Digitized Products: Challenges and Practices from the Creative Industries

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Abstract

Recent digital technologies like the Internet of Things and Augmented Reality have brought IT into companies' core products. What were previously purely physical products are becoming hybrid or digitized. Despite receiving a lot of recent attention, digitized products have only seen a slow uptake in businesses so far. In this paper, we study the challenges that keep companies from realizing the desired impacts of digitized products and the practices they employ to address these challenges. To do so, we looked at companies from a set of industries that are highly affected by digital transformation, but at the same time hesitant to move to a more digitized world: the creative industries. Based on a literature review and twelve interviews in creative industries, we developed a conceptual model that can serve as a basis for formulating testable hypotheses for further research in this area.

Keywords

Digitized products/artifacts, hybrid, digital-physical, smart-connected, cyber-physical, creative industries.

Introduction

Enriching physical products with digital technologies such as Internet of Things (IoT) technologies or Augmented Reality (AR) are increasingly relevant in research and practice. Porter and Heppelmann (2014) state that information technology (IT) is "revolutionizing products [as …] IT is becoming an integral part of the product itself." While Information systems (IS) research has traditionally focused on the impact of IT on processes, it has recently started to look at IT's impact on physical products (Herterich and Mikusz 2016; Novales et al. 2016; Püschel et al. 2016; Yoo et al. 2010). Examples of these hybrid, IT-enriched, digitized products (Novales et al. 2016) include the Philips Hue smartphone-controllable lightbulb, Audi Connect internet-connected cars, or Rolls-Royce's sensor-enabled pay per use jet engines.

Despite the attention that some of these products get, overall, digitized products have seen a slow uptake in businesses so far. According to a 2016 MIT Sloan Management Review report (Jernigan et al. 2016), only 24% of companies are actively using IoT technologies that are crucial for many digitized products. Our research tries to add to the understanding of what keeps companies from engaging in the production of digitized products. To do so, we looked at the use of digitized products in the creative industries (CIs).

On the one hand, the CIs are highly affected by digitization (think of the transformation of the music, film, newspaper and book publishing industries). Mangematin et al. (2014) even claim that "no set of industries has felt this impact [of digitization] more than the creative industries." While some CIs like music recording are moving towards a full digit*ali*zation of their products (e.g., purely digital MP3 files), there are also plenty of examples of digitized products in CIs. The German publisher Cornelsen is augmenting its textbooks with digital content; fashion designers at Levi's are developing a jacket that controls certain smartphone functions; the toy company LEGO is adding digital games to their physical bricks in products like LEGO Mindstorms, which augments assembled bricks into an app videogame; etc.

On the other hand, CIs are often considered to be especially hesitant with regards to embracing digital transformation (Farago 2017; Mangematin et al. 2014): "the role of digital technology [...] is rarely explicitly addressed" in research on CIs (Mangematin et al. 2014).

Given the fact that digitization matters to CIs, yet the resistance to employ them is viewed as high, studying what keeps CI firms from creating more digitized products can help us explore these challenges and the practices to overcome them. Thus, this paper sets out to explore the following research questions: 1) What is the (current and potential) impact of digitized products on CIs? 2) What keeps CIs firms from realizing this impact and/or getting more impact? 3) How can companies overcome these challenges? The remainder of this paper is structured as follows: first, an overview of digitized products in CIs is provided, followed by the methodology and key findings. We conclude with a discussion and the implications for future research.

Digitized products and the creative industries

Digitized products (e.g. Novales et al. 2016; Herterich and Mikusz 2016), also known as smart products (e.g. Yoo et al. 2012; Yoo et al. 2010) or smart-connected products (e.g. Porter and Heppelmann 2014 and 2015), are products that contain both physical (e.g., a car, tennis racket, mechanic machine, or t-shirt) and digital components (e.g. software, sensors, processors). According to Yoo (2013), the digitization of products is achieved via "the incorporation of digital materiality into objects that previously had a purely physical materiality." Recent research on digitized products has focused on their definition, classification and categorization (Herterich and Mikusz 2016; Novales et al. 2016; Püschel et al. 2016).

In this paper, we consider digitized products that include hybridity, smartness and/or connectivity (Novales et al. 2016). The products we consider have to include both digital and physical components and both types of components need to be integrated to complement each other in their functionality. Technologies used to integrate digital and physical components include, for example, IoT technologies, AR, and Virtual Reality (VR). Developing digitized products is far from easy for companies though. Previous research identified challenges in developing hybrid, smart, connected products (Novales et al. 2016). These can be grouped into technical, organizational and product-related challenges. On the technical side, firms have to build new technology infrastructures (Porter and Heppelmann 2014) that allow products to communicate via a network (Maass and Varshney 2008), while having to deal with hardware limitations (Sabou et al. 2009), such as mobile processing power for VR applications. Organizationally, firms are facing the challenge of adapting to "new management systems" (Lerch and Gotsch 2015) requiring them to change existing capabilities and build new ones, such as: data and information management (e.g., handling suboptimal data quality) (Sabou et al. 2009), dealing with complex algorithms (Lerch and Gotsch 2015; Sabou et al. 2009), managing devices remotely (Borgia 2014) and creating new generative platforms of knowledge and skills (Yoo et al. 2012). Even within existing capabilities, firms have to focus more on coordinating activities across functions (Porter and Heppelmann 2015) and on synchronizing the "clock speeds" of software and hardware development (Porter and Heppelmann 2014). The literature also mentions structural challenges like the more central role of IT and more complicated outsourcing decisions (Porter and Heppelmann 2014). On the product side, firms have to follow "new design principles" (Porter and Heppelmann 2014; Porter and Heppelmann 2015). This implies deciding which smartness features the product should include, which data maximizes the offering's value (Porter and Heppelmann 2015), and which functionality should be included in the product vs. in the cloud (Porter and Heppelmann 2014). While doing so, firms have to master the "simplicity paradox:" adding more features to the product, while simplifying the user experience (Mühlhäuser 2008). A prime challenge mentioned frequently in the literature is also ensuring product security and data privacy (Borgia 2014; Maass and Varshney 2008; Porter and Heppelmann 2014; Porter and Heppelmann 2015; Sabou et al. 2009).

As reasoned above, this paper focuses on digitized products in CIs. CI firms are frequently cited in the literature as examples for producing digitized products: Ralph Lauren's Polo Tech Shirt, Netflix's smart socks and Lego Fusion. These examples demonstrate that CIs include quite diverse firms. In fact, delineating CIs is not straightforward and there is significant discussion about their definition and subindustries (Mangematin et al. 2014). A broad definition is provided by the DCMS (2001), which states that CI subindustries are "those (...) which have their origin in individual creativity, skill and talent and which have a potential for wealth and job creation through generation and exploitation of intellectual property." Sondermann (2012) provides a list of CIs that includes the music, book, art, film, broadcasting,

performing arts, design, architecture, press, advertising and software/games industries. Our paper follows this definition.

Methodology

As outlined above, our previous literature review suggests that there are several challenges for producers of digitized products (Novales et al. 2016). These challenges either keep companies from producing digitized products altogether or from reaping the benefits digitized products might generate. Either way, these challenges negatively affect the desired impacts of digitized products. Hence, companies will need to employ practices (e.g., develop certain capabilities) that help them to address or eliminate the challenges to prevent a negative effect on the desired impacts. We summarized these relationships in a conceptual model with three different constructs: challenges, desired impacts, and practices (see Figure 1). Our research questions focus on the desired impacts, challenges, and practices, respectively.
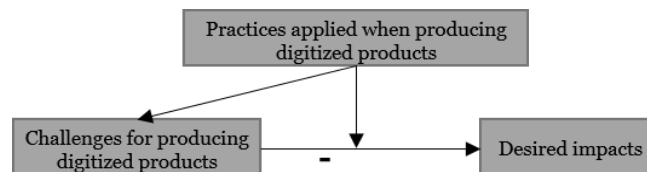

Figure 1: Conceptual Model

To answer theses research questions we conducted another literature review with a specific focus on CIs and interviewed representatives from 12 companies in CIs.

For the literature review, we conducted a database-driven keyword search using the EBSCO Business Source Complete database. As we had already performed a general literature review on digitized products (Novales et al. 2016), this one focused specifically on CIs. The following key words were used in title and abstract: (digit* OR smart OR connected OR augmented-realit* OR virtual-realit*) AND (creative industr* OR music* OR music* instrument OR book* OR art* OR museum* OR sculpture* OR painting* OR cinema* OR motion* picture OR film* OR movie* OR broadcast* OR podcast* OR design* OR fashion OR photo* OR cloth* OR wearable* OR architectur* OR press OR magazine OR newspaper OR journal OR adverti* OR game* OR theat* OR opera). We considered only publications in peer-reviewed journals from the years 2007-2016 that were written in English. The search resulted in 17,301 papers. To narrow our search further, we only considered the top 10 IS Journals (Lowry et al. 2013), top 10 Innovation Journals, and top 12 Management Journals, including the highest ranked practice-oriented journals: Harvard Business Review, MIT Sloan Management Review, and California Management Review. This resulted in 551 papers that were evaluated independently for their relevance and then discussed by the team. This helped sort out all papers that covered pure digital products in CIs, or papers dealing with digitized products without relating to CIs (as those were already covered by the previously performed literature review). This resulted in 35 potentially relevant papers that were considered for full reading. Finally, we selected 7 articles as relevant for the topic of digitized products in CIs.

To get insights from practice about the impact of digitized products, we conducted interviews with CI firms. To structure the results, we followed the content analysis phases (Holsti 1969; Weber 1990). For data collection, we conducted 12 individual, semi-structured telephone interviews with small- and medium-sized firms (5-200 employees) that already produce digitized products (see Table 1). The interviews were undertaken between November 2016 and January 2017 and lasted 30 minutes each. We used an interview guide following the conceptual model and addressed questions about the impact of digitized products, economic importance, experienced challenges, and possible practices companies employed.

Industry, country	Role of interviewee	Technology	Digitized product application
Press(1),DE	Head Prod. Mgmt	AR	Digital enriched magazine pages (editorial & advertising)
Software(2),DE	CEO	IoT	App to configure wheelchair via smartphone
Software(3),DE	CEO	AR	Enrichment of buildings/architecture with information
Software(4),DE	CEO	VR	VR simulation using stationary bike to move in virtual world
Software(5),DE	Tech Consultant	IoT	Toys racing track controlled via smartphone
Art(6),CH	Head of eCulture	AR	Exhibition equipped with AR
Book(7),DE	CEO	AR	Development of AR applications for books
Perf. Arts(8),FR	Art Director	AR	Interactive performance in which actors/props are enriched

Software(9), DE	CEO	IoT	App to control garage door via smartphone
Advert. (10), DE	CEO	IoT	Food preparation equipment controllable via the Internet
Music (11), DE	Account Director	Smart Clothing	Clothing converting sound into sensible vibration
Design (12), US	Head of PMO	Smart Textile	Clothing controls phone functions via touch-sensitive fibers

Table 1: Overview of interview sample

To analyze the interview transcripts we used the qualitative interview analysis of content structuring (Marying 2008). First, we performed an intra-case analysis of every single interview. In each of the 12 interviews, we distinguished between relevant and non-relevant content. Secondly, we assigned the relevant content to codes and sub codes (Graneheim and Lundman 2003). Two researchers discussed the findings of the intra-case analysis. We excluded the identified non-relevant codes and subsequently added missing codes. In total, we assigned 222 codes. In the second phase, we carried out an inter-case analysis, in which similar or related codes across all relevant interviews were grouped together, and the groups were then mapped onto the three constructs of our conceptual model. 133 codes were mapped onto "challenges", 62 onto "impacts" (with 30 being general assessments of current/future importance), and 27 onto "practices."

Findings

Findings from literature review

While the literature on digitized products in general is increasing, we observed a scarcity of literature on digitized products in CIs. CI-related digitization literature refers more to the general digital disruption and industry transformation of specific CIs: e.g., Thorén (2014) describes the transformation the print industry is undergoing. Other articles focus on purely digital or digit*ali*zed products (i.e., transformed from an analog to a digital state like an MP3 recording of analog music). For example, Benghozi and Salvador (2016) talk about the digital development in the book-publishing sector and the use of purely digital eBooks. Yet others discuss the use of digitized products (rather than their development, which is our focus) to improve the process of generating purely physical products (Boland et al. 2007).

In the seven papers that did focus on developing digitized products in CIs, the industries are only named as examples, but are seldom the center of the research: e.g., the architecture industry is named several times as an example of digitized products affected by smart cities and home automation (Iyer 2015; Jankowski 2014; Parmar et al. 2014; Porter and Heppelmann 2014; Porter and Heppelmann 2015). Porter and Heppelmann (2014) mention a digitized product in the design industry. El Sawy et al. (2016) talk about LEGO having moved into the CIs by creating digitized brick-video game combinations. Nevertheless, the central message of the papers does not revolve around CIs. Different issues like the capabilities for digital leadership, relevance of IoT technologies, and new business models are discussed. Only in one paper (Robson et al. 2016) are digitized products of CIs the central topic, where the authors examine wearables like the Netflix Socks, Google glasses, or a Smart Cap. The paper confirms the high future importance of digitized wearables, describing them as a "huge future market" (Robson et al. 2016). In very few cases were we able to identify specific challenges for CIs beyond the ones identified in the previous literature review. Those challenges included: the short period to create digital content (e.g. an AR catalog) (El Sawy et al. 2016), gaining customers' confidence (Iyer 2015) and increasing competition among different industries (Porter and Heppelmann 2014). In connection to wearables, we also identified as challenges security issues and the high cost for the user (Robson 2016).

Given the scarcity of literature on digitized products in CIs and the lack of empirical evaluations of existing findings in the literature, we conducted interviews with 12 companies operating in CIs to find out more about the challenges for developing digitized products, desired impacts and practices to overcome challenges.

Findings from interviews

The findings are structured according to the three constructs from our conceptual model (see Figure 1).

Desired impacts

The current importance of digitized products in CIs is seen as low by all interviewees, whereas views differ on future importance. Only two companies (1, 4) see a future in pure digital products, while all others think that digitized products are a growing market (perceived speed varies) and therefore have a growing

importance in the future of their industry. The reasons for CI companies to produce digitized products differ widely (Table 2): some merely seek marketing effects (looking more innovative), others aim to make the physical product more attractive, and others use technology to include additional information (e.g. due to lack of space in a print magazine). Some interviewees reported gaining a competitive advantage via digitized products by, for example, collecting data. One software company said it can now gain access to data on app usage and provide its partner manufacturer of the physical product with data about equipment use. In other interviews, firms talked about the possibility to enter new markets or reach new target groups using digitized products (e.g. museums can use new technologies like AR to reach a younger audience). Two interviewees mentioned that digitized products help them express new ways of creativity. Besides, one interviewee stated that digitized products allow them to delay a more radical move to full digital products. Finally, one firm reported that digitization helps them to connect physical and pure digital products.

Impacts identified	Sample quote (in parenthesis: interview quote is taken from)	Interview
Marketing tool	"It was a nice PR case." (1)	1; 2; 3; 10
Incr. phys. prod. attractiveness	"increase product attractiveness through the integration of AR." (12)	3; 7
Adding info to phys. product	"because of missing space, content was left out [previously]." (1)	1; 4; 7
Competitive advantage (CA)	"create CA by creating editorial and content value to the end user."(1)	1; 3; 8; 12
Data collection	"Now data is shared from the user to the producer: I can see how the app is used and manufacturer gets feedback about equipment" (2)	2; 4
Enter new markets/segments	"appeal to different customer groups like the cognitive, or ludic." (11)	2; 6; 10; 11
New creative expressions	"always looking at new ways to express [..] creative vision." (12)	8; 12
Postpone full digitalization	"delay the digital book which impacts existing business models" (12)	7
Bridge phys. & digital prod.	"close the gap between our digital products and print magazine." (1)	1

Table 2: Impacts identified from interviews

Challenges to develop digitized products

From the interviews, we identified four main categories of challenges that decreased the impact of digitized products in CIs: technology-, organizational, customer/user-, and product-related challenges (Table 3).

Named Challenges	Quote	Interview
Technology		
Technology is not developed enough	"In case of a technical progress, there is a potential market for similar product connections. With today's status, such a linkage is not given." (1)	1; 5; 8
Technical problems	"[..] so people feel a bit dizzy." (11)	4; 11
Infrastructure	"[..] to build up the infrastructure to be able to use Wi-Fi." (6)	5; 6
Organization		
Capabilities		
Lack of capabilities	"There is the question if we are able to handle things [..] Sometimes we lose jobs, because I am telling them: let's give me some time and look if I can handle it."(10)	2; 6; 8; 9; 10
Entry-barriers: no reference projects	"It is a difficult thing to get a customer project as a digital company. In my opinion, this is the reason why there are high barriers to entry in this field." (9)	9
Process		
Time span/Speed	"[..] he maybe only knows on Wednesday what content will be produced for the magazine [...] then there are only two days left [...] indeed a short time period." (1)	1
Operating	"As far as why it hasn't happen yet. I think what we have seen is: The fashion industry and the technology industry operate very differently in a lot of ways."(12)	5; 12
Skills		
Interdisciplinary skills	"As we hire user experience designers [..] we have to look for people with a kind of mindset for fashion as well. We realize that we kind of fill that gap now." (12)	12
Culture		
Terminology	"Some words are at least the same in English, like "hardware". In the electronics industry it means chips, but [in fashion] they are referring to metal buttons." (12)	12
Mindsets	"[..] innovation in fashion [..] has often been [about] 'how do I make something that looks new [..] when you are innovating in a digital space you get to things like user experience design.[..] a very different mindset for the fashion industry." (12)	12
Innovative culture	"There exist many static structures in cultural organizations." (6)	6; 10
Strategy		
Lack of concepts	"This is what we consider important [..] in our opinion there're no concepts." (6)	6
Unclear application	"Our AR app is ready for sales and we are now searching markets for it." (7)	7
New competitors	"There are really specialized providers for e.g. AR." (5)	5

Partners		
Partnering	"We make the step and look sometimes if there are firms that fit to our idea." (11)	11
Users		
Techn. efforts/skills		
Technical effort for users high	"Because of high technical demands, as well for users which often have no great affinity for technology, it was a high effort for a relatively low experience." (1)	1; 3; 7; 8; 12
Low technical know-how of users	" [..] little understanding for what is needed to realize something like that [..] the technical understanding. This requires [..] know-how on the customer side." (5)	1; 3; 5; 6; 8; 9
Willingness to adapt/change		
Customer structure	"In our case, it is often the customer. The willingness to do things that are really new, but which involve some investment." (5)	1; 5; 10
Value perception/expectations		
High expectations	"The whole thing is nice, but not more. People are further ahead in their mind and what could potentially be possible. However, results are often disappointing." (6)	6; 8
Low willingness to pay	"It is always difficult to make money, because people are used to get something in addition and do not want to pay for digital things." (7)	4; 7
Uniqueness	"Every aspect was a challenge, because there was no other performance like it."(8)	8; 12
Product		
Cost-benefit		
Effort to produce	"For us the difficult part was to develop the opulent contents. [..] These contents represent a high effort to produce." (1)	1; 2; 6; 7
High price/costs	"Some cost that arise are agency's cost to produce the content. Still, the greater proportion belongs to media production. What can we include in our books?" (7)	6; 7; 8; 9; 11; 12
Low value added	"[..] It is a gain related to the content: What is happening, does this have value for the customer, and is it the right format, the right context. (7)	1; 5; 6; 7; 8; 11
Only a gimmick	"This is our USP, to be able to create formats which make sense and are more than a gimmick. Because this wow-effect is only of short duration." (1)	1; 6; 7
Digital/physical substitutes	"So far we've been the most successful by separating [the digital product] from our printed version." (1)	1; 3
Difficult to estimate outcome	"I think it is difficult to say if this will work out or not. You focus on a certain direction and try it for 1-2 years. In the end, you look on how much money you earned and how much you spent. If things are not worth it you stop them." (4)	4
Low customer reach	"In the first 3-4 months, we were able to establish a good ground usage for the AR application. However, it had no further growth." (1)	1; 3; 10
No direct revenue	"They are in the end no sales products, but only marketing activities." (7)	7
Invest not justified by use	"Simultaneously, the success and the growth dynamic would not have justified any higher investment." (1)	1
Technical		
Tech. implement. difficult	"There is just the engineering challenge. It is very challenging on the engineering side to create this kind of [flexible] electronics." (12)	2; 5; 6; 7; 8;10; 11;12
Legal		
Unclear copyrights of digital content	"Another point is copyrights. Not all originators give the right to use their content for digital purposes." (11)	11
Quality		
Product quality low	"Because of low growth rate and stagnation of users, we invested only some editorial effort to produce new content. Thus, the product was not as good [..]" (1)	1

Table 3: Challenges identified from interviews

Interviewees mentioned the cost-benefit issue, as the cost and effort required to produce and operate digitized products was too high, especially when compared to the potential outcome (e.g., print companies have to produce high quality content, but the impact is very limited, as the period to produce the digital, interactive content is short and the customer reach is limited). Low reach does not justify high expenditure and therefore limits the variety and quality of the offering, making it less attractive, which in turn leads to fewer users, forming a vicious circle. The high expense required to generate and run digitized products is also seen as troublesome because of customers' value perception and expectations, as they are unwilling to pay for the additional cost. Digital additions are expected to be free. Moreover, customers are also unwilling to adapt and change their firm infrastructure. Customers are viewed as perceiving these products to be complex and difficult to use as they often lack some technical skills. Digitized products are often only seen as a gimmick, and "killer apps" are still missing on the market. Often cheaper pure physical or digital substitutes exist (e.g. displaying URLs in a book instead of using an AR app). Another reason for the low user value is that the technological development is not yet sufficiently advanced and there are specific

problems like motion sickness (caused by VR). Indeed, the technical implementation is often complicated. This is a problem that arises due to missing capabilities and infrastructure in an organization (e.g. Wi-Fi connection in museums). Because of a lack of skills (e.g. interdisciplinary skills), firms fail to acquire customer projects. Some interview partners said they have no clear digital strategy (lack of concepts, unclear application) and their knowledge is based on experiments. Moreover, many challenges arise from the combination of digital and physical parts. Firms need to work with new business partners that have different ways of working, processes, cultural mindsets, or even terminologies of products. At times, also legal problems like unclear copyrights for the digital content arise. Moreover, the innovation speed can differ a lot (e.g. the fashion design is much faster than the development of smart textiles) (interview 12).

Practices to overcome the challenges

The interviewed companies already applied practices to overcome challenges that arise when producing digitized products (see Table 4). Given CIs focus on generating content artifacts, one practice is to have the content lead rather than technology: instead of asking what AR/VR/IoT technologies can do, start by asking what the product/artifact is supposed to achieve and then identify the technology. As many firms reported to be in early stages, they mentioned that they experiment a lot and learn from mistakes to make adjustments (e.g. giving their staff time and space to think about new innovations). Further, implementing automation processes and developing a generic product platform are seen as practices that help reduce cost in the long run through re-use, while making it easier to adapt to customer wishes. To address missing skills, companies resorted either to acquiring those skills or to forming interdisciplinary teams with hybrid skills. Partnering with other firms was seen as a way to share risks and costs (e.g., a firm operating in the software industry divided its project volume among different partners to develop a digitized product) (interview 4). Adapting organizational structure is seen as another practice: some companies distribute their digital activities across the firm, others empower one central department for digital responsibilities. One final practice employed by firms was managing customers' expectations and helping them handle new technology by, for example, using employees as a bridge between the user and the product.

Practices identified	Sample quote (in parenthesis: interview quote is taken from)	Interview
Focus on content, not technology	"The technology is not initially planned. First, one have to know what do you want to do, why do you want to do it, and for whom are you doing it" (6)	6; 8
Experimentation (learning process)	"We are currently in the integration phase to transform our brands into digital [..] We experiment here a lot." (1)	1; 6; 12
Experimentation (invest)	"You focus in one direction, give it a time of about 1-2 years. In the end you look how many money did I invest and how much did I spend. If things are not working out quick enough, you drop the whole thing." (4)	4; 7
Innov. time for staff	"I want my employees to do something different and be willing to finance this."(10)	10
Automation	"We try to make AR products more cost efficient and to automate things" (7)	7
Reusable, cross-platform product	"We tried to think the project laterally. That is why we concluded to produce a more generic product which can be used like a building block system and can be adapt to the customer's business logic." (9)	2; 4; 7; 9
Buying external skills	Partially, bought in addition. (9)	9
Interdisciplinary working	"As we hire user experience designers, we have to look for people with kind of a mindset for fashion as well. As we realize that we kind of fill that gap now."(12)	12
Partnering	"Several partners share the project volume. In addition there exists a financial funding and one part we contributed with our capabilities." (4)	1; 4
(De)centralization of activities	"We try to integrate digital components in every department." (6)	6
	"The product management department has full power of every digital products"(1)	1
Manage customer expectations	"It comes back to having [..] the right expectations up front. [..] We had to let them know [..] it may take longer to work through this." (12)	12
Employee acts as a bridge between users and technology	"That was when I made a decision to take an actress. I wanted her to act like a bridge between audience and performance. I wanted the people to be able to speak to her and ask her questions if they didn't know how to connect to the server." (8)	8

Table 4: Practices identified from interviews

Discussion

In the following lines, we discuss the findings in relation to the three research questions we posed.

1) What is the (current and potential) impact of digitized products on CIs?

Interviewees were almost unanimous that the current impact is limited. This corresponds well with cross-industry survey findings mentioned in the introduction (Jernigan et al. 2016). When considering future impact, views differed. Most respondents saw a potential (at varying degrees) for future impact, while two participants (1, 7) were more skeptical. We hypothesize that specific firm and industry characteristics play a role here. For some industries, such as those with more information intensive products (Porter and Millar 1985) (e.g., music), firms are likely to move directly to digital products rather than to digitized products.

We recorded a diverse set of potential benefits of digitized products. Several benefits appear obvious: making physical products more attractive or creating a marketing effect that makes the company look more innovative. More noteworthy is that digitized products were also seen as a way to delay the move towards full digitization and protect the company from more fundamental business model changes (e.g. the move from physical books to (full digital) eBooks in the classroom might be delayed by the use of digitized (digitally augmented physical) books). As IS researchers, we tend to focus on the transformational aspects of digital technologies, not on the effects that help delay transformations. One impact specific to CIs is that digitized products are seen as a new means of artistic expression. Because the physical "product" is also seen as a symbol and aesthetic artifact, adding digital components enhances the spectrum.

2) What keeps CI firms from realizing this impact and/or getting more impact?

All of the challenges highlighted in the literature (see p. 2) were also identified in our interviews. While this might not come as a surprise (after all, we interviewed companies about digitized products), this is the first empirical validation of the challenges named in the literature and confirms that – with regards to digitized products – CIs are not unlike other industries such as manufacturing that have received most of the research attention so far. Our interview data provides richer and sometimes counterintuitive detail on the challenges faced than what was previously available. For example, while the challenge of "different clock speeds" is mentioned in the literature (Porter and Heppelmann 2015), it is generally assumed that the speed of IT innovation is quicker and more agile than the innovation speed of the physical product (Svahn and Henfridsson 2012) (e.g., it takes several years to develop a new car or machine). Our research confirms this to be a challenge, but also provides an example in the reverse direction: fashion clothing design can be faster than the design of smart textile technology.

There are several challenges though that have either not been identified in research previously or that received more attention in our interviews than in prior research (e.g., the challenges identified from previous literature (Novales et al. 2016) focused on technological, organizational, and product-related issues) (see Table 3). Our interviewees also highlighted challenges on the customer/user side, economic and legal challenges, and emphasized issues related to partnering. On the customer side, challenges related to a potential mismatch between the customers' technical abilities and the enhanced technical requirements necessary to use digitized products. Technology requires effort (e.g., connecting to Wi-Fi, downloading an app, setting it up, opening it, applying it) that can be seen as potentially distracting from the actual product/artifact in some cases. Customers might have inflated expectations for what technology can deliver, while being unwilling to pay for the additional digital component (e.g. if customers paid a certain amount for a book, they are perceived as unwilling to pay more for a book that is augmented with digital content).

This relates well to the overall doubts interviewees had about the economic viability of digitized products. They stressed the enormous effort of adding and integrating digital components and the comparably low potential benefit that does not warrant the effort. This becomes even more pertinent when pure digital or physical substitutes exist, when digitized products are merely seen as a gimmick, or when they only have a temporary marketing effect. While we tend to assume that there is significant value in smart, connected products, our findings remind us that this might not always be the case. Research on when product digitization is value-adding, and when it is not, seems warranted.

Finally, given the fact that CIs are defined around the "generation and exploitation of intellectual property" (IP) (Mangematin et al. (2014), it is not surprising that legal issues of IP are mentioned more in the interviews than in the literature. Due to the digital component (e.g., music, text), content ownership in CIs is much more at the core of the product than in manufacturing, for example.

3) How can companies overcome these challenges?

The practices we identified from the interviews vary a lot. Some of them are more technical (building platforms, reusing), others refer to organizational structure (centralizing vs. decentralizing; composition of

teams), processes (e.g., experiment, automate, partner) as well as to customers (e.g., expectation setting with customers). Still, we identified less practices than challenges – an indication that it is much easier for companies in the current stage to identify what is difficult than how to mitigate it. As one interviewee said: "there is no playbook" yet. In fact, many of the practices mentioned dealt with the economic uncertainty of digitizing (see challenges above) and the uncertainty of how to proceed with product digitization. Hence, several interviewees spoke of enabling experimentation and learning.

It should also be noted that some practices apply to all kinds of innovations (e.g., providing free time for employees to help create a culture of innovation). Others are more specific to the fact that digitized products are hybrid products (e.g., using cross-functional teams with people from different areas like art and technology).

We would also like to highlight that certain practices seem to contradict each other (e.g., centralizing vs. decentralizing responsibility for digitization efforts). Yet, the literature mentioned a likely more central role of IT unit (Porter and Heppelmann 2015). While clearly more research is needed on this issue, our findings might hint at situational factors that influence when to centralize and when to decentralize.

Finally, it should also be noted that some practices are directly linked to challenges. For example, using cross-functional teams is seen as a useful practice to produce digitized products successfully, while at the same time, making the required interdisciplinary teams work together is seen as a challenge. Similarly, building platforms that can be re-used in a modular or generative way is seen as a useful practice, but within the literature it is also seen as a challenge (Yoo et al. 2010).

Given the early state the companies are in (see RQ 1 above), the practices cannot be completed, but they provide a picture of what companies are using today. In this way, they can serve as a basis for forming testable propositions for further research on which practices actually help companies when creating digitized products and which ones do not. In particular, the seemingly contradictory practices can help to form the basis for deeper consideration: when is decentralizing more effective and when is centralizing – or is there a dominant approach when it comes to digitized products?

Conclusion

In this paper, we explored the challenges that keep companies from developing more digitized products and the practices that can implemented to overcome these challenges. To do so, we looked at firms from the CI, an industry facing a high digitization impact, but at the same time hesitant towards digital transformation. We identified a set of challenges that can be partly matched to those previously identified in the literature, but also new ones that seem more specific to CIs or provide more details on existing challenges. We also identified a varied set of practices companies might use to overcome the aforementioned challenges. Like most research, our paper also has several limitations: we focused on CI, which is a somewhat eclectic collection of industries. This might affect the generalizability of our findings. Given the limited number of interviews, we were not yet able to identify contextual factors that might explain some of the variation. Albeit we interviewed senior executives, conducting single interviews failed to provide us with more depth.

At this early stage, our basis can still serve as a means to form testable hypotheses along our conceptual model: which practices can help companies to overcome which challenges to gain (more) desirable impacts? In this sense, our paper makes a first step towards a theory of successfully developing digitized products. Once tested, these hypotheses can serve as guidelines for practitioners on where to invest organizational effort. Formulating and testing these hypotheses using a large sample survey will be the next step of our research. Furthermore, we plan more in-depth case studies with CI companies that are particularly effective in addressing the challenges.

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