

# Digital Innovation Management and Path Dependence: An Integrated Perspective of Manufacturing Incumbents

Milen Ivanov  
WU Vienna, Vienna, Austria  
[milen.ivanov@s.wu.ac.at](mailto:milen.ivanov@s.wu.ac.at)

Edward W.N. Bernroider  
WU Vienna, Vienna, Austria  
[edward.bernroider@wu.ac.at](mailto:edward.bernroider@wu.ac.at)

## Abstract

*Is digital innovation a big chance or a big threat for physical product-centric incumbents? Building on the unique characteristics of digital innovation, new market players can break the dominance of incumbents by providing digitally enabled products with distinct characteristics. Therefore, this paper empirically explores the dynamics within incumbents related to digital innovation management. Qualitative methods are used to systematically and inductively gain insights into how digital innovation is considered in the context of incumbents with physical product-driven business models. We use path dependence theory to explain the findings and support theoretical generalization of our results. The study contributes to the literature on digital innovation, how incumbents manage digital innovation under certain circumstances, and the related impacts on their business model. Further, we suggest three stages of digital innovation management in the context of path dependence.*

**Keywords:** Digital innovation management, path dependence, incumbents

## 1. Introduction

In the past few decades, rapid progress in information technology (IT) has led to many innovations in digital services and products (Liu et al., 2022; M. J. E. Porter & Heppelmann, 2015; Raff et al., 2020; Yoo et al., 2010). In today's business world, IT is evolving continuously, transforming the competitive landscape for incumbent product-centric companies. Thus, new players with strong technological capabilities (digital natives) can quickly gain market shares by offering innovative digital products (M. J. Porter & Heppelmann, 2014). By leveraging digital innovation (DI), industries can horizontally integrate, bringing new offerings and stimulating demand across previously unrelated fields. The growth of DI leads to the adoption of products, services, and partner networks, along with changing business models (Hanelt et al., 2021). Since

incumbents manage their product innovation according to organizational logic and manufacturing principles (Svahn et al., 2009), largely in contrast to digital product innovation practices (Svahn & Henfridsson, 2011), they struggle to compete in a newly created digital space, mainly because of path-dependent behavior, which prevents them from adapting to technological changes (Bohnsack et al., 2014; Singh et al., 2015). More precisely, due to the stability in processes built in the past, incumbents decide on a certain path of action, limiting their choices, which leads to irrevocable lock-in conditions (Garud et al., 2010; Sydow et al., 2009). As a result, technology-savvy new entrants outperform them in the digital space (Svahn et al., 2017; Yoo, 2013). A crucial aspect of DI is that incumbents must adapt their product innovation regime to the requirements of DI within the same innovation process (Svahn & Henfridsson, 2011). Developed in the context of manufacturing, the product innovation regime is characterized by distinct organizational logic, product architecture, and market dynamics (Svahn et al., 2009). Therefore, incumbents face multiple challenges to adapt their business models and processes to fully utilize the benefits of technological advancements and remain competitive as new opportunities in the market emerge (Lansiti & Lakhani, 2014; M. J. Porter & Heppelmann, 2014; Yoo et al., 2010). DI contributes to the firm's performance and is a potential source of competitive advantage (Liu et al., 2022). The radically changing product architecture results in new products and ecosystems, and offers new scenarios for connecting products across industries (Lansiti & Lakhani, 2014; Yoo et al., 2012). In the absence of an understanding of the logic of DI, incumbents will face a real threat (Fichman et al., 2014; Svahn & Henfridsson, 2011; Yoo et al., 2010).

Previous studies on managing technology-driven innovation have enriched our understanding of the dynamics and challenges of such innovation (Krejci & Lausanne, 2022; Raff et al., 2020; Sebastian et al., 2017; Svahn & Henfridsson, 2011). Macro-level explanations, however, often neglect detailed views of the problem, as well as the role of individuals in technology-driven innovation (Fallon-Byrne &

Harney, 2017; Nylén et al., 2015). In the context of incumbent product-centric firms, little is known about how actors and organizational structures interact in managing DI (Svahn et al., 2017; G. Wang, 2022). The process of emergence of DI from traditional physical to digitally enabled products requires additional attention, as it represents the natural path to DI for incumbents and also digital natives (G. Wang, 2022). This opens new investigative avenues to delve deeper into the practical implications of DI for organizations and individuals, and to shed light on how to best cope with challenges arising from the complex requirements DI puts on incumbents.

While the extant literature provides a wide range of views on the correlation between dynamic capabilities development and innovation (Helfat & Raubitschek, 2018; Teece, 2007, 2017). Less focus is on how path dependencies (PD) impact innovation activities (J. Wang et al., 2016). Such studies emphasize future dynamic capabilities for digital transformation, often neglecting the path-dependent behavior of incumbent firms (Warner & Wäger, 2019). Since, most studies on PD have been conducted before the "digital age" (Kurtz et al., 2021, p. 10), which calls for additional attention to the impact of DI on path-dependent conditions within incumbent organizations and vice-versa.

Therefore, this study seeks to examine the forces of DI management within incumbents. Our goal is to examine whether there is a pattern of DI development that follows a sequence of activities. Therefore, the research question is defined as follows: "How do incumbents manage DI activities, and how do those activities influence organizational path dependency?" We use PD theory to anchor the empirical findings and provide a structured explanation of the ongoing processes of DI development within incumbent firms. PD theory suits our study on several grounds. Path theories provide "a powerful perspective increasingly used to explain the emergence of novelty" (Garud & Karnøe, 2001, p.5). Considering DI as a novelty in the context of product-centric incumbents, the PD lens helps us frame the forces supporting or preventing change towards DI. Path theories are considered "universal regarding the domain of investigation" (Tiberius, 2011, p.3) As they are based on the idea that history determines the current course of action, PD could be applied in any period. As incumbents undergo various stages of DI development and at a different pace, PD helps equalize the findings based on the reference of the past, rather than a specific point in time. Finally, path theories consider external and internal factors that influence the change outside and inside organizations (Tiberius, 2011). This is particularly important for evaluating DI in

incumbents, as endogenous and exogenous forces shape their DI development.

Given the exploratory nature of the study and the complexity of the subject, we adopted a qualitative research approach, applying research techniques used in the grounded theory (GT) (Strauss & Corbin, 1990) and took the interpretive philosophical stance, which is a well-recognized method, particularly in the field of Information Systems (IS) (Orlikowski, 1993; Seidel & Urquhart, 2013; Urquhart & Fernandez, 2006).

The paper aims to contribute to the growing area of DI research by exploring DI management patterns across incumbents and extending the understanding of the impact of DI on path-dependent behavior and as such on the whole organization.

## **2. Theoretical background**

### **2.1 Digital innovation management**

As academia and practitioners have focused on DI, multiple definitions have emerged, leading to semantic differences (Hund et al., 2021; Magnusson et al., 2021). One of the first conceptualizations of DI was provided by Yoo et al. (2010) in the context of physical products, who defined DI as the process of combining physical products with digital features to create digitally enabled products with a high degree of novelty, i.e., not comparable to those on the market. An extended conceptualization of DI includes "...creation of (and consequent change in) market offerings, business processes, or models that result from the use of digital technology" (Nambisan et al., 2017, p. 224). A unique characteristic of DI is that it emerges when individuals interact with digitally enabled technology (Sandberg et al., 2020), changing patterns of socio-technical interaction (Baygi et al., 2021). Therefore, we understand DI in terms of the interactions between actors, technologies, and digital artifacts. From a novel perspective, DI is seen as a combination of digital objects (Faulkner & Runde, 2019) and digital technology (Hund et al., 2021). Raff et al. (2020) provide a framework defining four digital product archetypes based on DI properties integrated into physical products. The resulting digital products could be digital, connected, responsive, and intelligent, as each of the archetypes encompasses the previous archetype, adding new digital features. For example, a connected product is based on a digital product that can communicate with other products or services (Raff et al., 2020).

The transformational character of DI offers extended value propositions and creates new business model pathways (Ciriello et al., 2018; Coreynen et al., 2017; Nambisan, 2013; Raff et al., 2020; Steininger et

al., 2022). DI sets different requirements on organizational logic, market dynamics, and architectural design (Svahn & Henfridsson, 2011). In this scenario, incumbents are forced to explore the new opportunities that DI presents (Liu et al., 2022). The process of how each firm systematizes DI activities and organizational structures is known as DI management, which "...refers to the practices, processes, and principles that trigger the effective orchestration of DI" (Nambisan et al., 2017, p224).

## 2.2 Path dependence and DI

In the extant literature, the term "path dependence" is used predominantly to characterize all forms of organizational behavior related to rigidities, inertia, or inflexibility. (David, (1985) developed the theory of PD, using the QWERTY keyboard, which remained largely unchanged despite the technological progress of other computer components. In essence, PD represents the process of incrementally reducing the decision options of a company, resulting in a stable decision-making process and neglecting any alternative paths (Garud et al., 2010; Vergne & Durand, 2010). Motivation initially drives the path-dependent behavior for reaching efficiency in the firm, which has a positive effect. However, gradually, this behavior leads to decreasing choices and eventually lock-ins (Sydow et al., 2009).

PD emerges through three phases based on the timing sequence of actions (David, 1994). Pre-formation phase, in which a wide range of options are available and decisions are taken without relation to previous events (Sydow et al., 2009). Positive feedback of previously taken decisions and confirmation of certain decision choices leads to a critical junction, which is the turning point to the formation stage of PD, in which self-enforcing mechanisms define decision patterns that become obvious (Sydow et al., 2005). During the formation phase, strong self-enforcing processes rule out any other alternatives and finally lead to path-dependent behavior, which characterizes the lock-in phase for the company (Sydow et al., 2005, 2009). The lock-in phase is characterized by only one determined course of action, followed by which alternatives are neglected (Sydow et al., 2005). Firms' performance is not necessarily adversely affected by entering a lock-in condition (Koch, 2011). However, in cases of significant external changes, e.g. industrial shocks or technological changes, the PD could become a challenge for incumbents (Kurtz et al., 2021). The self-reinforcing mechanism in the lock-in phase is considered irreversible. To change that condition, "exogenous shocks are required to shake the system

free of its history" (J. Vergne & Durand, 2010, p. 752) Considering, for instance, that the reasons for lock-ins and consequently PD may be both cognitive and resource-based (Sydow et al., 2009) also endogenous factors may contribute to a break-out. While cognitive-based PD is associated with cognitive patterns within the organization that influence the decision-making process, resource-based PD is determined by the use of complementary assets and capabilities owned by incumbents (Helfat & Raubitschek, 2018; Teece, 2018), but also due to the product and service architecture built progressively, which is difficult to change (Svahn & Henfridsson, 2011).

## 3. Methodology

As our research aim was to explore the complex nature of DI management in incumbents and its socio-technical impact, we chose a multi-case study design (Yin, 2017) based on semi-structured interviews with managers in the field of DI. We took an interpretative philosophical stance to examine the complex socio-technical phenomena of DI management. As the perspective of the participants in DI management activities is key to our research, we adopted an interpretative qualitative design drawing on GT techniques based on Strauss & Corbin (1990) and Glaser (1992).

The benefit of adopting a GT approach and relying on our findings to the PD theory was two-fold. Firstly, with the methods of GT, we were able to capture the real-life perspectives of the participants in the field of DI (Suddaby, 2006). As we were interested in the meaning actors place on their interactions and how they perceived reality, we felt closer to the paradigm of symbolic interactionism (Chamberlain-Salaun et al., 2013, ) and consequentially to the process of data evolving, as suggested by Strauss & Corbin, (1990). Secondly, engaging with the PD theory during selective coding helped us frame our results to better articulate the contribution of our research. Recent reviews in IS literature welcomed such interpretations and flexible deployments of GT techniques (Matavire & Brown, 2011; Seidel & Urquhart, 2013). We seek to contribute to this development of adapted GT approaches.

### 3.1 Case selection

To explore the dynamics of DI in manufacturing companies, we looked for large international manufacturing companies, with initial experience in DI development. Not all the companies originally approached responded to our research request. We

were able to work with seven companies based in Germany, Austria, and Switzerland. The companies were between 25 and 75 years old, with a rich history in manufacturing physical products. They were operating globally, with revenues between EUR 300M and EUR 5000M. Our fieldwork resulted in 14 interviews with managers directly (as contributors to DI solutions) or indirectly (as decision makers) involved in the DI management process (Table 1). The combination of different roles and companies, and the use of GT techniques to examine the individual perception of the actors in the study, provided an array of perspectives and experiences that help answer our research question. We used the digital product framework of Raff et al., (2020) to provide information on the type of DI the firms work on. The cases selected showed similar properties in terms of industries, market position, and physical product development. We aimed for “a literal replication” (Yin, 2017, p. 55) of the results to make our findings more generalizable. The fieldwork started at the end of 2019 and was conducted over 17 months, including coding and data analysis.

**Table 1. Interviews**

N	Position	Smart Product Archetypes (Raff et al., 2020)	Age of the company	Interview date
#1	Product Manager	Connected	>50 years	10.2019
#2	Head of Digital	Connected	>60 years	11.2019
#3	Sales Manager	Digital	>50 years	09.2019
#4	Head of Sales	Digital	>60 years	01.2020
#5	IT Manager	Connected	>50 years	12.2019
#6	SW Programm Manager	Connected	>50 years	11.2019
#7	Senior Manager Digital Unit	Connected	>60 years	06.2020
#8	IT Project Manager	Digital	>60 years	05.2020
#9	SW Product Manager	Connected	>60 years	06.2020
#10	Head of Manufacturing	Digital	> 35 years	06.2020
#11	Project Manager (Digital Solutions)	Digital	> 70 years	07.2020
#12	Head of Research and Development	Digital	>25 years	08.2020
#13	Head of Digital	Connected	>40 years	07.2020
#14	Product Manager	Connected	>60 years	03.2021

### 3.2 Data collection

The interviews have been guided by a semi-structured questionnaire. It started with an introduction to the study and direction of the research, followed by a general section about the background of the interviewees and their areas of responsibility. Several questions addressed the challenges of DI development, leaving room for reflection from participants and a chance to collect specific recommendations. Open-ended questions have encouraged an open discussion with real-life examples of DI management. The interviews were taken in person or online and lasted between 45 and 60 min. In some cases, we reached out to the participants for clarification questions after the interviews.

Records were transcribed, anonymized, and coded after each interview (Urquhart et al., 2010). During the data analysis, we allowed theoretical sampling

(Charmaz, 2008), resulting in a few modest revisions to the questionnaire.

### 3.3 Data analysis

We applied a three-phased thematic coding approach to answer questions grounded in the data (Fernández, 2004; Strauss & Corbin, 1990; Tan, 2010) through which we make “knowledge claims about how individuals interpret reality” (Suddaby, 2006, p. 634). As recommended, we simultaneously processed data collection and data analysis (Strauss & Corbin, 1990; Urquhart et al., 2010). Firstly, we used open codes to classify the data. Constant comparison of open codes and new themes during the data analysis took place. For example, after one of the interviews, we added a question related to the DI state of the industry, as we recognized that it might give additional insights for our study. Next, we grouped the open codes into categories representing similar themes and summarized those from the research perspective. In the last step, we merged the categories into theoretical forms. We aggregate the categories around the three stages of DI management, lock-in, emergence, and development. This is where we engaged with the PD theory to link our findings in a wider context.

## 4. Findings

We observed that there is a common pattern of DI management, which follows an incremental process through three stages: DI rooted in the physical product development, organizational and functional separation of DI from the product development, and integration into the core business. Next, we will present more detailed empirical findings, using two viewpoints: a general perspective of the DI management dynamics, resulting from how incumbents manage DI activities, and the evolutionary perspective, resulting in the phases of development of DI identified in the data.

### 4.1 DI management dynamics

One finding was that despite the recognized importance of DI and its relevance for the future, DI is considered an add-on to the core business. Further, the participants stated that DI is hype, which each firm shall work on. Due to several barriers (which we discuss further), it cannot yet be considered a solid contribution to the company's business success. *“At the begging, DI was managed within the product teams with the existing processes and tools” #1.* Therefore, DI activities were carried out with a different level of engagement, but with no tangible

results and return on investment. Consequently, we found that in our case, DI did not call for any major adoption of incumbents' business models. The participants gave the following reasons. To begin, remuneration concerns were encountered in most cases. A major stumbling block of DI's success was a lack of clarity on the payment model for DI output.

Secondly, customer expectations regarding DI solutions were vague regarding their benefits and perceived value to remunerate. In addition, incumbents were rarely seen as DI innovators. *"I think the customers are not having the perception of us that we are strong in digital solutions"* #2. Still, customer expectations were related to the physical products of the firm. All these factors contributed to the incumbents' lack of willingness to change their business models. Some companies, on the other hand, attempted to pitch DI solutions as ancillary services to their core physical product business. In these circumstances, there was no evidence that DI directly contributed to increased income.

DI did not significantly alter the firms' strategic approach. This bolstered the argument that DI serves as a backup or supplement to incumbents' physical products.

The integration of DI output into the existing incumbent's business model was a third important conclusion. The data offered several instances. In one case, DI outputs were completely decoupled from the business model and used as a prototype to test the market. Others positioned DI solutions very close to the physical product offerings at a minimal fee. Integration attempts produced tension inside the company in all circumstances, due to a lack of awareness of DI practices, the fact that DI cannot be capitalized, and the many misaligned expectations created by the actors working on physical and DI solutions

## 4.2 Stages of DI management

### 4.2.1 DI emergence in lock-in conditions

The starting stage we observed was termed "Lock-in", in which DI manifested in self-motivated individuals without notable implications for resource configurations at the organizational level. Against the organizational background of low motivation for engaging in DI activities, DI in most cases still starts as an individual initiative with no organizational support and undefined structures.

Existing teams largely concerned with the development of physical items begin working on DI initiatives at this stage. The efforts to develop DI solutions were conducted within existing structures

and knowledge. *"We had the same people who developed physical products developing the DI. They work in the same way. That is why that took us quite a lot of time to come up with a such digital product"* #13. Isolated DI solutions characterize this phase, with unclear financial benefits, and a lack of understanding of the attributes of DI.

We observed an increase in DI awareness from individuals to groups to organizations. DI has become a topic of discussion among senior management, and the first working groups to deal with possible DI initiatives have been formed. Participants mentioned that during the phase, various attempts were made to reorganize the organization's resources. These changes took place on a smaller scale, within a business unit or department, and led to the formation of DI working groups. Nevertheless, those with experience in physical product creation formed the groups.

Two major insights emerged from the data in this stage: DI requires a different organizational setup and specific DI knowledge.

### 4.2.2 DI formation

The second phase was dubbed DI formation, as it became clear that a different organizational architecture was required for DI development after a basic DI awareness was achieved at the senior management level. DI strategy had not yet been defined in all cases, and less emphasis had been placed on strategizing DI operations.

The actual DI formation was initiated by attracting DI experts on the management level to shape the understanding of DI in the organization. These efforts resulted in setting up dedicated organizational structures for DI. They have been separated from traditional product development. The data showed that in traditional product development, no significant changes related to DI have been performed. *"The department was newly created, also including people with history in the company. It was a mix of people understanding the hardware product portfolio and people with a strong digital background but with less understanding of the main business"* #3.

Further, we observed an increased understanding of DI, a certain level of commitment towards DI activities, and a strong sense of the organization to build and develop the DI mindset. *"For sure, this is also a mindset topic. The required agility or flexibility in the software development processes is not given in the product organization, not on theory or paper but in the practice."* #6

The DI formation phase was not aided by significant strategy shifts. Instead, DI was viewed as a

future issue, and attempts to build DI practices were viewed as a learning path toward DI.

#### 4.2.3 DI deployment

As a result of the efforts incumbents conducted in the DI formation phase, new structures emerged. We observed dedicated organizational units for DI and clear delamination between the physical product and DI development. DI activities have been organized around dedicated DI projects, senior management support, and the evaluation of partners and platforms to scale DI solutions.

Two narratives emerged from the data, organizational tension, and integration. The consolidation of DI activities around dedicated teams and the separation from physical product development led to tensions inside the organization. The tensions were due to the unclear DI product strategy, the remuneration for DI, and the overall contribution of DI products to the business. *...(DI)... is still not perceived as positive, and considering the products are the main source of revenue, the software team has difficulties convincing the other departments that they do the right thing" #11.* The subsequent frictions established the idea within the organization that DI is a secondary concern, and it is viewed as an add-on to incumbents' core business.

Further, we found incumbents struggled to integrate the DI output into existing processes. *"...in terms of process integration, the customer expects the process of acquiring the digital solution is very easy and intuitive" #8.* In some cases, market-relevant DI solutions have been developed. The problem they encountered was bringing the technology to market and integrating it into existing processes. In one situation, this resulted in considerable delays in implementing solutions, negatively impacting customer satisfaction.

We discovered that organizational tension and DI integration are inextricably linked. The data showed that the deployment of DI creates tension due to the low remuneration of DI solutions, partly due to the lack of integration into existing processes. As the business models of incumbents remained widely unchanged, integration was identified as a success factor for the future deployment of DI.

## 5. Discussion

Digital technology innovation requires incumbent organizations to develop new tactics to maintain their market position and ensure long-term success. Existing literature offers limited insights into how

incumbents should or can respond to DI (Nambisan et al., 2017). In this study, we sought to gain a practical understanding of how DI is positioned within incumbents' firms and to identify potential phases of DI advancement in the context of incumbents with physical product-driven business models. Next, we discuss the findings of the study and build on the PD theory to determine a potential DI development model.

### 5.1 DI management

The study found that DI activities are seen as opportunities with secondary importance, rather than strategic game-changer for the examined cases. It is interesting to discuss why this is the case.

DI starts ad-hoc as decentralized activities often triggered by individuals. An organizational holistic approach at this stage is missing. Attempts are made to decouple DI development from the traditional research and development process, which leads to the improvement of the DI outcome and consequently to difficulties in its integration into existing processes.

Secondly, the firms face resistance from customers to reward DI solutions. Two major reasons for this behavior have been identified: the perceived low added value of the DI and the difficulties of the firms to provide a business model for the remuneration of DI. As a result, free digital offerings emerge, resulting in a perceived diminished value of DI both within and outside the firm. Thirdly, due to the long tradition of physical product development, DI is seen as an opportunity to improve internal efficiency and processes, rather than providing digitally enabled products to customers. The findings are partially supported by the research of Warner and Wäger (2019) who found that there is a general misalignment in the activities related to DI in incumbent German firms. Further, Warner and Wäger (2019) indicated that for incumbent firms the first steps toward DI are the realignment of the business model leading to wider process and organizational changes. In contrast, no evidence was found that the examined firms intend to change their business models to accommodate differently the DI outcomes.

There are several possible explanations. A successful business model is determined by the configuration of its three main elements: value proposition, delivery, and a revenue model (Bohnsack et al., 2014; Chesbrough, 2010; Chesbrough & Rosenbloom, 2002). We found low motivation for business model adaptation on the individual and organizational levels for either element. None of the three elements were driving a strong need for business case adaptations for DI. As the core capabilities of incumbents are so deeply rooted in their process and

culture, the organizational inertia becomes a constraint for DI deployment (Vial, 2019).

We also discovered that, following initial attempts to deliver standalone DI solutions, some incumbents positioned those as add-on services or products to their core business. Despite the perceived marginal changes in business models due to the positioning of DI as an add-on to physical product offerings, it appears DI is unable to change any of the self-reinforcing events (leading to PD) based on product innovation regime, complementary assets, and cognitive activities. (Sydow et al., 2009). Hence, the exogenous (technology development) and endogenous factors (attracting digital experts, developing new business units) are not strongly developed to force incumbents out of their lock-in.

## 5.2 Path dependence in the DI development

We observed that in all cases in the study incumbents were locked into their product innovation regime. We have not found any evidence for path-breaking events e.g., changing business models to the scale of a significant change of the company's direction. However, based on time, we identified three stages of DI development: emergence, formation, and deployment (Figure 1).

The DI emergence occurs in the situation of lock-in for incumbents, as contingency events (opportunities for DI solutions) are managed with the available resources by applying the product innovation regime. We detected a limited option space as no alternatives for DI have been evaluated due to existing resource configuration and contingency events (Sydow et al., 2009).

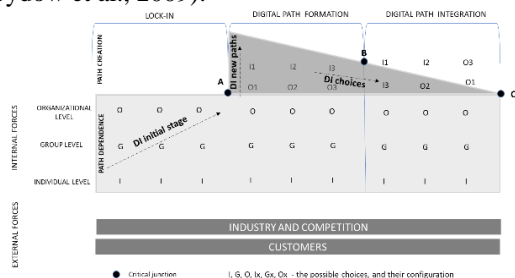


Figure 1. DI development stages

This is in line with other studies, confirming that incumbents are “cognitively constrained by existing business models” (Bohnsack et al., 2014, p.286) and it is their natural tendency to stick to what they know because they cannot see beyond the status quo (Chesbrough & Rosenbloom, 2002; Sydow, 2020). The process of DI management was characterized by leveraging any complementary assets with existing resources (Teece, 2018). However, we discovered that

over time, there is a growing DI awareness from the individual to the organizational level reaching a turning point in which incumbents change their course of action (Point A in Figure 1). The identified conditions could be summarized as an increased understanding of the specifics of DI, concluded first attempts to develop DI with complementary assets and resources within the product innovation logic. Turning point A could not be identified as a break-out from PD but rather as an intermediate step towards the formation of DI.

The DI formation stage is characterized by creating a broader option space for DI activities. Incumbents seek opportunities to develop DI capabilities at individual, group, and organizational levels. For example, hiring digital experts, further increasing DI awareness in the organization, and extending the resource base by establishing dedicated teams on DI. The separation of DI activities from the product innovation logic was performed as a parallel endeavor, characterized by the evaluation of a broader scope options for DI. Similar development of DI is known as digital paths (Kurtz et al., 2021) which are positioned parallel to traditional product development processes. However, the difference to the study of Kurtz et al. (2021) is that they examined incumbent car manufacturers dealing with a high degree of changes forced by the digitalization and electrification of the automotive industry. Considering the weak external forces in our study, we could conclude that also internal forces could lead to DI path formation without breaking out from PD (product innovation regime remains dominant). We further observed that in the formation stage the DI path is rather disconnected from the product development, as newly created teams are independently structured and focused on the development of capabilities and tools for DI. However, both paths operate in parallel and are viewed as distinct streams within the business. Hence, we could conclude that due to the parallel development and separation of DI into a DI path there are no strong conditions for PD break-out.

The data showed that DI becomes an important issue in the organization in the formation phase. Consequently, the parallel co-existence of physical product development and DI creates tension in the organization due to the unclarity of remuneration of the DI output and the delivered customer value. In the given context, the industry and customers remain stable, meaning they do not force for breaking PD. DI related topics were managed in the DI path, while the traditional business remains stable.

The data showed that after initial attempts to evaluate DI development options, the created DI path is consolidated around dedicated teams and projects.



At the end of the DI formation process (point B in Figure 1), the configuration of the DI path is accomplished by taking decisions on the resource configuration and organizational structures.

The third stage focuses on the forthcoming DI development in the organization. Dedicated DI projects were initiated, leading to a higher number of DI solutions. The pressure of demonstrating DI success and the mixed customer acceptance increased further the tension in the organization. Still, the product innovation regime dictated the future strategic development. The active complementary role of DI is also reflected by the use cases incumbents seek for DI output. The combination of weak external forces, the strong cognitive impact of the product innovation regime, and path-dependent behavior do not create strong contingency events, forcing incumbents to change their business models. DI has a marginal impact as a strengthening instrument to further support the core business of incumbents. A possible way of development would be to observe over time an integration of the DI path into the PD. This development could be attributed to two major factors: Firstly, we have identified that the remuneration of DI activities becomes an issue, as incumbents struggle to identify and implement a dedicated DI business model. The integration of DI output into the traditional business model could justify DI investments by providing a path to additional revenue. Hence, incumbents will be forced to improve the DI's revenue model. Secondly, a parallel existence of the DI path not supported by a dedicated business model will further increase the tension within the organization. A solution would be to integrate the DI path on the organizational level into traditional product development (Point C in Figure 1). We do not consider such development as breaking out from the PD, as we have not found any evidence that any of the described stages imposes changes to the product development process.

## 6. Limitations and future research

With this study, we seek to provide a deeper understanding of the development of DI in incumbent organizations and examine the role of PD in the evolutionary process of DI development. While the study includes useful insights about our sample, it is limited in several ways. In addition to the limitations of qualitative research using GT methods, a shortcoming of our study is the sample size and the limited time horizon in which the study was conducted. We tried to address these shortcomings by applying a PD perspective, which is generic in terms of relevance to the industry, as well as not anchored in

any specific point of time (Tiberius, 2011). Further, we looked for incumbents with similar characteristics and at different stages of development to enhance our sample and describe an evolutionary development. To reduce the impact of the limitations, we have also included the exogenous factors, which are important determinators of DI development. We were not able to provide any indications of the magnitude of DI-relevant events that supported a break-out from PD in incumbents, which might be an interesting avenue for further research. Furthermore, due to the rapid pace of DI advancement, the findings should be seen as a glimpse of a specific stage of DI development. We believe that with the use of PD, the findings could be transferred to other cases. Moreover, other scholars could try to build their research on the further development of DI in similar PD and DI conditions, and examine the points in which a clear break-out of PD is achieved.

## 7. Conclusion

The present study was designed to determine the dynamics of DI development in incumbent product-centric firms with strong roots in the product innovation regime. The study has shown that DI is considered an important topic, but mainly due to the strong PD being set to co-exist as an add-on to the main business of incumbents. One of the more significant findings is that DI developments undergo several stages of evolution and create a dedicated DI path, which is closely positioned next to path-dependent physical product development. Therefore, it seems that the exogenous and endogenous conditions and factors determined in the study are not strong enough to lead to a break-out of PD. The evidence of the study suggests that despite DI path creation in incumbent organizations, their business models remain stable, leading to a tendency for an integration of the DI path into the physical product path. Last, the study further promotes the use of qualitative methods in the domain of IS, especially in a complex socio-economic situation with multiple actors and unpredictable dynamics.

Therefore, based on the analysis of the data, we can conclude that in the given conditions of the industry and the absence of strong demand for digital solutions, DI is positioned as a supporting path in the core business of incumbents.

## 8. REFERENCES

- Baygi, R. M., Introna, L. D., & Hultin, L. (2021). Everything flows: Studying continuous sociotechnological transformation in a fluid and



- dynamic digital world. *MIS Quarterly: Management Information Systems*, 45(1), 423–452.
- Bohnsack, R., Pinkse, J., & Kolk, A. (2014). Business models for sustainable technologies: Exploring business model evolution in the case of electric vehicles. *Research Policy*, 43(2), 284–300.
- Chamberlain-Salaun, J., Mills, J., & Usher, K. (2013). Linking Symbolic Interactionism and Grounded Theory Methods in a Research Design: From Corbin and Strauss' Assumptions to Action. *SAGE Open*, 3(3).
- Charmaz, K. (2008). Grounded Theory as an Emergent Method. *Handbook of Emergent Methods*, 3, 155–170.
- Chesbrough, H. (2010). Business model innovation: Opportunities and barriers. *Long Range Planning*.
- Chesbrough, H., & Rosenbloom, R. S. (2002). The role of the business model in capturing value from innovation: evidence from Xerox Corporation's technology spin-off companies. *Industrial and Corporate Change*, 11(3), 529–555.
- Ciriello, R. F., Richter, A., & Schwabe, G. (2018). Digital Innovation. *Business & Information Systems Engineering*, October.
- Coreynen, W., Matthyssens, P., & Van Bockhaven, W. (2017). Boosting servitization through digitization: Pathways and dynamic resource configurations for manufacturers. *Industrial Marketing Management*, 60, 42–53.
- David, P. A. (1985). Clio and the economics of qwerty. In *American Economic Review*.
- David, P. A. (1994). Why are institutions the “carriers of history”? Path dependence and the evolution of conventions, organizations and institutions. *Structural Change and Economic Dynamics*.
- Fallon-Byrne, L., & Harney, B. (2017). Microfoundations of dynamic capabilities for innovation: a review and research agenda. *The Irish Journal of Management*, 36(1), 21–31.
- Faulkner, P., & Runde, J. (2019). Theorizing the digital object. *MIS Quarterly: Management Information Systems*, 43(4), 1278–1302.
- Fernández, W. D. (2004). The grounded theory method and case study data in IS research : issues and design. *Information Systems Foundations: Constructing and Criticising Workshop at The Australian National University, July 16-17*, 43–59.
- Fichman, R. G. R. G., Dos Santos, B. L., Zheng, Z., & Santos, B. L. Dos. (2014). Digital Innovation as a Fundamental And Powerfull Concept In the Information Systems Curriculum. *MIS Quarterly*, 38(6), 1–15.
- Garud, R., & Karnøe, P. (2001). Path Dependence as a Process of Mindful Deviation. *Path Dependence and Creation, August 2016*, 1–40.
- Garud, R., Kumaraswamy, A., & Karnøe, P. (2010). Path dependence or path creation? *Journal of Management Studies*, 47(4), 760–774.
- Glaser, B. G. (1992). Basics of grounded theory analysis: emergence vs forcing. In *Recherche*.
- Hanelt, A., Bohnsack, R., Marz, D., & Antunes Marante, C. (2021). A Systematic Review of the Literature on Digital Transformation: Insights and Implications for Strategy and Organizational Change. *Journal of Management Studies*, 58(5), 1159–1197.
- Helfat, C. E., & Raubitschek, R. S. (2018). Dynamic and integrative capabilities for profiting from innovation in digital platform-based ecosystems. *Research Policy*.
- Hund, A., Wagner, H. T., Beimborn, D., & Weitzel, T. (2021). Digital innovation: Review and novel perspective. *Journal of Strategic Information Systems*, 30(4), 101695.
- Koch, J. (2011). Inscribed strategies: Exploring the organizational nature of strategic lock-in. *Organization Studies*, 32(3), 337–363.
- Krejci, D., & Lausanne, U. De. (2022). A Case Study of Enterprise-Wide Digital Innovation : Involving Non-It Employees. *Ecis*, 1–15.
- Kurtz, H., Bohnsack, R., Kurtz, H., & Hanelt, A. (2021). Re-examining path dependence in the digital age: The evolution of connected car business models. *Research Policy*, 50(9).
- Lansiti, M., & Lakhani, K. R. (2014). Digital ubiquity: How connections, sensors, and data are revolutionizing business. *Harvard Business Review*, 92(11), 90–99.
- Liu, Y., Dong, J., Mei, L., & Shen, R. (2022). Digital innovation and performance of manufacturing firms: An affordance perspective. *Technovation*, December 2021, 102458.
- Magnusson, J., Holmström, J., Magnusson, J., & Mähring, M. (2021). Orchestrating digital innovation: The case of the swedish center for digital innovation. *Communications of the Association for Information Systems*, 48, 248–264.
- Matavire, R., & Brown, I. (2011). Profiling grounded theory approaches in information systems research†. *European Journal of Information Systems*, 22(1), 119–129.
- Nambisan, S. (2013). Information Technology and Product / Service Innovation : A Brief Assessment and Some Suggestions for Future Research. *Journal of the Association for Information Systems*, 14(April 2013), 215–226.
- Nambisan, S., Lyytinen, K., Majchrzak, A., & Song, M. (2017). Digital Innovation Management: Reinventing Innovation Management in a Digital World. *MIS Quarterly*, 41 No. 1(March 2017), 223–238.
- Nylén, D., Holmström, J., Holmstro, J., & Nyle, D. (2015). Digital innovation strategy: A framework for diagnosing and improving digital product and service innovation. *Business Horizons*, 58(1), 57–67.
- Orlikowski, W. J. (1993). CASE Tools as Organizational Change: Investigating Incremental and Radical Changes in Systems Development. *MIS Quarterly*, 17(3), 309.
- Porter, M. J. E., & Heppelmann, J. E. (2015). How smart connected products are transforming companies. *Harvard Business Review*, 1(November).
- Porter, M. J., & Heppelmann, J. E. (2014). How Smart,

- Connected Products Are Transforming Competition. *Harvard Business Review*, November.
- Raff, S., Wentzel, D., & Obwegeser, N. (2020). Smart Products: Conceptual Review, Synthesis, and Research Directions. *Journal of Product Innovation Management*, 37(5), 379–404.
- Sandberg, J., Holmström, J., & Lyytinen, K. (2020). Digitization and phase transitions in platform organizing logics: Evidence from the process automation industry. *MIS Quarterly: Management Information Systems*, 44(1), 129–153.
- Sebastian, I. M., Moloney, K. G., Ross, J. W., Fonstad, N. O., Beath, C., & Mockler, M. (2017). How big old companies navigate digital transformation. *MIS Quarterly Executive*, 16(3), 197–213.
- Seidel, S., & Urquhart, C. (2013). On emergence and forcing in information systems grounded theory studies: the case of Strauss and Corbin. *Journal of Information Technology*, 28(3), 237–260.
- Singh, R., Mathiassen, L., & Mishra, A. (2015). Organizational Path Constitution in Technological Innovation: Evidence from Rural Telehealth. *MIS Quarterly*, 39(3), 653–665.
- Steininger, D. M., Mikalef, P., Pateli, A., & Ortiz-de-guinea, A. (2022). *Dynamic Capabilities in Information Systems Research : A Critical Review , Synthesis of Current Knowledge , and Recommendations for Future Research*. 23, 447–490.
- Strauss, A., & Corbin, J. M. (1990). Basics of qualitative research: Grounded theory procedures and techniques. In *Basics of qualitative research: Grounded theory procedures and techniques*. (Vol. 15). Sage Publications, Inc.
- Suddaby, R. O. Y. (2006). From the Editors : What Grounded Theory is not. *Academy of Management Journal*, 49(4), 633–642.
- Svahn, F., & Henfridsson, O. (2011). The dual regimes of digital innovation management. *Proceedings of the Annual Hawaii International Conference on System Sciences*, 3347–3356.
- Svahn, F., Henfridsson, O., & Yoo, Y. (2009). A Threesome Dance of Agency: Mangling the Sociomateriality of Technological Regimes in Digital Innovation. *International Conference on Information Systems*, 1–18.
- Svahn, F., Mathiassen, L., & Lindgren, R. (2017). Embracing Digital Innovation in Incumbent Firms: How Volvo Cars Managed Competing Concerns. *MIS Quarterly*, 41(1), 239–253.
- Sydow, J. (2020). Path Dependence and Routine Dynamics. *Cambridge Handbook of Routine Dynamics*, July, 501–512.
- Sydow, J., Schreyögg, G., & Koch, J. (2005). Organizational paths: Path dependency and beyond. *21st EGOS Colloquium*, 1–42.
- Sydow, J., Schreyögg, G., & Koch, J. (2009). Organizational path dependence: Opening the black box. *Academy of Management Review*, 34(4), 689–709.
- Tan, J. (2010). Grounded theory in practice: issues and discussion for new qualitative researchers. *Journal of Documentation*, 66(1), 93–112.
- Teece, D. J. (2007). Explicating Dynamic Capabilities: The Nature and Microfoundations of (Sustainable) Enterprise Performance. *Strategic Management Journal*, 29(13), 1319–1350.
- Teece, D. J. (2017). Dynamic Capabilities and (Digital) Platform Lifecycles. *Entrepreneurship, Innovation, and Platforms*, 211–225.
- Teece, D. J. (2018). Business models and dynamic capabilities. *Long Range Planning*, 51(1), 40–49.
- Tiberius, V. (2011). Path dependence, path breaking, and path creation: A theoretical scaffolding for futures studies? *Journal of Futures Studies*, 15(4), 1–8.
- Urquhart, C., & Fernandez, W. (2006). Grounded Theory Method : The Researcher as Blank Slate and Other Myths. *Information Systems*, 12(31), 456–464.
- Urquhart, C., Lehmann, H., & Myers, M. D. (2010). Putting the “theory” back into grounded theory: Guidelines for grounded theory studies in information systems. *Information Systems Journal*, 20(4), 357–381.
- Vergne, J., & Durand, R. (2010). *The Missing Link Between the Theory and Empirics of Path Dependence : Conceptual Clarification , Testability Issue , and Methodological Implications*. June.
- Vial, G. (2019). Understanding digital transformation: A review and a research agenda. In *Journal of Strategic Information Systems* (Vol. 28, Issue 2, pp. 118–144).
- Wang, G. (2022). *Digital reframing : The design thinking of redesigning traditional products into innovative digital products*. January 2020, 95–118.
- Wang, J., Hedman, J., & Tuunainen, V. K. (2016). Path creation, path dependence and breaking away from the path: Re-examining the case of Nokia. *Journal of Theoretical and Applied Electronic Commerce Research*.
- Warner, K. S. R., & Wäger, M. (2019). Building dynamic capabilities for digital transformation: An ongoing process of strategic renewal. *Long Range Planning*, 52(3), 326–349.
- Yin, R. K. (2017). *Case study research and applications: Design and methods*. CA: Sage.
- Yoo, Y. (2013). The Tables Have Turned: How Can the Information Systems Field Contribute to Technology and Innovation Management Research? *Journal of Association for Information Systems*, 14(May 2013), 227–236.
- Yoo, Y., Boland, R. J., Lyytinen, K., & Majchrzak, A. (2012). Organizing for Innovation in the Digitized World. *Organization Science*, 23(5), 1398–1408.
- Yoo, Y., Henfridsson, O., Lyytinen, K., Tiwana, A., Konsynski, B., & Bush, A. A. (2010). The New Organizing Logic of Digital Innovation: An Agenda for Information Systems Research. *Information Systems Research*, 21(4), 724–735.