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Abstract. The phenomenon of digital transformation received some attention in previous literature concerning industries such as media, entertainment and publishing. However, there is a lack of understanding about digital transformation of primarily physical industries, whose products cannot be completely digitized, e.g., automotive industry. We conducted a rigorous content analysis of substantial secondary data from industry magazines aiming to generate insights to this phenomenon in the automotive industry. We examined the impact of major digital trends on dominant business models. Our findings indicate that trends related to social media, mobile, big data and cloud computing are driving automobile manufactures to extend, revise, terminate, and create business models. By doing so, they contribute to the constitution of a digital layer upon the physical mobility infrastructure. Despite its strong foundation in the physical world, the industry is undergoing important structural changes due to the ongoing digitalization of consumer lives and business.

Keywords: Business Model, Digital Transformation, Innovation, Automotive.

1 Introduction

Research on digital technologies has predominantly focused on either describing the transformation of industries, whose products could be completely digitized, e.g., music, movies, photos, newspapers [1-4], or on specific effects in various industries, e.g., the resulting adaptations in the customer-supplier-relationship [3]. Nevertheless, as Yoo et al. [5] point out: "Digital technology's transformative impact on industrial-age products has remained surprisingly unnoticed in the IS literature".

What is missing to date is an understanding of how digital transformation manifests itself in industries in which the core products are primarily physical, and to which extent this transformation impacts dominant business models of incumbent industry players. The key difference between industries that can completely digitize

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their products and those that need to rely on physical elements as a core element, is the inevitable need to deal with the tensions that result from interweaving physical and digital layers into business models that originate from a pure physical world [3], [6-7]. The automotive industry is an instance of this latter type of industries. In the last years, the amount of digitalization in and around the motor vehicle has increased, creating substantial dynamics in markets and changes in business models, as automobile manufacturers strive to find a balance between the digital trends and their established competences and assets that relate to the physical world [8]. New technologies are enabling this industry to become part of the consumer electronics world, where in-vehicle information technology (IT) and consumer IT will be essential elements [6].

The topic of business model change has gained a lot of attention in recent years, especially within the information systems (IS) community [9-10]. However, there is still a very limited understanding about how external factors, also known as adaptation factors (e.g., new technologies) force companies to change their business models [9]. For example, in the context of the automotive industry, as mobile digital technologies enter into the traditional context of physical mobility on the ground, they bring along challenges related to consumer demands, such as the need for information, environmentally responsible mobility solutions and safety [11], [12]. This challenges automotive industry players to rethink and change their business models in order to find the right mix between components focused on the physical world of mobility, and transport and components focused on the digital world of mobile technology-related mobility. Industry players may need to integrate new offerings, since digital solutions may be needed within and outside the vehicle [6].

This paper focuses on examining the digital transformation of the automotive industry and aims at providing insights on the following research question: *What is the impact of key digital trends on dominant business models of automobile manufacturers?* We therefore employed a substantial secondary data collection from industry magazines, which led to a data set of over 1,100 articles about digital technology-related initiatives in the automotive industry. By employing rigorous selection criteria in the analysis phase, this material was reduced to a set of 180 relevant articles that were coded according to guidelines provided by Krippendorff [13]. With our research, we mark an important first step toward opening the black box of what digital transformation means for primarily physical industries and through which mechanisms established business models are changed as a result of digital trends.

2 Theoretical Background

2.1 Digital Technologies and Digital Transformation

IT can be defined as including "all modes of information collection, processing, storage, and dissemination" [14] and has been influencing business operations ever since. Through its increased diffusion in many aspects of our lives [15], new kinds of applications become possible by combining and integrating multiple technologies that are accessible anytime and anywhere [16]. These digital technologies are therefore defined as "combinations of information, computing, communication, and connectivity

technologies" [17]. Among the biggest emergent digital technology trends that are driving dramatic changes in the infrastructure of many organization spanning different industries and sectors are cloud computing (e.g., remote access to centrally provided information), social media (e.g. online interactions in social networks), mobile technology (e.g. smartphones and tablet PCs) and big data (e.g., use of huge amounts of data for predictive analytics) [3], [17-19]. Digital technologies have enabled rapid pace of product and service innovations, shorter product life cycles, and cross-boundary industry disruptions, which requires new forms of business strategies [18]. For example, in the financial industry, internet and mobile technologies have fundamentally altered the traditional way of investing in stocks. The user experience moved from making phone calls to a full service broker to placing electronic orders. This enabled new organizations such as electronic stock exchanges and e-Trade to emerge and forced major stock exchanges into mergers that totally change the traditional structure of the industry [3]. Similarly, the media, publishing and telecommunication industries were also affected by the transformative power of digital technologies (ibid). Increasingly, even in industries in which products are primarily physical (e.g., automotive), business models are being reshaped by the implementation of digital initiatives and solutions [6].

Applied management literature describes the phenomenon of digital transformation as the employment of new digital technologies to foster major business improvements in organizations [19]. This phenomenon is, to the best of our knowledge, still underexplored in IS and in management research and an elaborate definition of digital transformation has not been provided. Nevertheless, we identified discussions around the transformational impacts of new digital technologies not only relevant for organizations but also for society at large [3], [20-21]. Scholars have argued that digital technologies are shaping the way people live, communicate, consume and work, breaking barriers of time and space [21]. Yoo [15] states that the way people perceive technology has also changed because it is embedded in everyday activities such as running, driving and communicating. In relation to mobility, consumers' digital lifestyle impacts their expectations for new functionalities and features in the car that can provide them with more information, mobility services (e.g., carsharing), and safety [12], [22].

2.2 Business Model Change

A business model can be described as "a template of how a firm conducts business, how it delivers value to stakeholders (e.g., the focal firms, customers, partners, etc.), and how it links factor and product markets" [23]. There has been a lot of work on the foundations of the concept, including definitions, its relation to other concepts in the management literature (e.g., business strategy [23]), and the description of interlocking components [24]. Osterwalder et al. [25] describe the business model as consisting of four business model pillars (comprising nine building blocks) that specify, how a product/service creates value (value proposition/product - BM1), which customer segment is targeted as well as the way it is reached and linked to the company (customer interface - BM2), which internal and external competences, resources and part-

ners a company needs (infrastructure management - BM3), and how products/services produce costs and generate revenues (finance - BM4) [25].

With reference to the impact of innovations such as digital technologies, the topic of business model change is of major importance. Concerning the degree of business model change, Cavalcante et al. [26] offer the following view. A business model creation refers to the initial business model design based on a business idea. Business model extension is described as adding further activities to an existing business model without fundamentally altering the existing core logic. Business model revision refers to a profound redesign of the existing business model and thus can be related to radical or disruptive change. Finally, business model termination is described as the elimination of business activities [26]. According to Burkhart al. [9], the effect of external forces (e.g., new technologies) forcing incumbents to adapt their business models is not well understood yet. This also applies to the digital transformation of business models.

According to Veit et al., a "business model is digital if changes in digital technologies trigger fundamental changes in the way business is carried out and revenues are generated" [10]. El Sawy and F. Pereira describe that the emergence of digital technologies enables interconnected digital eco-systems that comprise new actors, structures and rules, eventually resulting in digital business models that entail such attributes as "time compression, turbulence, and new architectures" [27]. This phenomenon affects more and more industries and is not yet captured by most existing business model conceptualizations [27]. Research on the impact of digital technologies on established business models mostly observes transformations in industries that are more or less related to the digital world such as software, internet, and media industries [3-4], [28]. Thus, the insights on the transformation of business models by digital technologies in traditional industries are difficult to transfer [5]. This especially holds true for the automotive industry. As long as goods and persons need to be transported physically from point A to point B, a substantial core of an automotive player's business model will be grounded in the physical world. Even though there are specific differences among automobile manufacturers, the current dominant business model in the automotive sector can be described as follows: Development, production and distribution of sophisticated, conventionally fuelled cars, mostly against a non-recurring purchase price, as well as some additionally after sales services like maintenance, leasing or insurance [29], [30]. Concerning the target customer, it can be broadly differentiated between mass-market and luxury segments. The former is associated with a high-scale and low margin business, the latter with low scale and high margins for luxury cars [30]. Automobile manufacturers mostly employ a dealer network or cooperate with sales agents. The customer relationship is mainly built around the buying processes and certain maintenance appointments. In order to produce the vehicles, automobile manufacturers mostly rely on competencies in engineering, design, and electronics. They integrate a large network of suppliers, which delivers parts and services [31]. Business models in the automotive industry have been argued to start shifting toward more differentiated, sustainable, service-oriented, and integrated mobility solutions [8]. For automobile manufacturers this represents a change, away from their established business models, which they have been learned for decades.

3 Research Methodology, Sample and Data Analysis

In this study, we conducted a content analysis of secondary data as a starting point to collect evidence on the phenomenon of digital transformation without being biased by firm specific or individual characteristics that might be the case for case studies or surveys. In deciding to analyze practitioner literature, we followed Bohnsack et al. [32] and conducted a content analysis of two automotive industry trade magazines, i.e., Automotive News and Ward's Auto World, as well as a car magazine, i.e., AutoWeek. These magazines were chosen because they provide insights into the automotive industry and organizational perceptions in relation to technologies and associated business models [32]. Krippendorff [13] defines content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use". With a content analysis of secondary data we aim to understand major trends associated with digital technologies and their impacts on dominant business models of automotive manufacturers in the context of this industry.

To identify relevant articles for our study, a keyword search was performed using search terms referring to the biggest emergent digital technology trends mentioned above (i.e., cloud computing, social media, mobile technology, and big data). To assure a comprehensive coverage of all important articles, we used additional keywords related to these technologies that could lead us to further significant digital technologies in the automotive industry, as well as names of each of these technologies industry leaders. Thus, we applied the following search keywords in our study: "digital technolog*," "cloud computing," "Amazon," "Microsoft," "social media," "Facebook," "Twitter," "blog*," "mobile technolog*," "mobile device*," "smart phone*," "tablet*," "Apple," "Samsung," "big data," "connectivity," "connected car*," "analytics," "Google," and "IBM." These keywords were applied in the title, abstract, and main text of the magazines' articles. Our search resulted in a total of 1107 articles. We carefully screened the articles' abstracts and texts and selected those that were related to the focus of our study, i.e., articles related to digital technologies related trends and their impact on business models [33]. To check the validity of the content reported in the articles, we searched for press releases or website reports of the respective firms confirming the mentioned aspects. If we could not find this supporting evidence, we dropped the article out of the sample. Our final sample consisted of 180 articles covering a timeframe ranging from 1996 until 2014 and can be divided as follows concerning the four technology trends: cloud computing (13), big data (20), mobile technology (64) and social media (83). We adopted the framework of Krippendorff [13] to content-analyze the identified articles, since his approach is recognized in IS and social science qualitative research [34-35]. Our framework is depicted in Figure 1.

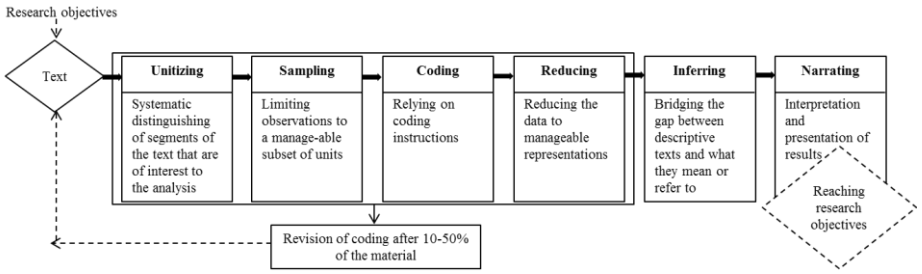

Fig. 1. Content Analysis Framework based on Krippendorff (2004)

Following Krippendorff [13], in the first step we unitized the texts' segments that were relevant for our analysis by reading every article and highlighting excerpts in the text every time a digital technology was mentioned. Subsequently, we limited our observations to the segments of text that related the digital technology to a trend in the automotive industry as well as to business model components and the different types of business model changes of automotive manufactures. We first coded emergent data about trends associated with digital technologies in the automotive industry. This coding procedure was thus of explorative nature. Then, we further developed our coding instructions based on the previously described theories of Osterwarlder et al. [25] and Cavalcante et al. [26]. Thereafter, we created manageable representations of data by cross-tabulating the coding intersections between an excerpt referring to a digital technology trend and an excerpt of the coding category business model components (see Table 1). The same procedure was done concerning intersections between a digital technology trend and an excerpt of the category business model change. Finally, the steps inferring and narrating, which represent respectively our data analysis and our interpretation of findings, are illustrated and discussed in the following sections. The articles were analyzed and coded using the qualitative data analysis software NVivo 10. In order to accomplish reliability of our coding, one of the two first authors coded an article and the other one controlled and refined that coding, resulting in intensive discussions over the interpretation of the data.

Table 1. Overview of Coding Instructions

Coding category	*Coding sub-category*	*Illustrative example*
Digital trends [16]	Social media; big data; cloud computing; mobile technology	Social media: "The goal is to turn Ford into a "social business" that rewards its fans and gives them a chance to influence future product."
Business model components [25]	Product; customer interface; infrastructure; financial aspects	Product: "Automakers keep pushing the boundaries of what's possible. General Motors, for instance, is testing an application that will allow drivers to dictate status updates to Facebook."
Business model change [26]	Creation; revision; extension; termination	Business model extension: "Audi also said that it is ready for LTE, the true 4G network, as soon as it becomes widely available in about two years, which will allow infotainment to flow into your car at unprecedented speeds."

4 Findings

In the next sections, we describe how specific digital technology trends affect business model pillars [25] in the automotive industry leading to the different types of business model change [26]. Because these digital technology trends sometimes overlap and have multiple effects, we present them according to the specific phenomenon they enable (i.e., interaction, connectivity, self-driving, mobility services, new driver services, new data services and virtualization).

4.1 Business Model Extension – Digital Enrichment of Established Business Models

Based on the characteristics of business model extension (see chapter 2.2), in this type of change we categorized the digital technology trends that were used to extend the offering for specific customer segments with minimal changes to the core logic of the dominant business model of automotive manufactures [26].

Interaction. Concerning the trend social media, we observed that it mainly concerns changes in customer interfaces (BM2). Social media allows automobile manufactures to respond to the general societal trends of customers wanting to be more informed, participating and thus becoming more empowered [3], [20]. Moreover, the target customer segments are increasingly including an emergent customer group: young and tech-savvy people. This customer segment expects more information, dialogue, and dynamics [3], also when buying a car. This points to changing customer relationships as well as the competencies required to handle them (BM3). Generally, the group of digital natives places more emphasis on the digital aspect of life and is used to having constant access to information as well as receiving immediate responses to their requests.

'They engage digital media, they consume it on their own terms and timetables, and it's nonlinear: They jump from watching a video to locating a vehicle to building and pricing a car to e-mailing their dealer". (Automotive News, 1/20/2014)

Automobile manufacturers extend their business models by adding digital interaction with their customers, e.g., in the processes of product design. They need new competencies in order to engage the customer in co-creation processes (BM3). Studies about product co-creation have indicated that by interacting with customers virtually, organizations are able to rapidly sense and respond to changing customer needs, which has become essential for the survival of organizations in the digital age [20]. This represents a specific change for automobile manufacturers, as they were used to leveraging their engineering competences to create a sophisticated physical product, while the customer's role was limited to buying this offering.

Connectivity. Concerning the trends of mobile technology and cloud computing, many automobile manufacturers undertake high efforts to ensure the compatibility of mobile devices—most notably smartphones—with the car. Automobile manufacturers can thus offer customers the possibility to access their personal data.

"Consumers want to get their information and entertainment the same way whether they are in their home, office, or car". (Wards' Auto World, 02/2008)

This compatibility also enables the customers to stay connected while they are on the road. Thus, extending the value proposition of the vehicle to a certain extent (BM1). Moreover, automobile manufacturers are developing mobile applications that provide further functionalities to customers, such as vehicle status.

"To assess more distant road conditions - say, a mile or more away - the vehicle's onboard computer would get updates from the cloud through a cell phone link". (Automotive News, 9/23/2013)

Through these mobile applications in combination with car-connectivity, other fields, aside from the mobility domain, are being explored by automotive manufactures (e.g., service offerings to locate restaurants and make reservations on the road). Some automotive manufacturers are therefore including programming skills to their core competencies, by either developing them inside of their organizations or extending their partner networks (BM3). Consequently, the business model of automobile manufacturers is adapted to the customer's desire for increased connectivity. This adds a digital dimension to the physical driving experience. Furthermore, connectivity allows consumers to reach (and be reached by) other consumers and companies almost anywhere at any time [36]. This presents great opportunities for automobile manufacturers, since they can reach consumers, communicate with them, and better understand or analyze their behavior to develop more individualized offerings [36].

4.2 Business Model Revision – Digitalization of Established Business Models

Following the description of business model revision (see 2.2), in this type of change we attempted to categorized digital technology trends that might substantially alter the dominant business model of automotive manufacturers [26]. Although most of these technologies are currently still in development, we learned that they have the potential to completely substitute existing business models of automotive manufacturers.

Self-driving. The self-driving car is related to digital automation and concerns the processing of a large amount of data, having the road as a data set to be mined [37]. Enabled by on-board Internet, sensor and GPS-technology, self-driving cars represent a changed driving experience, being especially attractive for digital native customers.

"In a world where Nevada and Florida have already passed laws allowing the licensing of self-driving cars, the rush is on to make the job easier for drivers. For many, the ultimate goal is to take the steering wheel totally out of consumers' hands and eliminate accidents altogether". (Automotive News 08/18/2012)

Here, the value proposition is substantially changed, as the customer no longer needs to drive the vehicle (BM1). This gives the customer more freedom to use his smartphone, check his emails or use the vehicle infotainment.

"Eventually, the prospect of sleeping, snacking, entertaining themselves and even working on the way to work could convert many a dedicated driver to self-driving vehicle". (Ward's Auto World, 02/2014)

Nevertheless, the change in the value architecture of most automobile manufacturers is rather moderate (BM3), as some of the required technologies for self-driving are already embedded in modern cars (e.g., lane assistance, parking pilots). Self-driving establishes a new way of thinking about the car. In former times, the customer experi-

ence was almost solely connected with driving the car. Now, the car itself as a physical entity will become less important. The balance between digital and physical will be truly shifting, when drivers become passengers. As a result, some engineering competencies, formerly competitive advantages, will decline in importance.

"Vehicles then become simple mechanical devices that can be built by just about anyone. The only important parts are the electronics and sensors made by Google and its suppliers". (Ward's Auto World, 12/2012)

The trend of self-driving reminds us of IT's role of automation [14]. Although automation has been recognized in the auto industry for decades, the application fields are now changing. Formerly, automation in the automotive industry was associated with manufacturing processes in production lines [38]. With self-driving, digital-enabled automation has moved forward in the value chain to actual product use, resulting in increase in performance, convenience and information, enabling organizations to innovate revenue models (BM4), e.g., congestion pricing for parking [21].

Mobility Services. Automobile manufacturers have started to offer "car-independent mobility solutions" [38], such as integrated service-based mobility offerings involving several means of transportation. Through mobile devices and GPS technology, multi-modal mobility solutions become more integrated. By such offerings, automobile manufacturers revise their value proposition (BM1), which changes from delivering only a product (the vehicle), towards delivering also a service (mobility). Moreover, the revenue model (BM4) is substantially altered as these services comprise pay-per-use pricing schemes. By offering multi-modal solutions, automobile manufacturers need further to extend their partner networks towards public transport providers (BM3). The relationship to the customer is altered as there is no longer a 1:1 relationship between vehicle and customer (BM2). In service business models, the concept of ownership is revised, leading to an n:n type of relationship. Because of the societal mega-trend of urbanization and related phenomena (e.g., congestion, limited parking space) owning a vehicle in cities is becoming increasingly associated with inconvenience and limited personal freedom, and less associated with a status symbol. In this regard, some automotive manufactures are also offering carsharing as a mobility service.

"German archrivals Daimler AG and BMW AG have launched sharing programs. The automakers say the move was prompted by changing attitudes about car ownership, especially among young buyers, and increased urban congestion. … Vehicles can be reserved on the Internet or by using an iPhone with an application that shows where available cars are parked". (Automotive News, 12/20/2010)

The mobile device is thus becoming key for the customer's physical mobility experience, for example by directing him to the nearest transportation possibility or, making reservations and payments. For automobile manufacturers, this represents a drastic shift from a transactional product-oriented system towards pay-per use business models. This could be a shift in what is considered fundamental to being competitive within the automotive industry [39]. As in integrated mobility services they need to rely more on external service providers from other mobility sectors or IT-firms that offer apps for mobility planning, the strategy of the firms changes towards an building open eco-systems and multi-sided business models with network partners [7].

4.3 Business Model Creation – New Digital Business Models

Based on the characteristics of business model creation (see chapter 2.2), in this type of change we classified digital technologies trends that were used for creating new automotive business models [26]. In this case, digital technology trends are not used for extending or substituting dominant business models, but instead they support creating separate, stand-alone models.

New Driver-Services. The connectivity of the vehicle with smartphones and the Internet has given rise to product-related service [40] innovations.

"OnStar's model is to continue offering hands- free technologies that promote safe driving, such as real-time navigation services that take into account traffic patterns, based on the 5,5 million subscribers using OnStar." (Automotive News, 12/20/2010)

Product-related service offerings are primarily subscription based, thus they create a new forms of revenue (BM4). There is a wide array of services offered, such as preconditioning of the vehicle, vehicle diagnostics or automatic emergency calls (BM1). As most of these product-related services are accessed by mobile devices, automobile manufacturers need further competencies in programming apps (BM3). Moreover, as these services produce data that needs to be stored in the cloud and that could be analyzed for other business purposes (such as optimization of vehicle diagnosis processes), automobile manufacturers must expand their IT-resources and infrastructures (BM3). Through these new business models, automobile manufacturers are enabled to find new revenue sources from the increased connectivity of the vehicles they sell [41]. They thus enter the digital world by offering product-related digital services themselves.

New Data-Services. Through the increased penetration of digital technologies in the vehicle [13] substantial amounts of data are generated (e.g., about mobility behaviors or vehicle usage). This data is of explicit value for automobile manufacturers, as it helps them optimizing their products or production processes. Moreover, this data could be source of new types of data services that automotive manufacturers could provide to different types of customers (BM2). For example, data about mobility behaviors could be offered to local governments interested in optimizing traffic planning.

"Vehicle data will generate $700 to $800 per vehicle in savings for automakers, vehicle owners, service providers and local governments". (Ward's Auto World, 06/2010)

New data business models are being created increasingly, representing completely new value architecture and value capture concepts. Here, the physical mobility process is used as an input (BM3), while the data that it produces is the output (BM1). This shifts perception of the physical vehicle from being the focal aspect to being a device to create value in the digital world.

4.4 Business Model Termination – Eliminated Physical (Parts of) Business Models

Digital technologies in certain areas increasingly drive the substitution of prior physical activities. Following the description of business model termination (see chapter

2.2), in this type of change we categorized digital technology trends that eliminated prior physical processes to some extent [26].

Virtualization. Processes before and after the vehicle production are being increasingly changed by digital technologies (BM3). In the design phase, both prototypes of new car models and production lines can be built virtually by drawing on the increased computing possibilities, thus decreasing planning times and costs.

"DaimlerChrysler AG said digital technology shaved six months off the construction time of its Jeep plant in Toledo, Ohio. The automaker said that by 2005 every DaimlerChrysler production plant will be planned, built, launched and operated first using full simulation". (Automotive News, 10/11/2004)

After production, virtualization is also important in the sales process (BM2). Automobile manufacturers provide virtual showrooms or even allow potential buyers to test the vehicles virtually in video games.

"Ford is giving Sony PlayStation3 users a look at its Edge and Fiesta in an online virtual showroom on the PlayStation Network". (Automotive News, 6/27/2011)

It is not the value proposition, but rather the infrastructure management (BM3) and the customer interface that change substantially (BM2). When virtual realities are used, competencies and cost structures are also altered. For automobile manufacturers, vehicle design and production were core processes associated with their engineering competencies for decades. Now, digital competencies have started replacing them.

Summing up, our findings have shown which specific business model components are affected by new digital technologies and how these components change over time. Furthermore, when analyzing our longitudinal data set, we found that digital technologies drive all four of the types of business model change named by Cavalcante et al. [26]. The following figure conceptually depicts this evolvement towards digitalization of automotive manufacturers' business models.

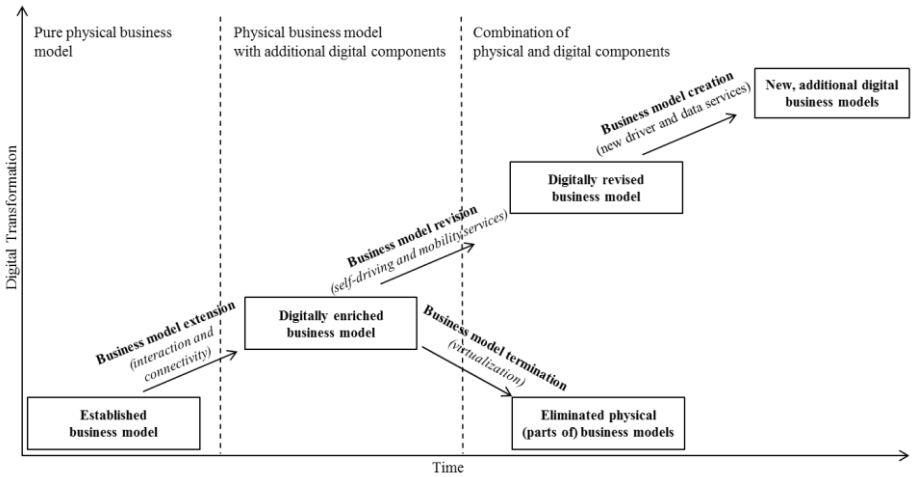

Fig. 2. Development Path of Business Model Changes

5 Discussion

Through the different types of business model changes described in the previous chapter, automobile manufacturers react to the increasing diffusion of digital technologies, and, thus, contribute with varying intensity to building a digital layer upon the physical mobility infrastructure. By interacting with customers through social media and ensuring their connectivity while they are in the vehicle, automobile manufacturers take account of the increasing desire of customers to be 'always on' as well as their changing demands towards increased informedness and experience [3], [42]. However, with these digital initiatives automobile manufacturers do not fundamentally change their established business model but expand it by adding specific digital aspects and making it compatible to the digital world. In a greater level of change, automobile manufacturers use digital technologies to respond to the increasing change in customers' digital lifestyle. Through our findings, we could observe that the vehicle itself may change its role from a status symbol to a device for digital experiences [39], [43]. Drawing on the digital trends of big data, cloud services and mobile technology, automobile manufacturers are enabled with new possibilities to offer mobility solutions that do not require a vehicle at all. These revised business models comprise mobility offerings that can be accessed over the digital layer or, as in the case of self-driving, are controlled by such layer. Digital technologies open up the potential of new types of business models based on mobility data, either by targeting at the driver or at new possible customers, such as local governments [39]. Here, the physical process of driving is only used to generate the core (data) offering, which is completely digital [44]. We understand the transformation process in automotive industry as presenting a technical and a societal side. On the former, it concerns advances in the digital technologies themselves, for example increasing computation power, miniaturization, and ubiquitous broadband internet access [45]. This emphasizes the importance of digital in all aspects of life, including mobility [15]. Intertwined with the technological possibilities is society's changing expectation both about what mobility is as well as regarding the role of digital technologies in their lives. We found that especially the digital natives consider certain factors more relevant than other generations do when evaluating a car [42]. It appears that preferences are shifting from the sheer feeling of driving or technical performance measures towards aspects such as connectivity, information or entertainment. Together with these societal trends, our findings have shown that digital technologies drive the industries' transformation from goods-dominant- towards a service-dominant logic [46]. Along with this transformation comes a changed role of the customer towards a co-creator of value, which cannot be captured in established business model designs [47]. The customer relationship is thus getting more demanding for automobile manufacturers as customers want to be more than just buyers. Eventually, our study shows an enormous shift in the role of IS in the automotive sector. While they have been an engine for industry transformation ever since [39], prior applications were more or less focusing the back-end of automobile production. In contrast to this, with the rise of digital technologies, as we have shown, all business model pillars including also the relationships with customers and the value propositions of business models are penetrated with IS.

6 Limitations and Future Research

As we rely on secondary data from practitioner literature, the validity of the data can be questioned to a certain degree as they also comprise opinions, assumptions or statements that may be biased for various reasons. Nevertheless, as the topic of our study is a relatively new phenomenon, related scientific literature in high quality outlets is scarce. However, we have tried to counteract the validity aspects by drawing on three internationally accepted industry magazines and a long time scale. The selected sources can be attributed as being more responsive to recent developments and thus provide important insights on emergent phenomena as a starting point for further research [32]. By drawing on the concept of digital transformation, business models and business model change, we rely on theoretical constructs that are yet in a premature stage and surely need to be further testing and elaboration. Nevertheless, with our exploratory approach, we hope to contribute to this very fact, provide a first step and trigger further research. Therefore, basing the examination proposed in our study upon in-depth cases and expert's experiences would be recommendable.

7 Conclusion

In this study, using a substantial secondary data analysis, we shed light on the nature of digital transformation in the automotive industry, an industry that has a strong grounding in the physical world. To the best of our knowledge our study entails novelty in that it explores how digital transformation plays out and manifests itself in a primarily physical industry. We employed the business model concept, including its components and change over time, as theoretical lens to examine the digital transformation of the automotive industry at the strategic business level. Our findings point to the ongoing transition toward a digitalized world, which impacts primarily physical industries too. With our analysis and discussion, we contribute to business model and IS research by examining the impacts of digital technology trends on business models, as well as by proposing a development path to explain how such changes occur. Thus, we seek to offer a foundation and important first step for developing a comprehensive understanding of the nature of digital transformation in the automotive industry.

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