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# The Internet of Things and the case of Bosch: Changing business models while staying true to yourself

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## ABSTRACT

The Internet of Things (IoT) has disrupted many existing industries and provided new business opportunities to new and incumbent firms. In this paper, we focus on how companies change the way they work and organize themselves in light of IoT. Based on a single case study of Bosch, one of the largest incumbent German engineering firms, we shed light on how a product-centric company that focused on manufacturing for more than a century, adapts its business model to transform into an IoT company. We outline the changes that occur in terms of the company's (1) value proposition, (2) value creation, and (3) value capture. Our findings show how some of the imprinted company values play a crucial role in this transformation. Through a mechanism we call *imprint anchoring*, we find that these core company values serve as a leverage for Bosch to transform into an IoT provider.

## 1. Introduction

The Internet of Things (IoT) was introduced by the British technology pioneer Kevin Ashton, who first coined the term Internet of Things back in the 1990s (Ashton, 2009). Since then, a plethora of definitions for the Internet of Things emerged. What all these definitions have in common is the idea that IoT digitizes the physical world by allowing an exchange of information between connected devices, using connectivity technologies and semiconductor elements (Whitmore et al., 2015; Benamar et al., 2020). IoT is increasingly applied across all industries: each day, the number of connected devices increases, creating a powerful source of data that allows for new applications and services. Forecasts predict that there will be 38.6bn connected devices by 2025 worldwide, and up to 50bn in 2030 (Strategy Analytics, 2020).

The introduction of IoT has led to a number of possibilities and new economic opportunities. IoT has the potential to disrupt existing industries, offer new market opportunities, and shift the balance of power of existing players as well as new entrants. Especially for incumbent organizations with more traditional, manufacturing-centric business models, the impact is immense. Many companies now need to expand their current product offering from a purely physical portfolio to one that includes digital solutions as well (Porter and Heppelmann, 2015). In most cases, this has proven to be a challenging task. According to

Gebauer et al. (2020), one of the reasons is the difficulty to successfully modify these companies' established business models. Therefore, in this paper, we investigate how incumbent firms adapt their business model when morphing from a manufacturing, product-centric company towards a company offering IoT solutions.

Business models in essence outline *how a firm does business* (Amit and Zott, 2015; McDonald and Eisenhardt, 2020; Zott et al., 2011). Business models explain "both value creation and value capture" (Zott et al., 2011, p. 1020) and describe "how the pieces of a business fit together" (Magretta, 2002, p. 91). In this paper, we focus in particular on three major business model components: value proposition, value creation, and value capture (Clauss, 2017; Zott et al., 2011) and we investigate the impact the new technology paradigm surrounding IoT has on the respective business model components.

Our insights are based on a qualitative, in-depth case study of a single organization. We collected our data within Bosch, a German engineering and technology company which is one of the largest automotive suppliers worldwide. Bosch is traditionally a manufacturing, product-centric firm whose traditions reach back to the 19th century. The company was particularly useful to study as, in light of current changes in the industry, it explicitly announced its ambition to become a leading IoT company, providing connected products and creating additional value by offering digital services. We followed this major transformation

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over a period of three years and collected data from various sources. Conducting this case study enabled us to develop a better understanding of the impact of adopting IoT on a company's business model.

We find that providing IoT solutions called for decisive changes with regards to the company's value proposition, value creation, and value capture mechanisms. First, with regards to the value proposition, we find that the company changed its offering, combining the physical and the digital world. In addition, our findings also show how the company shifted focus from a technology push approach towards a customer-centric development strategy. Second, Bosch implemented changes in terms of its value creation mechanisms. Our findings reveal how Bosch increasingly adopted an ecosystem approach, which entailed the company (re)defining its role within the ecosystem. In addition, the company entered into cross-divisional collaborations and shifted its focus from traditional one-way logistics processes to multi-directional processes and non-thing transport routes. Finally, in terms of value capture, we noted that Bosch increasingly adopted a holistic view of the product lifecycle, which offered the opportunity for new monetization models, but also required new metrics for success. We outline the changes we observed across the three dimensions of the business model and underpin our findings with examples from our case company.

Our case study also reveals that in transforming into an IoT provider, the company stayed true to itself, through a mechanism which we call "imprint anchoring". We find that while the company fundamentally changed its business model, it also built on its strengths as an established, manufacturing firm. In changing its business model, our analysis shows that some core historical values of the company played a crucial role, in that they served as a leverage for the necessary changes of the company's business model.

This study contributes to our understanding of how IoT impacts incumbent manufacturing firms. From a theoretical perspective, we bridge the literature on imprinting and business models. First, we show how companies manage to transform traditional business models that are typically associated with manufacturing, product-centric organizations. Second, we show that through imprint anchoring, some of the original core company values underlying the older business model can be leveraged in this transformation.

## 2. A changing business landscape

### 2.1. The advent and evolution of IoT

The spread of the Internet of Things has been facilitated by several important technical developments. Some of the key enablers were the rise of communication technology, developments in the semiconductor industry, as well as the changing role of software (Jankowski et al., 2014). These developments, leading to a rising number of intelligent and connected devices, have significantly reshaped companies and competition as firms have increasingly shifted their offerings from purely physical products toward digital ones (Porter and Heppelmann, 2014, 2015).

The advent of IoT solutions has benefited customers as well. In many areas, IoT solutions have made people's lives easier by relieving people of thinking, or by making "things" more efficient. An often-cited example is washing machines that automatically determine the ideal amount of washing powder and water, and inform the user when a wash cycle is completed (Dararian and Michael, 2008; Tan and Wang, 2010). Through the collection and analysis of huge amounts of data, IoT solutions help humans to anticipate events based on observed behavioral patterns and to take well-informed decisions.

For companies, the technological developments that enabled and shaped IoT have led to numerous opportunities, either through the enhancement of the current product offerings, but also through the internal optimization of processes, resulting in significant cost efficiencies and higher profit margins (Greenhalgh and Rogers, 2010). Focusing on the opportunity to expand their classical value proposition, companies

can now benefit tremendously from new revenue streams through additional products and services. Instead of building their business on one-time product sales, companies can expand their scope and monetize digital services that generate recurring revenues (Metallo et al., 2018; Turber et al., 2014). Well-known examples such as Uber, AirBnB and PayPal even go one step further and reveal that it is economically attractive to forgo physical infrastructure, products or assets for doing business. With the increase in number of intelligent and connected devices, the overall economic impact of IoT applications has been estimated to be extremely high (Manyika et al., 2015).

However, what is easily neglected in the discussion of how to exploit the potential of IoT is the organizational challenges that digital transformation initiatives entail, in particular for established firms. In line with this, Gebauer et al. (2020) introduce *the digital paradox*, referring to the fact that although companies invest in IoT initiatives, they struggle to realize additional revenue. One reason might be that incumbent firms are often not able to effectively address those opportunities with their existing business models (Ehret and Wirtz 2016). Extant research has shown that incumbent firms might need to disengage from their traditional way of thinking, and start developing new business models to be competitive on the long run (Gassmann, O., Frankenberger, K., & Sauer, R., 2016).

### 2.2. The need for new business models

In recent years, the business model concept has gained increasing popularity, both in practice and in academia. According to Zott et al. (2011), a business model offers a "holistic perspective on how firms do business" (p. 1021). Teece (2010) describes a business model as "the design or architecture of the value creation, delivery, and capture mechanisms [a firm] employs" (p. 172). He further states that "the essence of a business model is in defining the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit" (Teece, 2010, p. 172). Driven by different scholars, the literature on business models has developed into distinct streams, each of them following own approaches and theories. Yet despite the fact that extant research on business models is dispersed, most scholars agree on three central aspects of a business model, referred to as (1) *value proposition*, (2) *value creation*, and (3) *value capture* (Clauss, 2017; Gassmann et al., 2016; Zott et al., 2011).

While the current debate around IoT has primarily centered around the technical developments as well as the newly emerging opportunities, less attention has been paid to the consequences that IoT has for incumbent firms that face the challenge of adapting their business model to leverage the potential of IoT and survive on the long-term. Yet it is arguable that the transition towards IoT requires fundamental changes in the company's value proposition, value creation, and value capture, especially for manufacturing companies that are traditionally product-centric.

In this paper, we focus on this under-addressed issue, and we look at how an incumbent firm changes its existing business model when morphing from a manufacturing, product-centric company towards a company offering IoT solutions.

## 3. Methodology

Our exploration of the impact of IoT on an incumbent firm's business model is based on a qualitative single case study of Bosch. We chose a qualitative study as our goal was to construct insights into a phenomenon that was not well explained by the existing literature (Eisenhardt, 1989) – in this case, how an incumbent, manufacturing company changes its business model in transforming into an IoT provider. We decided to do a single case study as we found this a particularly useful method to address our research issue and to focus on "how" or "why" questions. The choice of a single case study was motivated by the fact that we recognized that close involvement with the research setting was

necessary in order to understand the phenomenon sufficiently to generate new theory and new insights (Yin, 1984).

### 3.1. Research setting

Since our goal was to investigate how an incumbent company transforms into an IoT company, we looked at the German engineering and technology company Bosch, where the phenomenon was salient and particularly present.

Bosch employs over 400,000 people worldwide and is a global player in multiple industries including mobility, consumer goods, industrial technology and energy and building technology. The company was founded in 1886 by Robert Bosch as a “Workshop for Precision Mechanics and Electric Engineering” in Stuttgart, Germany. In the following decades, Bosch developed into a global industry leader and became known worldwide for its high-quality products, based on cutting-edge technology. Having a legacy as a manufacturing company ever since, it recently announced its ambition to become a leading IoT company, entering into competition with tech giants such as Google, Apple and Microsoft. A major reason for Bosch’ decision to engage with IoT and develop a specific IoT strategy at an early stage was driven by the fact that the company recognized the need to take a pioneering role in the field. They wanted to shape standards from the outset, in order to be able to take a relevant position in the ecosystem and establish successful business models later on.

The company’s vision was to leverage its expertise in products as well as deep domain know-how, to connect all its electronic products, and to apply AI to create additional value for users who benefit from new digital services and additional products. In addition to the company’s distinct hardware competence, a key prerequisite was the software and IT expertise, which Bosch had been expanding for several years.

The company certainly represents a best practice case, as it initiated a considerable number of IoT projects in the past, some of which were already successfully awarded innovation prizes. Besides this, Bosch has been repeatedly mentioned as a company that is successfully mastering digital transformation (e.g. Bieler, 2020). In line with this, Bosch set itself a goal to become a leading IoT provider by 2025.

We find that the transformation into an IoT company required decisive changes with regards to Bosch’ business model, and that this gave rise to several challenges. The example of Bosch gave us the chance to have a deeper look at the implications of evolving from a purely manufacturing company towards an IoT company, and to underpin challenges with real examples. Our analysis shows that during this transformation process, Bosch succeeded in leveraging the company’s strengths built up over decades and that the company transformed them into key differentiators for their new business model centered on IoT.

### 3.2. Data collection and analysis

Our data collection took place over a period of three years from January 2018 to December 2020. To be able to get deep insights into the company’s transformational process towards an IoT company and the ongoing changes with regards to its business model, we adopted an “insider-outsider” approach (Gioia and Chittipeddi, 1991).

Over a period of three years, the first author spent time in the company, constantly observing the company’s development, and engaging in conversations with employees from different departments and hierarchical levels to investigate the impact of the ongoing transformation. The author documented all observations in a total of five notebooks, which resulted in a collection of over 1000 pages.

While the first author was closely involved with the organization, she also engaged in several practices to maintain professional distance and neutrality (Anteby, 2013). First, through her field notes and a field diary she was able to reflect upon her own observations of, and interactions with, people within the company. From time to time, she would also write memos that helped her to relate her insights to the literature, and

to abstract from her observations and conversations. Second, based upon her field diary and memos, she had regular discussions with one of the other authors – who was not involved in the field research – to talk through events and changes within the organization and her evolving insights, as well as identify areas where additional interviews were required to balance the findings of her participant observation. Finally, she had full access to other data sources such as formal and informal internal and external communication. This helped her to triangulate her insights from the field and compare findings from various data sources and identify patterns across these.

Those field observations and field notes were the major source of data for the paper, together with 27 interviews that were conducted on top management level as part of an internal strategy project. The interviews were transcribed, allowing us to incorporate the insights of individuals that experienced the challenges of transformation in their daily work environment.

In addition, we used archival data including internal and external documents. Internally, we got full access to white papers, company presentations, project reports, internal press releases, and company blogs. Externally, we included press articles as well as internet resources. In October 2019, the first author helped organize a conference with presentations and discussions focusing on corporate transformation. The conference allowed to collect additional data with regards to the implementation of the IoT strategy, as well as challenges encountered. The complete list of data sources used for this study can be found in Table 1.

In the next step, we analyzed our data to investigate how Bosch changed its business model when developing into an IoT company.

We started our analysis with a broad lens, seeking to better understand the changes that Bosch was implementing in its transformation towards an IoT provider. We read our field notes, company documents, blog posts, and reviewed our interview transcripts. During this initial phase, we focused on the broader context and the different organizational aspects that were affected by IoT. Based on our analysis of this broader set of data, we constructed a timeline of how the company transformed into an IoT player, and we realized that the most significant changes occurred on the level of its business model. Hence, we decided to further focus on this particular aspect.

**Table 1**  
Overview data sources.

Data source	Type of data	Use of data
Field observations	<b>Field notes (1020 pages):</b> record of internal meetings and observations over a period of three years	Familiarizing with the organization, investigating the company’s approach towards transformation, identifying fields of conflict and challenges.
	<b>Informal conversations:</b> Informal talks with employees holding different functions and hierarchical levels	Recognizing particular concerns of employees, understanding especially considerations that are not officially expressed.
Interviews	<b>Exploratory interviews (27):</b> interviews with top management and employees working on IoT projects	Incorporating view of individuals into the research, triangulating data from field observations.
Archival data (internal)	<b>Strategy documents:</b> internal presentations, process instructions, white papers	Observing the overall transformation of the company.
	<b>Internal news articles:</b> reports on internal events and recent developments	Identifying transformation projects and recent organizational changes.
	<b>Videos:</b> recordings from top management	Following the official internal communication about current events.
Archival data (external)	<b>Media sources:</b> from diverse journals and newspapers	Familiarizing with the company, investigating external company image.

After this exploratory phase, we read the literature on business models and IoT and we iterated back and forth between the literature and the data. One author manually coded the interview transcripts and field notes for patterns. Based on the literature, we decided to look at Bosch' business model from the perspective of its value proposition, value creation and value capture mechanisms, as we found that this was in line with the patterns we observed in our data. We realized that the transfer towards an IoT company required significant changes at each of the three levels. Contrary to our initial expectations however, we realized that although change proved essential for transformation, certain core values of the company continued to be the cornerstone of the newly emerging business model.

In a third step, we thus focused in more detail on the persistence of these core values, which led us to the literature on imprinting. Imprinting theory describes how initial characteristics of organizations shaped during founding have an enduring and persistent effect within organizations (Marquis and Tilcsik, 2013; Stinchcombe, 1965). We subsequently focused our inquiry on the company's imprinted values and compared them to the core elements of the company's new way of doing business. Doing so, we found that there were in particular two core company values that served as a leverage for Bosch to transform its business model in becoming an IoT player.

4. Findings

The transformation into an IoT company was for Bosch a major change. It wasn't seen as the next innovation project, but as an important strategic move towards the future, that would require a significant mindset change, and become very central. One of the managers said how IoT would be "the future [...] a topic that is not just the tenth pig to be herded through the village, but central [...] no getting around it" (Business Model Expert). Whereas for certain business areas, IoT was not that different from Bosch' traditional way of doing things, in most areas, IoT certainly represented a different world, requiring significant changes in the company's business model:

To a certain extent, IoT and traditional business go hand in hand. In manufacturing, it's obvious. The collection and networking of data. The I4.0 stories. That's where it becomes relatively concrete and it's close to previous processes. In the traditional core business however, we are confronted with two different worlds.

Interview with Business Developer of a Bosch Platform Business

Based on our analysis, we identified how three dimensions of the company's business model were altered in its transition from a product-centric manufacturing company into an IoT company. Yet while we found that certain aspects within the three dimensions drastically changed to enable the transition, we also found that through a mechanism of *imprint anchoring*, there were certain core corporate values that had a strong impact on how this change occurred. These values were originally imprinted by Robert Bosch, the founder of the company, and continued to affect the company throughout its history. We find that these values formed the basis for certain business model elements that remained the same. Table 2 gives an overview of these new business model components, and of how the imprinted values affected this change.

In what follows, we first describe the core company values that were imprinted by the founder of Bosch and that had played a role throughout the company's history. We subsequently outline the changes that happened across the individual business model dimensions, and how the imprinted values played a role in this.

4.1. Imprinted values by Robert Bosch

In analyzing our data, we found that there were two core values that strongly defined the company culture and its business model: (1) focus

Table 2 Business model change in light of IoT.

Business Model Dimensions	From	To
<b>VALUE PROPOSITION</b>	<ul style="list-style-type: none"> <li>Traditional value proposition focused on hardware</li> <li>Technology push</li> </ul> <p><i>Imprint anchoring</i> Focus still on connected "things": Component business stays at the heart of the company's business model and serves as enabler for IoT business.</p>	<ul style="list-style-type: none"> <li>Novel offering combining physical and digital world</li> <li>Increased customer centricity</li> </ul>
<b>VALUE CREATION</b>	<ul style="list-style-type: none"> <li>Vertical value chain</li> <li>"Silo-thinking"</li> <li>One-directional logistic processes</li> <li>One-to-one centrally</li> </ul> <p><i>Imprint anchoring</i> Strong focus on product quality and security. Therefore, attention is paid to controlling potential partners and solutions are developed in-house as far as possible.</p>	<ul style="list-style-type: none"> <li>Adopting ecosystem approach and defining the company's role within ecosystem</li> <li>Increased cross-divisional collaboration</li> <li>Non-thing transport routes</li> <li>Multi-directional logistic processes</li> </ul>
<b>VALUE CAPTURE</b>	<ul style="list-style-type: none"> <li>Traditional product lifecycle</li> <li>Traditional revenue models e.g. one-time payment</li> <li>Classical performance metrics</li> </ul> <p><i>Imprint anchoring</i> Superior technology and high quality come at a price. Technology remains a driving force for prices charged, be it through a one-time payment or through a recurring revenue model.</p>	<ul style="list-style-type: none"> <li>Holistic view on product lifecycle</li> <li>Novel revenue models, e.g. recurring revenue</li> <li>New metrics for success</li> </ul>

on technology and (2) focus on products. Our analysis further shows that these two company values had a particularly strong impact in how Bosch changed its business model to become an IoT provider.

First, with regards to the *focus on technology*, the company had always valued a strong focus on superior technology as a solution for everything. By founding the "Workshop for Precision Mechanics and Electrical Engineering" (Bosch Group, 2021b), Robert Bosch laid the foundation for an element that always played a central role throughout the company's history: technology and technical devices. Over more than 100 years, the company managed to strengthen its role as a technology leader, selling technology-based products across multiple industries.

Second, with regards to the *focus on products*, the company had always had a reputation of superior product quality, including – among other aspects – product security. The focus on sophisticated high-quality products was again imprinted by the founder and had played a crucial role throughout the company's history. The company's mission statement stated that products are "invented for life" (Bosch Group, 2021a), pointing out the strong emphasis Bosch placed on product quality. To achieve this goal, Bosch had always been investing large amounts of money in research and development, and the product's quality had always been reflected in comparatively high prices.

We find that these core corporate values both constrained but also enabled the change into an IoT provider, and that they affected each of the three dimensions of the company's business model: value proposition, value creation, and value capture. In particular, our data shows how the company engaged in a practice we call *imprint anchoring*, whereby the core imprinted company values served as an anchor which provided guidance and leverage for the necessary changes in their transformation into an IoT company.

In what follows, we describe the changes that occurred along each of the dimensions of the business model, and how *imprint anchoring* played out.

4.2. Value proposition

We observe that as IoT solutions fundamentally differ from traditional business, Bosch had to adapt their value proposition. There are two elements in the company’s value proposition that significantly changed. This included the offering, which shifted from a purely hardware driven product offering, towards a new offering combining the physical and the digital world, as well as the product development strategy that shifted from technology push towards a customer-centric approach.

4.2.1. New product offering based on physical and digital world

IoT solutions include both tangible – “thing” - and intangible - “non-thing” – components, which are typically assigned to different technology layers – also called the IoT tech stack. The basis of each IoT solution are “connected things”, which consist of sensors and semiconductors that serve to collect data. Additionally, IoT solutions include information and communication technologies that form the overall infrastructure for each IoT solution. Finally, there are IoT analytics and applications, which leverage the core business and represent the final layers. As an illustration, Fig. 1 outlines the different components and layers of a typical IoT solution or IoT tech stack.

As a result of this multi-component layered nature of IoT solutions, Bosch, traditionally a manufacturing company, was faced with the need to expand its positions along the value chain. They were forced to move beyond the development and production of tangible “things”, as one of our interviewees told us:

The business world is changing in such a way that growth can only be increased if the position is also expanded in the value chain. Much stronger share of services, of value proposition elements that go beyond purely tangible things.

Interview with Business Developer of a Bosch Platform Business

For decades, our case company had developed great expertise and a reputation as a supplier of components, or “things”. However, the rise of IoT was bringing the physical and digital worlds ever closer together. Forced by these developments, the company initially tried to not only operate at the bottom level of the IoT tech stack, but to serve large parts of the value chain itself. For instance, the company developed a proprietary cloud platform for sensitive data to offer new solutions. This put Bosch in a unique position, as the company was thus initially active on all three levels of the Internet of Things. Bosch offered key technologies such as sensor technology and software for networking, provided the IoT backbone, and at the same time developed new services based on these technologies. Over the course of time, however, we find that Bosch re-focused on the bottom layers of the IoT tech stack, and made more and more use of external cloud solutions. It was a learning process for Bosch to acknowledge that IoT implied concentrating on inherent

strengths and involving partners in other areas, and that this approach brought a clear advantage in the era of this new technology paradigm:

To succeed we need to find a way to use the power of Bosch – connected things.

Interview with Lead Engineer

Hence, despite the fact that the company’s value proposition now consisted of thing and non-thing components, Bosch realized that in order to succeed, they had to focus on their core competencies which were connected “things”. Fig. 1 is a visualization of the layers Bosch over time decided to focus on, and for which layers of the IoT tech stack they relied on partners.

4.2.2. Customer centricity

Additionally, we find that another important aspect of the value proposition that changed was the increased customer centricity to develop new products and services in the area of IoT. As part of the organizational transformation, Bosch aimed to completely rethink the traditional way of product and service development. Whereas previously, the company was specialized in pushing technological innovations to the market, the company increasingly recognized the need for customer-centric approaches when developing new products and services.

One of our interviewees told us that, as a result of the engineering background of the company, there was a mentality within Bosch that if you create a good product, people buy it. He continued explaining how this was no longer the case with IoT, and how there was a need to shift the mindset of the company:

What I would like to emphasize is that I am firmly convinced that soft facts and the way people work together are issues often being neglected. This can be internal collaborations, but also technological partnerships. These topics are still underemphasized. But that is probably not least due to the fact that Bosch has a strong engineering background. So you create a good product and, if it’s good enough, people will buy it. But that’s exactly what’s no longer the case. And that has to get out of people’s heads.

Interview with Senior Vice President Integrator Business

To guide the shift in mindset and introduce the individual departments to the novel approach of customer centricity, dedicated departments were set up, to provide support along the product development cycle and to introduce customer-oriented development methods. The company increasingly used methods such as design thinking and the lean startup to focus attention on customer centricity. For instance, as time windows to build dominant market positions became rather short, several of those newly created departments encouraged internal groups to shorten time to market by applying MVP based piloting to test product-market-fit and to quickly pivot if

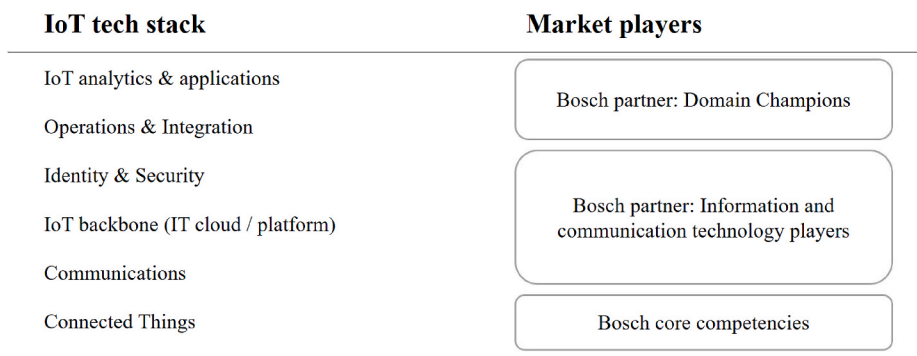


Fig. 1. IoT tech stack. Source: Bosch internal document adapted from Hunke et al. (2017) and Khan et al. (2012).

necessary, two practices that are part of the lean startup. To spread this change in mindset, the departments organized diverse internal conferences, and held speeches where success stories and key learnings were shared. Experts also joined different innovation projects to provide dedicated support. Our analysis shows that over time, the mindset within the company shifted. One of our interviewees told us how “we do what they [the customers] ask us to do” (interview with technology strategist). We thus find that there was an increased focus on the customer and that this now significantly impacted product development.

**Imprint anchoring.** Despite the major changes in the value proposition, we noticed that in their transition to an IoT provider, Bosch realized that the most important part of their business was still connected “things”. One of our interviewees explained to us how “the focus remained more on the *things*, than on the connected part”. Relatedly, our data shows how the focus remained to be on product and high product quality, and that these values were clearly reflected even in the new value propositions. In other words, despite the rise of digitalization and the bridging of the physical and digital world, the component business stayed at the heart of the company’s business model and served as enabler for their IoT business. Moreover, other market players continuously approached Bosch for their high-quality sensors as a basis for their own IoT solutions. Hence, we find that through imprint anchoring, the emphasis on products and superior product quality was transferred, even when the company transformed from a manufacturing firm into an IoT provider.

#### 4.3. Value creation

The introduction of IoT solutions also asked for changes in the way the company created and delivered value. This became evident as the company increasingly engaged in ecosystem thinking, and expanded external and internal cooperation. In addition, value delivery and logistic processes were significantly influenced by the increasing importance of IoT.

##### 4.3.1. Ecosystem approach and defining role within the ecosystem

Each individual layer of an IoT solution (see Fig. 1) requires certain capabilities, as well as different business and monetization logics. Over time, Bosch learned that they were no longer able to cover the entire value chain and provide an end-to-end solution. Instead, individual tasks were now typically performed by different types of market players that were specialized in and dominated a specific layer: sensor and semiconductor manufacturers offering connected things; information and communication technology players enabling communications, providing platforms or IT clouds, and ensuring data security; and domain champions integrating the IoT solution and providing applications and analytic services.

Hence, we find that our case company realized that developing IoT solutions required partnering and data exchange across different layers to create added value. One of our interviewees explained:

Since the Business Model is often data-based, as a company you are no longer able to generate value for your customers on your own. As a manufacturer, you are no longer in a position to generate individual use cases with several products completely independently. Instead, you are operating in an environment where data is exchanged and where the actual value for the user is created through this exchange of data.

Interview with digital strategy manager

Instead of offering the entire solution on its own, the company decided to concentrate more on those levels in the stack where it could best contribute, based on its own strengths. With the increasing relevance of cooperation and the understanding that a single player could no longer build up all skills on its own, an ecosystem perspective was

getting ever more important. The creation of ecosystems to benefit from the strengths of others became a basic prerequisite for the company if they wanted to offer IoT solutions.

Originating from biological studies, James F. Moore (1996) originally introduced the concept of an ecosystem into a business context. He defined a business ecosystem as a network of interdependent niches that are occupied by different organizations (Moore 1996). Ecosystems vary in size and can be interconnected among themselves or nested in larger meta-ecosystems. Companies can take different roles and either participate in an existing ecosystem, or decide to establish one on their own.

Thus, as Bosch was morphing into an IoT company, the question of how to leverage the IoT ecosystem to deliver outcomes and solutions became crucial. For each newly emerging IoT ecosystem, Bosch had to define its targeted ecosystem role, decide how to control data streams, and think about effectively managing relevant partnerships within the ecosystem.

Bosch considered two potential ecosystem roles. First, the role of “contributor” who provides parts of a particular IoT solution such as smart products or apps. Contributors usually participate in several ecosystems at the same time to scale their business. Second, the role of “orchestrator” who creates and controls the system.

We find that over time, our case company recognized the importance of ecosystems, and at the same time learned that a focus on its own strengths was essential. On the one hand, Bosch decided to act as a contributor, strongly relying on its core competency, which was the provision of smart “things” such as sensors, semiconductors and other products around which the ecosystem is built, as well as the analytics and applications that enable other players to use the solutions. The company took on an important role in the ecosystem, offering the interface between physical devices and the internet.

On the other, Bosch considered the role as orchestrator as a viable option too. In the automotive industry for example, given Bosch’ neutral position as a Tier-1 supplier and its deep technical understanding of a broad product range, the company already was in a good position to ensure value towards the user, and create an attractive environment for all participants of the ecosystem. Original equipment manufacturers (OEM) would not buy components directly from competitors, but always from a neutral market player in order not to weaken their own position vis-à-vis the competition. The same applies to data: swarm optimization requires data input from different players. In the automotive industry, a neutral Tier-1 supplier was more likely to succeed in merging data from various sources and providing a respective solution than any of the OEMs who were in direct competition with each other.

Ultimately, the respective role taken up by Bosch depended on the specific IoT use case. To identify what role was realistically achievable within the ecosystem, the existing capabilities had to be matched to the capabilities required for orchestration. When assuming the role of the orchestrator, Bosch realized they had to demonstrate a unique selling point (USP) in the ecosystem - such as access to a unique data set -, control data flow, and be able to monetize via relevant monetization channels (Bosch Group, 2019).

##### 4.3.2. Increased cross-divisional collaboration

In addition to intensified external collaborations through ecosystems, internal cross-divisional collaborations were stimulated, in order to benefit from synergies and to provide an even greater value to the customers. As IoT solutions and the digital business models built around them are complex, they required multiple competencies and expertise from different fields. Product development and service design had to be tightly integrated and aligned to cover large parts of the value chain – a major prerequisite for the provision of IoT solutions. A close cooperation between individual divisions was also important to manage partners effectively and thus increase negotiating power towards dominant players.

Another learning was that the employees had to start looking beyond the borders of their own projects when it came to the internal collection

and combination of different data points. Since IoT driven services became more valuable, more relevant data points were included, and the company had to consider data pools and the combination of data points across projects. The creation of a Bosch-internal data consortium served as data pool for the input into new services.

Due to the increase in internal collaboration, cost allocations of shared infrastructure also had to be revisited and redesigned. The development of an internal IT cloud solution to collect and store data for example involved significant pre-investments. Allocating all costs directly to the first unit and project adopting the solution would have resulted in a negative business case for this particular project and caused a “first-adopters”-dilemma: other business units that adopted later would have built their products or services on the same cloud solution and benefited from the platform and capabilities financed by the innovator’s pre-investments.

Such a “first comes first pays” option was not suitable as in this case, every unit would have tried not to be the first to adopt centrally developed solutions, which ultimately would have slowed down the corporate innovation process. Instead, pre-investment costs that were needed across different units had to be fairly distributed. However, this again led to a further challenge. The need for a joint solution that would be co-financed by everyone, but at the same time had to meet all individual requirements, led to the fact that development became extremely inflexible and time consuming. To counteract this, Bosch decided that substantial cost reductions could be attributed to the first units that decided to use the internal solution. These cost reductions could be complemented by additional budget to allow the units to finance the adjustments needed to make the solution best suited to their individual needs. This way, the company created a strong incentive for other units who saw that the internal solution was already being used by others.

#### 4.3.3. Changing logistic processes

Finally, we found that the transformation towards an IoT company also required a shift in the way Bosch delivered value through its logistics. The company moved from one-directional logistic processes that were organized one-to-one centrally, to multi-directional logistic processes, where for example products were exchanged in return for data, and a higher number of players were connected through direct or indirect links. Fig. 2 visualizes these multi-directional logistic processes.

One of our interviewees explained the complexity of these changing logistic processes as a result of IoT:

This issue alone, that I don’t just produce anything and put it in a cage and deliver this cage via traditional logistics chains to a plant at a certain point. But that I deliver worth to, but often not in rem, via cloud APIs and then also not one-to-one centrally, but to a larger group.

Interview with Vice President Digital Strategy

Additionally, non-thing transport routes became more prevalent as the company started developing and delivering IoT solutions:

Depending on how the service is structured, I have other non-thing transport routes. That goes up to who am I delivering to?

Interview with Vice President Digital Strategy

Consequently, the company started working on a partnership management strategy to combine their own expertise with the know-how of external partners for delivering value to the customer. Therefore, the relationship with the partners had to be redefined. For example, the points of contact with partner organizations changed, and as a result of this, communication patterns also changed:

There are other contacts, even if I deal with the same companies. There are often other contacts or other parts of the organization that I have to deal with in order to realize the value and make it tangible. I have to find new ways of communicating or describing.

Interview with Digital Business Model Expert

The focus on product quality and product security were values that were originally imprinted by the founder of Bosch, and this was reflected in the way Bosch had been building relationships with their partners over the past decades. To ensure product quality and product security, the company had always paid a lot of attention to the standard of their partners and suppliers. Yet while Bosch had always striven to establish a contractually secured supplier relationship, IoT implied that some relationships with partners developed into rather loose partner management systems in some areas. Despite this shift, Bosch continued to be careful about who it partnered with and emphasized sustainable collaboration with clear rules and predefined standards.

**Imprint anchoring.** We find that the changes that happened in terms of the value creation (and value delivery) components of Bosch’ business model presented a challenge for the company. Bosch had a tradition of focusing on product quality, and an important aspect of this was product security. Yet as the company adopted an ecosystem approach, relied on other players for part of the solution offered to the end user, and engaged in multi-directional logistic processes, it became more difficult for Bosch to keep full control over product quality, product security, and data handling. Moreover, the market did not seem ready yet to value (data) security and quality in the digitized world the same way they would value this in a purely physical world. However, Bosch persisted in keeping its focus on quality and security as much as possible. One of the interviewees told us how “our brand can take a lot with product security, and right now we are trying the same in the digitized world.” To keep ensuring this as much as possible, we find that the company developed a practice of controlling potential partners by setting standards, combined with building up internal competence to the extent that IoT solutions

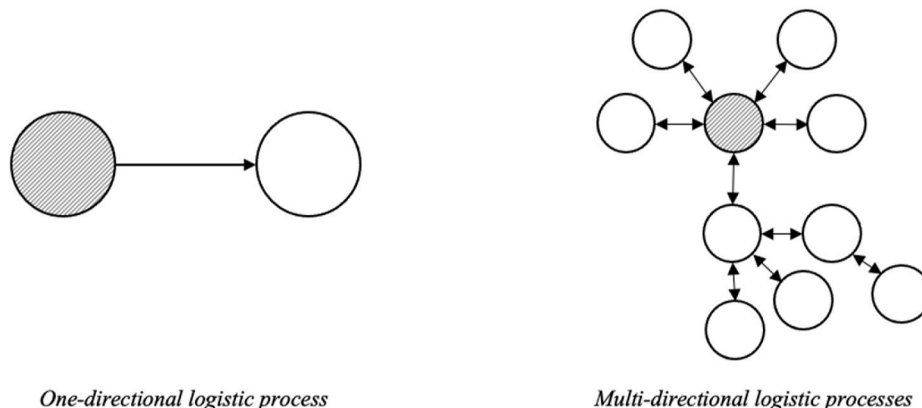


Fig. 2. Changing logistic processes.

could also be developed in part in-house. Hence, we find how through imprint anchoring, the focus on product security and product quality was transferred into the new business model. This unique selling point thus continued to represent an important component of the company's value creation mechanisms, even when the company significantly transitioned its business model.

#### 4.4. Value capture

Finally, the introduction of IoT solutions also asked for changes in the way the company captured value. We find that Bosch adopted a holistic view of the product/service life cycle and that as a result of this, novel types of revenue models emerged that were recurring in nature. Additionally, our data also shows that the company started developing new metrics for evaluating success in transforming into an IoT player.

##### 4.4.1. Holistic view of life cycle leading to new revenue models

Since most IoT solutions involve a complex interplay of products and services, Bosch was forced to increasingly adopt a holistic view of the product life cycle. Customer relationships no longer finished with the delivery of the product in exchange for a one-time payment. Instead, services along the entire product life cycle had to be considered right from the beginning, long-term obligations had to be met, and costs had to be calculated so that the business was profitable over a long period.

New monetization models arose from the emergence of service costs, with two strategies dominating. On one hand, the IoT solution could be first offered free of charge for a limited period, and subsequently charged through a graded system. On the other, based on the chosen breadth of the service, different prices could be offered (Gunnarsson et al., 2014). Both options required a different investment strategy than what Bosch was used to. Instead of investing in incremental product innovations and receiving a one-time payment in return, IoT solutions required higher initial investments in exchange for recurring revenues over a longer period of time. To tap into the full business potential, Bosch had to focus on how to raise the share of predictable annual recurring revenues in the future.

##### 4.4.2. New metrics for success

Additionally, since new business models emerged and the rules for success significantly shifted, Bosch was forced to rethink their way of measuring the performance of new businesses. Classical metrics were no longer sufficient for several reasons. One of our interviewees told us how the actual cost and value of IoT solutions were difficult to estimate, implying a need for change in thinking about value propositions, and moving away from cost-plus mindset:

In IoT business, it is more blurred what to do and what to deliver. What the actual value proposition is. It has to be defined in more detail. That means value from linking the metadata needs to be validated first. It's not on the table like when I have an injection pump. I can't grab what it costs and what its value is. I have to get away from a cost-plus mindset. That's where it closes the shutter on a lot of people.

Interview with Digital Business Model Expert

First, traditional metrics did not account for the value of data. Our analysis of Bosch showed that becoming an IoT provider required a shift from being pre-occupied with "things" to focusing on "data":

The IoT transformation is special in that, on the one hand, it naturally involves other structures of value creation and added value. It is a preoccupation with not "things", namely with data. Simply talking about networked things is not tangible enough. It requires a different way of thinking, beyond the scope of what has been done so far. You have to get involved in something new, you have to take risks. But

then, in the medium to long term, you also have higher revenue potential.

Interview with Digital Business Model Expert

Second, the time span between value creation and monetization was often time-delayed in comparison to traditional business models. We find that, very often, digital business models required initial investments generating a large customer basis driving network effects while the generation of revenues only came later. Traditional evaluation metrics such as earnings before interest and taxes (EBIT) therefore had to be complemented by additional metrics to allow the creation of new business in the field of IoT. In a user-oriented business model for example, the number of active users was added as one important indicator. In a data-driven use case, the amount of data points were added. In partner-oriented use cases, Bosch looked at the number of involved partners.

Without changing these metrics, individual business units with direct profit and loss responsibility were little attracted to invest in the development of new IoT solutions as the investments had a negative impact on the business result at first. In order to motivate them in a targeted manner, top management had to adopt a long-term perspective and set appropriate incentives. Such an incentive system included for example the fact that individual departments had to invest a certain amount of money in the digitalization of their business models. In return, a reduction in EBIT was accepted for a certain period.

For Bosch, it became a declared goal to increase the share of annual recurring revenue as well as EBIT on annual recurring revenues by growing scalable service business. These efforts were particularly important in unstable times as recurring revenue stabilized cash flows, improved the predictability of the business, and improved ROI. The company distinguished between five different service categories ranging from product-driven services to product-independent services. To drive the development, the company developed specific tools and guidelines to support individual business units in implementing service business.

**Imprint anchoring.** We find that with the changes that occurred in terms of the value capture component of the business model, Bosch realized that the product was no longer the sole differentiator, but that data became increasingly important. In line with this, and as mentioned above, the company expanded its monetization scheme to account for software elements and services, and developed new metrics for success. Yet, even though Bosch expanded its scope, the company maintained its focus on scalable business, and it kept positioning itself as a provider of superior technology and outstanding quality. As a result of this, technology remained the driving force for the price-setting of the company, be it a through a one-time payment or through a recurring revenue model. Low-scale IoT niche products were not what the multinational company focused on. In this sense, we find that the imprinted value of superior technology kept exerting an influence on Bosch as it adapted its value capturing mechanisms in morphing into an IoT provider.

## 5. Discussion and conclusion

In this paper, we discussed several implications when an incumbent, manufacturing firm adapts its business model to transform into a company offering IoT solutions. We find that major changes were needed along three dimensions. These key changes are summarized in Table 2. First, we discussed the company's changing value proposition. With the advent of IoT, the offering of the company evolved, and increasingly included elements from the digital as well as the physical world. Moreover, whereas the company traditionally had a technology push approach to developing new products or services, they shifted to a more customer-centric approach. Second, we highlight the changes made in terms of the company's value creation mechanisms. IoT solutions heavily depend on an ecosystem approach. As a result of this, we show how Bosch opened up, forged alliances with partners from different



industries, and found their particular role in the ecosystem. Additionally, they increased cross-divisional collaborations, and changed from one-directional logistic processes to multi-directional processes and non-thing transport routes. Finally, the transformation into an IoT company implied a major change in the way Bosch captured value. We found that the company increasingly adopted a holistic view of the product life cycle, looked at the value of data and developed different success metrics for this.

We find that despite these changes, the core company values of “superior technology as a solution to everything” and “superior product quality” kept being reflected across the three dimensions of the business model. As such, through a mechanism of imprint anchoring, some of the old imprinted values underlying the more traditional manufacturing business model were transferred onto the newer IoT-based business model.

Our findings contribute to the literature by combining a business model lens with insights from imprinting theory. On one hand, we show how some of the components of the business model that were imprinted and existed for a very long time change in the face of IoT. On the other, we show how in this process, the underlying imprinted values matter in that they serve as a leverage to enact those changes.

Imprinting theory stipulates that initial characteristics of organizations shaped during founding have an enduring and persistent effect within organizations (Marquis and Tilcsik, 2013; Stinchcombe, 1965). Imprinting is the “process whereby, during a brief period of susceptibility, a focal entity develops characteristics that reflect prominent features of the environment, and these characteristics continue to persist despite significant environmental changes in subsequent periods” (Marquis and Tilcsik, 2013, p. 201). In recent years, the intuitive appeal of imprinting increasingly attracted the attention of organizational and entrepreneurship scholars (De Cuyper, Clarysse & Phillips, 2020; Ellis et al., 2017; Mathias et al., 2015) who applied imprinting theory across different levels of analysis including the individual, the organization and organizational collectives (Marquis and Tilcsik, 2013; Simsek et al., 2015).

When using imprinting theory as a lens to look at business models, we know that important characteristics of business models are shaped during the founding period and that these characteristics can persist for long periods of time (Chesbrough and Rosenbloom, 2002; Marquis and Tilcsik, 2013; Siggelkow, 2002). In a recent study, Snihur and Zott (2020) used an imprinting lens to look at business model innovation. They find how founders achieve novelty imprinting, which they conceive as imprinting processes that result in novel imprints. Furthermore, there are a few other papers that have examined imprinting in the context of novelty and innovation, and they point to the role of founders and their cognitive processes as a potential source for new business models (Ellis et al., 2017; Powell and Sandholtz, 2012).

Our study connects to this literature that bridges imprinting theory and business models. We focus on an incumbent firm with a rich tradition, whose business model was imprinted and established long ago. In this paper, we show how this imprinted business model changes over time in light of a new technology paradigm. Additionally, through the mechanism of *imprint anchoring*, we show how the underlying values of the previous business model affect the development of a new business model. The values of superior technology and product quality that were imprinted onto the organization and its business model strongly affected strategic choices regarding the company’s value proposition, its value creation and capturing while morphing from a manufacturing company into an IoT provider. Even though the company’s legacy seemed an inhibitor at first sight, when analyzing our case in more detail, we effectively found that these values in fact enabled the company to make this shift, and even provided a leverage for the company to successfully establish its new identity and business model as an IoT provider.

### 5.1. Limitations and future research

Our intention with this study was to stimulate awareness and draw attention to the individual business model dimensions in which challenges can be expected when companies change to accommodate a new technology paradigm, in this case IoT. While we have provided first insights in the components of the business model that need change, this study also opens up avenues for future research. First, this paper is based on a single case study and sheds light on how an individual firm changes its business model from being a manufacturing company to being an IoT company. However, we mainly focus on one case here and we do not address what happens at the level of the organizational collective. Future research could therefore investigate how business models change in a more collective sense, and how collective identities and collective forms are being shaped in response to the technological developments of the Internet of Things.

Second, scholars can investigate IoT organizational archetypes with regards to their impact on firm performance. In addition, future researchers are encouraged to advance this research by gaining a deeper understanding of additional governance mechanisms and their suitability to successfully manage IoT initiatives in multi-business manufacturing companies. In this regard, the present data indicates a high relevance of deviating collaboration models for orchestrating necessary IT capabilities across different organizational units (e.g., between centralized corporate units and more decentralized business units).

Third, as we focus on the organization as such, and do not zoom in on the individual level, future research could look into how individual employees respond to the changes that occur in terms of the company’s business model, and the implications this has for their day-to-day work environment.

### 5.2. Practical implications

The study offers two major implications for practitioners. First, the study provides detailed insights into the business model changes of a company facing the challenge of having to adapt in the course of increasing digitalization. Practitioners get an overview of the dimensions of these changes. In particular, we outline three components of the business model which require change: value proposition, value creation and value capture.

Second, our study provides new insights into the role of core imprinted company values for new technology paradigms. Our study shows a two-sided effect. On one hand, imprinted values associated with product-centric manufacturing firms can possibly provide some constraints when companies develop in new directions dictated by a technology trend, especially compared to younger startups characterized by high flexibility and velocity. On the other, we find that these values also enable a company to expand its strengths into new areas. Managers in established companies are faced with the challenge of breaking away from established ways of doing things and at the same time recognizing how they can turn the company’s strengths into a competitive advantage. An understanding of the company’s strengths, coupled with a willingness to change within the bounds of possibility, is key for incumbent firms when mastering the transformation to an IoT company.

### Declaration of competing interest

Two of the authors are employed by the Bosch Group.

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