API that is very simple. And then they can report incidents directly from their system with a simple mouse click. (CEO TowCar)

In the case above, interfacing spanned nearly the entire offering, except for features that were specific to the original use context (e.g., the auctioning mechanism by which the matching takes place in b2c contexts). TowCar

¹ While this is a common tactic for platform providers as well, selected interfacing does not result in the company becoming a platform. Our analysis suggests that digital ventures primarily enact this activity as a means to enter into other adjacent markets without high resource commitments.

Fig. 3 Emergent model of continuous post-launch product development in digital ventures



realized the importance of such a move on the route of becoming a viable organization. One of the co-founders described the strategic importance of such initiatives as follows:

We also work with [a major supplier]. They approached us because they want to enter the breakdown service market. And they were looking for a network and thought: They could set up a network themselves or build on an existing network. And we already had a network. They said: Okay, we'll take TowCar. And they use it for eCalls, which will be mandatory for new cars next year. And there will be a button in your car that connects you to the next support center. [...] And they just thought: 'We're already in the car, with the eCall and the concierge service. We could also do breakdown service.' That was their idea and they looked for a network. [...] And they are now trying to diffuse our network, our technology, to car manufacturers, to fleet customers, etc. (CEO TowCar)

5 Emergent Theoretical Model

Our empirical analysis uncovered three specific design mechanisms through which digital ventures continuously develop their digital offerings post-launch. Figure 3 presents our emergent theoretical model that captures these design mechanisms together with the mutually constituent relationships between them. This is important because our analysis of the temporal-logical relationships between the

mechanisms indicates that they do not occur in isolation; they interact with and constitute one another.

First, the *deploying complementary digital objects* mechanism was key for architectural amplification to occur, as the deployment of digital objects to integrate their market offering into the environment allowed the ventures to develop deep insights about user habits and needs, thereby *initiating* change in the market offerings' digital architecture. Consider how ScanFeet adjusted its scanning algorithm to also allow for inputs from new sensor technologies such as the iPhone X camera. Further, the deploying complementary digital objects mechanism *supplements* porting in that digital ventures more readily identify niches to tap with their offerings. An example is EventPromo, whose integrations with social media tools allowed them to better understand how to promote all sorts of goods and service.

Second, the architectural amplification mechanism is essential for the further development of digital ventures' market offering. On one hand, architectural amplification, in the form of retrospective modularization, *generates* options for the venture to address emergent demands and new use contexts through porting. Only by having a modular and well-maintained digital architecture, can digital ventures isolate core technology and deploy it to new contexts. ScanFeet, as an example, was suffering from a fragile digital architecture, which needed to be refactored prior to developing a white-label solution. On the other hand, architectural amplification also *complements* the deployment of digital objects in that digital ventures can readily connect to the various resources they draw on to

instill their offerings into user workflows. TowCar, for example could simplify the onboarding process for towing services by clearly demarcating the areas in which it would be active, thanks to the development of a graph-based matching algorithm.

Third, porting interacts with other mechanisms in two important ways. First, in order to port, digital ventures *require* a digital architecture that supports such design acts rather than prevents them. For instance, monolithic digital architectures hamper their deployment to new use contexts. Consider how ContentBlock switched to a micro-service-based architecture prior to pursuing new collaborations with browser developers. Second, as porting allows digital ventures to enter new industries, it *enables* the deployment of further digital objects to accommodate new use contexts, for example in the form of dedicated APIs for specific industry segments. RemoteService, for instance, added augmented reality features as it began support the servicing of particularly large machines.

6 Discussion

Our study contributes to the blossoming discourse on digital entrepreneurship (Berger et al. 2019; Von Briel et al. 2021; Nambisan 2017; Steininger 2019) by developing three new empirically grounded theoretical mechanisms (deploying complementary digital objects, architectural amplification, and porting) that explain how digital ventures work on their products “on the ground”, and which are specific to the post-launch phase of the entrepreneurial journey, yet distinct from digital innovation activities prevalent in preceding (Marion et al. 2012, 2015) or succeeding (Huang et al. 2017) entrepreneurial stages. While some aspects of our analysis also feature in other studies, such as the ability to cater core digital technology to new use cases (Antonopoulou et al. 2016; Huang et al. 2021), *how* the mechanisms come together and collectively allow digital ventures to continuously evolve their products substantially advances our understanding of the role of digital technologies for entrepreneurial processes and outcomes and how they shape entrepreneurial pursuits (Autio et al. 2018; Nambisan 2017). Our multiple case study leads us to conclude that digital ventures skillfully advance their entrepreneurial agenda after they launched a digital offering by deliberately leveraging the unique capacity for change inherent in digital technology. Below we focus on three implications in particular that flow from our findings and explanation: digital artifacts and their evolution, continuous product design in digital ventures, and trajectories of digital entrepreneurship.

6.1 Digital Artifacts and their Evolution

Our study draws attention to *digital offerings* as a new unit of analysis, which responds to calls in the entrepreneurship literature for stronger emphasis on the role of artifacts (Berglund et al. 2020; Dimov 2016). An important implication that follows from this focus concerns how digital technology traits come into being. While much research has been devoted to theorizing about the consequences that digital technology’s malleability, openness, and re-programmability hold for product and service designs (Yoo et al. 2010) as well as value creation and capture (Nambisan 2017; Parker et al. 2017), little research has looked into how these traits come about. Our case analysis suggests that these traits play a crucial role in the further development of digital ventures (e.g., think of the selected interfacing activity), yet the ventures’ digital offerings often did not exhibit these traits when launched. To illustrate this point, recall how ScanFeet spent substantial time on refactoring their digital architecture to ensure their offering was malleable, generative, and open.

Our research also suggests that digital ventures need to be mindful in how they construct their digital offerings, as the changeable design of their properties influences their long-term prosperity. As our study revealed, these properties should not be taken for granted. They require deliberate design, for example by employing contemporary digital architecture design principles (e.g., micro service architectures). Existing research refers to such designs as *modular layered architectures* (Yoo et al. 2010). Our study thus points to a delicate tension for digital ventures: While designing modular and flexible *nearly-decomposable* (Baldwin and Clark 2000; Simon 1996) digital artifacts is key for digital ventures’ future development, the time and cost associated with designing such layered modular architectures are higher compared to the *quick-and-dirty* approach, that digital ventures often follow in their early days, as they seek to quickly enact and validate a business idea (Woodard et al. 2013). As such, the technical debt that ventures accumulate in their early days may hamper their future development as they evolve. A prominent example is MySpace, whose simplistic digital architecture limited its ability to sustain growth and respond to changing environments, which ultimately resulted in its failure. Future research should thus look more closely at the processes by which these traits come about, and explore the contingencies of design decisions, and how digital ventures can address the trade-off between short-term demands of being quick and long-term viability.

6.2 From New to Continuous Product Development in Digital Ventures

Past research has characterized product and service innovation as well-bounded phenomena with discrete boundaries (Nambisan 2003, 2013; Takeuch and Nonaka 1986). With our study, we show that digital ventures continue to develop their products after they have been introduced to the market to ensure they are and remain useful, and thus create value for customers (Autio et al. 2018; Autio and Thomas 2020). The mechanisms we present in this paper provide an important first step towards developing theoretical language that can be used to capture the implications of the inherently fluid and porous boundaries of digital products and services for their continuous development (Garud et al. 2008) or for organizational identity (Wessel et al. 2021). Importantly, we find that digital ventures deliberately draw on their product’s malleability and generativity to entertain relationships with a diverse set of social (e.g., market incumbents) and technological agents (e.g., third-party products), to enhance the value they generate for users (Huang et al. 2017). Our study thus acknowledges that digital ventures do not operate in a vacuum; creating value in a digital world is increasingly dispersed across multiple actors with diverse goals. An important quest for future research is thus to explore how value creation is organized and orchestrated in a digital world, to understand new opportunities that the diffusion of digital technologies into entrepreneurship brings about for the continuous development of new products.

6.3 Appreciating the True Trajectories of Digital Ventures

A core interest of digital entrepreneurship research is *rapid growth* (Huang et al. 2017; Tumbas et al. 2017a). But few studies have investigated how digital ventures’ market offerings evolve, despite the purported fusion of processes and outcomes (Nambisan 2017; Nambisan et al. 2017). Yet there is growing interest in understanding how digital ventures leverage digital technology to pursue new entrepreneurial efforts, for instance by repurposing core digital technology (Huang et al. 2021). What is unique about digital ventures is their ability to do so at comparably low costs because digital technology is malleable and has close to zero costs of reproduction (Huang et al. 2021; Nambisan 2017).

While our study takes a focus on the time *after* market launch, our findings complement this stream of research by putting into focus the products that digital ventures develop and the actions that ventures pursue on the group when doing so. The mechanisms we identified would perhaps differ, had we focused on another venturing stage. This

leads us to believe that we need a more nuanced understanding digital entrepreneurship, one in which *context* (Nambisan 2017; Zahra and Wright 2011) features more prominently. How digital ventures appropriate digital technology is likely to evolve along with the venture. For instance, concepts like *data driven operation* and *swift transformation*, which are associated with the rapid growth of digital ventures (Huang et al. 2017, 2021), did not feature strongly in our empirical data. We conjecture that one of the reasons is the focus we took in our study: data driven operation requires the existence of large volumes of data, which is not necessarily available to digital ventures upon the launch of their offerings; digital trace data streams oftentimes are generated through later iterations of the digital products where more emphasis is placed on data capturing (e.g., through more sophisticated sensor technology) or when more usage data is accrued through a much larger user base. For example, RemoteService as well as ScanFeet were actively seeking to accumulate data for the further development of their ventures, yet this proved to be difficult for numerous reasons, including a small user base. In all, we believe that future research should look more closely at the way in which digital technology’s role evolves along with the ventures that employ them.

6.4 Practical Implications

Our study also has implications for practitioners. First, it highlights that digital ventures do not exist in a vacuum. While digital technology affords potentially open-ended and unbounded possibilities for developing innovative products, those products have to be situated within prevalent industry conditions. Digital ventures need to be aware of potential dependencies, such as when relying on third-party APIs, and revise initial assumptions about their customers’ digital literacy, for instance in case they enter largely non-digital industries, to ensure that their products are fit to survive in these contexts.

Second, digital ventures, with every major change to their products, also need to balance how much technical debt they accumulate. While there are some known benefits of acquiring a certain level of technical debt, such as reduced development time, a chaotic product architecture (think ScanFeet) may severely hamper a digital venture’s ability to launch new functionality and/or adapt the product to new use cases. Ultimately, the accumulation of technical debt may thus negatively affect a digital venture’s future prospects.

6.5 Limitations

There are several limitations to our study. Foremost, typical limitations related to inductive research and the reliance on retrospective data apply to our work. For example, other research teams could collect different data, pursue different analysis strategies, or interpret the data differently from us. We attempted to report on our procedures, data and abstraction in the most transparent way possible but other interpretations and analyses remain possible.

As is common, our main source of data were interviews, some of which were retrospective. This strategy could be prone to interviewee bias, recency bias, and selection bias, which could impact the accuracy of our data. By using a variety of data sources (archival documents and interviews) and focusing on key events that were publicly traceable, we hope to mitigate potential bias. Future research could benefit from relying on real-time data to chronicle product development post launch (e.g., through commits on software development repositories), to corroborate our findings.

Finally, our sampling strategy focused only on ‘successful’ cases. As such, we are unable to make any statements about the effectiveness and expedience of the mechanisms we identified for ensuring a digital venture’s long-term prosperity. Future research may investigate if the behaviors of unsuccessful digital ventures differ from those identified in this study.

Appendix: Interview Protocol

Introduction

- (1) Welcome and thank you very much for the time
- (2) Project description: A scientific study of the role of digital technologies in startups
- (3) Aim of the interview: Understand how your startup has evolved and what role digital technologies have played and your perspective on digital technologies.
- (4) Confidentiality: If possible, the interview will be recorded for transcription and analysis. All content will be kept confidential, recordings and transcriptions will be anonymized and not shared.
- (5) Do you have any questions before we start?

Main Part

- (1) Background and context
 - Could you please describe your startup?
 - What is the startup called and what does it do? Why was the company founded?

- Who were the founders? What training do the team members have?
- Who else was involved in founding the company? How did the financing take place?
- What kind of product/service does your startup offer?
- How does the product/service offered today work? How is the product/service structured? IT components?
- What is the company’s business model? What is the central value proposition?
- Who are the target customers?

(2) Interviewee background

- What is your role in the startup? What are your tasks?
- Has your role changed over time? If so, why? What points of contact do you have with digital technologies?
- What do you understand by digital technologies?
- How and for what purpose do you personally use digital technologies in your professional environment? How has the product changed over time?

(3) Development of the product

- Could you describe your product in as much detail as possible and how you developed it?
- What did the idea look like at the beginning, how did it change? Where did the idea come from?
- Were there situations where several ideas were pursued at the same time? If so, why? What were these ideas?
- Could you describe, in as much detail as possible, how your product has changed since it was first launched and how you have used digital technologies in this process?
- How has the development path of the product changed over time?
- What has caused these changes? Why has the change occurred?
- What was the situation before and after the change? What did the product look like and how did it change over time?
- Which, and how were digital technologies used before and after the change?
- What problems and challenges arose during the development of your company?
- What did you do to counter the problems?
- How did you use digital technologies to counter the problems?

Were there any other events that had a significant impact on the company’s development? Change/Changes?

Miscellaneous

- Did we forget something you'd like to say?
- Are there any other events or circumstances worth mentioning?
- Who else could we talk to, to learn more, and can you help us get in touch?

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