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OPEN INNOVATION AT DEUTSCHE BAHN

HOW A LARGE INCUMBENT FIRM USES OPEN INNOVATION TO ADRESS THE CHALLENGE OF DIGITALIZATION

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Abstract

This case describes how Deutsche Bahn AG, a traditional incumbent in the rail industry, is building a portfolio of open innovation initiatives to advance its digital transformation. It presents the key trends shaping the industry (environmental regulation, market liberalization, digitalization), the company's current situation with low operational and financial performance and its digital strategy before detailing how the rail operator is adopting several open innovation initiatives to reap the benefits of digitalization. These include a corporate accelerator, user contests, strategic alliances and a venture capital unit. A teaching note is provided to help instructors and students apply relevant theoretical concepts and frameworks of open innovation to the case.

Keywords: Open Innovation, Corporate Accelerator, Digitalization, Digital Transformation, Rail Industry, Knowledge Management

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1. Introduction

Tackling a Changing World

"*We are facing the most radical change since the German Rail Reform, and we have to adjust to the changing realities of people's lives*"

Rüdiger Grube, Deutsche Bahn CEO 2009-2017

March 16th, 2016. Rüdiger Grube, then the CEO of Deutsche Bahn (DB), seats together with the Board of Management at the annual Report and Accounts press conference in Berlin to present the operational and financial results of the previous year. Grube, who had been leading the company since 2009, was used to reporting solid results every year at this conference. On that morning in 2016, however, DB's CEO was tasked with explaining the weakest financial performance in over a decade.

DB had recorded positive earnings before interest and taxes (EBIT) each and every year of the previous decade. The rail operator's EBIT had fluctuated from 1 352 M€ in 2005 to 1 830 M€ in 2014, before it fell to -154 M€ in 2015 (Exhibit 1). Similarly, over the same period, the company's net income had always been higher than 500 M€, changing from 611 M€ in 2005 to 988 M€ in 2014, before falling to -1 311 M€ in 2015 (Exhibit 1). The losses have been attributed to higher personal and operating expenses, poor performance of the passenger and cargo rail operations in Germany and, mostly, to an extraordinary impairment on its rail freight business (Deutsche Bahn AG, 2016).

Despite the consistent financial results in the previous years, the scale of the losses in 2015 urged the Board of Management to accelerate and strengthen their plans to improve the company's competitiveness. With almost 20 B€ of debt, there was a lesson to be learned that the established incumbent was financially more fragile than the steady financial results in the previous years would suggest: "A critical look at our own performance shows that we have not achieved what we set out to do", said Grube (2016).

Financial performance was just one of the challenges the company was faced with. A number of firm-specific and industry-wide trends has left DB in a volatile situation. Increasing customer demand for tailor-made transportation solutions started to stretch DB's business model based on massification. Public complaints against DB personnel and poor punctuality performance were affecting the company's reputation (Schäfer, 2015). New, born-digital companies started to offer customers attractive alternatives for transportation and EU policy for market liberalization was expected to strengthen competitors even further (Bertele, 2019). An aging population was affecting DB's ability to hire locomotive drivers and started impacting operational performance. At the same time, environmental awareness places trains as a popular mode of transportation for a growing number of commuters.

The mission ahead of DB was not easy. The company had to quickly build new capacity to both improve its competitiveness at current demand levels, and to accommodate future demand in an increasingly competitive environment.

What could DB do to quickly increase its capacity? How could the company take advantage of the chances raised by digitalization? How could DB, as a traditional incumbent, become an innovator to enhance its performance and customer experience? Which role should the company play in its ecosystem? How should it proceed with respect to the innovation management?

2. Industry Overview: from rail to mobility

The Dynamic Structure of Competition

With more than 420 operators, Germany has the biggest rail operation industry in Europe. Out of these, 180 are dedicated to freight transportation, 26 to long-distance passenger transportation and the remaining to local/regional passenger transportation (Müller, 2017). Having the longest rail network in the EU, Germany is also the European country with the highest number of foreign incumbents operating in its local market (Ramet, 2019). While the

demand for rail services has grown in the last years, the train share in the modal split has been stable over time, when compared to other means of transportation for both freight and passenger transportation (Müller, 2017).

Rail operation is a capital-intensive activity with a massified demand, turning the first movers into natural monopolies. Thus, despite the diversity of railway undertakings, the market is dominated by DB in all three areas. The state-owned operator holds approximately 54% market-share in freight transportation, and 74% and 99% in local/regional and long-distance passenger transportation, respectively (Müller, 2017). This position as uncontestable market leader is changing. With the exception of long-distance passenger transportation, DB market-share has decreased significantly in the last few years (Exhibit 1).

As environmental awareness increases and countries make further compromises to halt climate change, national governments are trying to bring both new passengers and new competitors to rail. In 2020, the German government has pledged a record high investment in rail infrastructure to increase the reliability and competitiveness of rail against other alternatives (BMVI, 2020). Additionally, the EU's 4th Railway Package is set to drive further liberalization of the market from 2020. The package has a technical pillar, where it sets the pace for harmonized train controlling and signaling across national borders, and a market pillar, that aims at opening long-distance markets, ensuring fair infrastructure access charges and making public tendering a rule for new contracts (Bertele, 2019).

In Germany, Flixtrain is currently the only challenger to DB in long-distance passenger transportation. Under the Flixbus brand, the company has previously disrupted the long-distance bus market with a low-cost based business model - relying on asset leasing instead of asset ownership, and with digital channels as the single source of interaction with customers. With its long-distance passenger bus operation, Flixbus itself has become a competitor to DB trains and quickly scaled its business-model to other countries. Now the company is trying to

replicate its road success on rail tracks. Since December 2019, the company has been operating three long-distance routes.

Digitalization as the main driver for innovation

In October 2017 a severe storm hit the north of Germany, leading to several trains being delayed or cancelled. At the stations, DB personnel were unable to provide waiting passengers with information on when the next trains would depart (Nau, 2017). In the age of information, the rail operator was failing to give its customers precise data about the service they had bought. Familiar with comparable examples, the industry is turning to digitalization to address such challenges and increase its competitiveness (Smith, 2018).

Digitalization is having a threefold impact on rail operators. First, it is blurring the boundaries between different industries. Railways do not compete among themselves only; for example, they also compete with digital-based companies dedicated to ride-sharing services (Exhibit 2). Second, digitalization led to a broader range of mobility solutions (Exhibit 3) that is forcing rail operators to change their business models based on Station-to-Station mobility in order to provide Door-to-Door mobility instead. Adding to this, shorter innovation cycles are challenging an industry used to invest in material that is expected to last for decades (Smith, 2018).

New technological developments such as big data analysis, sensoring, augmented reality or cloud computing are being used by rail operators with two main goals (Exhibit 4). The first is to enhance customer experience. Operators want to reach individual customers and provide them tailored offers, as well as a sense of participation and control similar to what they already find in other platforms.

The second main goal of increased investments in digitalization is to improve operational performance. With sensoring, for example, operators are increasing the availability of real-time data on passenger flows, infrastructure and rolling stock. This data is further analyzed and used

in remote monitoring and predictive maintenance, allowing companies to detect defects in advance and avoid interruptions in the regular operation. Additionally, drawing from increasing amounts of data, companies expect to increase capacity by deploying rolling stock that was formerly on backup into the regular service (Pierigud, 2018).

Despite its promises for rail operators, digitalization entails significant costs for traditional incumbents with strong legacies, both of implementation and of data security. Additionally, on their quest to become technological firms, railways will compete with digital-based firms in labor markets to hire the most skilled workers.

3. Deutsche Bahn AG

While the origins of a state-owned railway in Germany trace back to more than 180 years ago (Exhibit 5), DB was officially founded in 1994, following the merge of Deutsche Bundesbahn (Federal Republic of Germany) with Deutsche Reichsbahn (German Democratic Republic). The German State is still the single stockholder. Since it was launched, the company has grown steadily both operationally and financially. The number of transported passengers in Germany has risen from 1 785 M in 2005 to 2 581 M in 2018 (Exhibit 1). While in 2005 the company was carrying 4,8 M passengers per day, in 2018 that number rose to 7 M. The group overall revenues have followed this growth and increased from 25 055 M€ in 2005 to 44 065 M€ in 2018 (Exhibit 1).

With its headquarters in Berlin, the company has more than 310 000 employees, divided in 8 major business units (Exhibit 6). These business units extend along 4 key areas of activity: passenger transportation, freight/logistics, infrastructure and services/administrative. Over the years, logistics services have become the biggest source of revenue for the group (Exhibit 7). DB consists now of more than 500 subsidiaries in more than 130 countries (Deutsche Bahn AG, 2019).

Its international presence is mostly explained by the full acquisition of the logistics company Schenker in 2003, which allowed DB to rapidly become a worldwide player in logistics services, and by the acquisition of Arriva in 2010 – a leading passenger transportation company with significant market share across European countries.

This growth, however, has not been painless. Financially the group still holds 20 B€ of debt, leading the German government to issue a debt threshold for the company (Schlesiger, 2020). Operationally the rail network is running on its limit. Every tenth train operated by DB in Germany arrives late. Every fourth long-distance train reaches its destination later than scheduled. Punctuality performance is even lower in cargo rail (Exhibit 8). Customer satisfaction is shrinking across different business units (Exhibit 9). Additionally, DB is now asked to be responsive to future growth in demand for green means of transportation. To address this challenge the company is investing heavily in digitalization - it is estimated that the digitalization of the network alone will allow DB to increase capacity in 20%, without additional infrastructure (Deutsche Bahn AG, 2019).

A Strategy for Digital Transformation

A digitalization offensive started in 2014 with six 4.0 initiatives (Exhibit 10). From infrastructure to logistics, the six initiatives set the pace for the company's digital transformation and were followed by over 200 small scale projects across the organization. Improving customer experience with new business models, achieving operational excellence and establishing an internal culture of innovation were the three pillars of this strategy to which the company committed over 1 B€ (Deutsche Bahn AG, 2015).

The increasing investments in the digital transformation of the company have been reflected in its organizational structure. In 2016 the Chief Digital Office was created and in 2017, when a new Management Board was appointed, the existing Technology and Quality office was broadened to cover Digitalization and Information Technology, formerly under the direct scope

of the CEO. Sabina Jeschke was selected to lead the rebranded Digitalization and Technology office (Deutsche Bahn AG, 2018). With a solid academic background in Machine Learning, Artificial Intelligence and Robotics, she became the ultimate leader of the group's digitalization push.

Despite the potential opportunities raised by environmental consciousness and governmental incentives for collective transportation, the digital transformation should address four major challenges the company still faces. First, DB has to increase capacity on the tracks. Having one of the widest networks of high-speed rail worldwide, the operator "cannot squeeze in one single ICE (high-speed train) because the track is full" (Jeschke, 2018). Second, DB operations involve a significant degree of complexity, where state of the art components have to be jointly managed with material that is over 100 years old.

Adding to capacity and complexity, building new infrastructure takes time. While increasing demand stretches operational capacity in the present, it takes several years, if not decades, to have a solution ready to be implemented. One fourth challenge, human resources, is putting pressure on DB's ability to deliver solid operational performance. If on the one hand the company has strong incentives to double capacity, on the other it finds it increasingly difficult to hire new locomotive drivers (Nürnberger, 2018). Despite the company's demanding outlook, Jeschke is setting ambitious goals for the 4th Industrial Revolution: "Are we leading the new era of transformation again?" (Jeschke, 2018).

In 2018 the "Digital Railway for Germany" program was jointly launched with other stakeholders in the railway industry and in January 2020 it became a separate, fully owned subsidiary to monitor the implementation and rollout of new technologies across the rail network. The program has been focused on the digitalization of the network, through installation of sensors and digital interlocking systems, as well as on the digitalization of the operation management, making use of artificial intelligence and cloud technologies to automate traffic management.

4. Innovation at Deutsche Bahn AG

Using the Supply Chain as a Source of Innovation

DB's expenses with internal Research and Development (R&D) have been growing consistently in the last several years (Exhibit 1). Between 2009 and 2018, the company's investments in this area have increased from 16 M€ to 318 M€, leaving the rail operator ahead of its French counterpart, Société Nationale des Chemins de fer Français (SNCF), which spent 154 M€ (0,49% of its Revenues) on R&D in 2018 (Hernandez et al., 2019). Between 2015 and 2016 alone the costs with R&D have more than doubled from 74 M€ to 180 M€. Despite the significant growth in the last decade, costs with *Research and Development* did not rise beyond 0,72% of revenues in 2018 (Exhibit 1).

As a train operator, DB depends to a great extent on product innovations brought up by its supplying manufacturers. It explains its limited investment in R&D as follows: "As a service provider, DB Group does not conduct its own research and development in the narrow sense of the term. Due to our technological competence and broad operational experience, we do, however, initiate user-oriented developments and support industrial firms with services including extensive testing capabilities." (Deutsche Bahn AG, 2016). Using suppliers as a source of innovation has been common practice. Taking advantage of its leading market position, DB implements several pre-development projects with multiple manufacturers to assess how their innovations fit the rail operator's network. While the suppliers can make use of DB's wide network to test their inventions, DB avoids having to invest on an internal R&D capacity and spreads the risk by collaborating with an extensive network of suppliers (Siemens, 2019). To foster innovation throughout its supply chain, the incumbent has created a Supplier Innovation Award that rewards partners whose inventions strengthen DB's competitiveness (Deutsche Bahn, 2020).

Even though the company increased its investments and allocated more resources to build a competitive internal R&D capacity, the fast pace of innovation in mobility services meant the

company could not rely on itself alone. To seize the opportunities raised by digitalization, DB had to look beyond its core business (Bughin, 2017). Marius Pigulla (2017), who led Open Innovation at DB between 2018 and 2020, explains the urgency for DB to find new ways to become more innovative: "What can a corporate do to innovate? We can just be open. We can just be ready that we can work with other startups and get the right funnel of innovation into the corporate. A corporate cannot go into a small little chamber and think about how it is going to be in 10 or 15 years. It has to be open to the new collaborative world". Following this reasoning, the company has launched several forms of Open Innovation in recent years.

5. Open Innovation at Deutsche Bahn AG

The changing nature of competitive advantage

Formerly, established companies participating in capital-intensive industries were protected by high entry costs that gave first entrants an advantage and prevented new, smaller competitors from entering such markets (Grant, 1999). In the rail operating business, the need to build complex facilities (stations and maintenance workshops), infra-structure (tracks) and to acquire expensive equipment (locomotives and train cars) has given first-mover advantage to state-subsidized firms that effectively exploited economies of scale and scope. The resource-based view of the firm held that companies with the widest and largest set of internal resources were the ones who could have a competitive advantage over competitors and capture most value (Grant, 1999).

Today, digitalization is threatening the position of established incumbents and transforming the value of asset ownership. In the mobility services, examples such as FlixBus or Uber demonstrate the ability of small businesses to quickly scale their operations up. These digitally enabled platforms have "built a datafication layer around transportation" (Iansiti, 2020), gathering real-time data on passenger flows and individual preferences.

For DB, digitalization is not only a strategic matter; it is also a cultural challenge. As a 180-year-old enterprise, the German railway has to switch from being a group of different, powerful business units to one where information flows seamlessly across departments. Richard Lutz (2017) summarized this challenge with an anecdotal question shortly after being appointed CEO for DB in 2017: "Do we as an old-economy-heavy-stuff-rolling-stock-infrastructure-60B€-of-balance-sheet-asset-based kind of company really need to care about that new-stuff-of-digital-bits-and-bytes-4.0 Economy?". The question had an easy answer.

In the last several years, DB has rolled out important milestones to navigate the digital economy. Before the introduction of a formal digitalization strategy, the bike-sharing service *DB Call a Bike* started operating in 2000 and in 2001 the company launched the carsharing platform *DB Flinkster.* In 2009, the app *DB Navigator* was introduced for online ticket purchasing and journey planning. In 2017 it started *ioki*, an on-demand transportation service based on autonomous driving shuttles that works as an independent startup. To enhance its work with startups and use externally developed knowledge as a source of competitive advantage (Chesbrough et al., 2006), in 2015 the company launched its own startup accelerator.

Core Business Innovation: An Accelerator for Digitalization

It takes a 23-minute train ride to drive from the DB's HQ in Berlin to the company's startup accelerator. Located under the Jannowitz Bridge Train Station, *Mindbox*, as it is called, has been operating as an interface between DB and startups since 2015. Under the leadership of Onno Szillis, a small team of 14 people works on the integration of startups into the DB environment. "On the one hand, we try to be the founder's lawyer by opening the doors to the DB world for them. On the other hand, we are looking for areas in the company where their ideas can be implemented" (Fülling, 2019), says Szillis.

The main funding project at *Mindbox* is *DB StartupXPress*, an accelerator program that invites startups to provide new solutions for different areas of the company's core business (Exhibit

11). Since the first round of the program in 2015, the company has received applications from more than 1000 startups and partnered with more than 30 (Deutsche Bahn AG, 2019).

DB defines a specific area of intervention for each round of the program (Appendix 12). After the deadline for applications, startups are evaluated by both the *Mindbox* team and the corresponding business unit of the area of intervention at DB. Startups with solutions that are considered relevant for the company's digital transformation are then invited for a pitch day at *Mindbox* facilities in Berlin.

On the pitch day, the teams present their projects and are evaluated by a jury that includes both senior managers of different DB business units and non-DB personnel, such as members from the academic community. Startups selected by this jury enter a 3-month program to develop a prototype in close contact with a specific DB business unit. Throughout the program, startups receive know-how from DB (for example, in the form of data on the company's operations), mentoring from senior managers, permanent positions at *Mindbox* and a 25 000€ investment (no equity) to cover their expenses. Exhibit 13 provides an overview of the process from the startups' point of view.

Further cooperation between DB and startups after the 3-month program depends on a successful proof of concept. Usually, joint work between both parties continues to pilot tests and further optimization of the solution before its final implementation. This joint work has already enabled DB to improve its client-facing services. For example, together with SIUT, a Berlin-based startup that won the *DB StartupXpress* in 2016, DB is now installing lights on the floor of its train platforms to signal to waiting passengers both the trains' doors position and the least crowded cars before the train arrives to the platform. This is increasing punctuality and efficiency when passengers enter and exit trains.

Additionally, two other open initiatives fall under the scope of Mindbox. With *DB Challenges*, the company is opening up its ideation and development processes to the wider community,

collecting input not only from startups but also from individuals. *DB Challenges* focuses on enhancing the customer experience, targeting critical points in the customer journey that range from the interface of information corners to cleanliness in stations (Exhibit 14). Once the contest is broadcasted and DB selects the most relevant applicants, the participants are invited to present their first concept and to receive further information on the challenge. Initial concepts are then further jointly developed by the participants and the relevant DB department before being displayed in a final pitch. While the company is able to have ready-to-test solutions in less than a month, participants are rewarded with monetary prizes and mentoring from DB teams.

DB Open Data completes the triad of initiatives managed by *DB Mindbox*. It consists of hackathons and data analysis contests where the company selectively reveals internal information to the community (Exhibit 15). Individual participants are asked to create new applications or prototypes that might enhance customer experience and lead to new ways of exploiting existing company data. Revealed data ranges from the existing rail network to passenger booking information or the condition of escalators at stations.

Adjacent and Disruptive Innovation: Venture Capital and Strategic Alliances

Mindbox allowed DB to enter the world of startups and learn about potential innovations for its core business. However, in regards to the digital transformation ambitions of the company, the accelerator has two shortcomings. First, under such a framework, the company plays a passive role in searching for new knowledge - it can only wait that the best startups will apply for its program. Second, as the company defines specific problems of its current core business to be solved on each round of applications, it risks overlooking disruptive technologies and business models. These limitations pushed DB to quickly build additional mechanisms to access external knowledge. Following a cross-industry trend (Bielesch et al., 2017), in late 2016 the company

launched *DB Digital Ventures* (DBDV), an independent firm that works as the venture capital (VC) arm of DB.

The new unit started with a small team of investment analysts bringing together both analysts with previous experience at DB and newcomers to the group. The team received full backing from the company's leadership. Shortly before the new fund was launched, Grube announced it as a tool to be independent from the bureaucracy of a large company: "We will have a fund for investment in startups just to avoid the administrative hurdles of a large company" (Brisslinger, 2016). Additionally, the Board signaled its commitment to the VC with 100 M€ for investments to be made in the first three years of the VC unit.

The team was tasked by DB management to make equity investments in new, data-driven business models that could disrupt the company's core business. As explained by Pigulla (2017), "when the technology is disrupting us, we should be investing in it beforehand". The goal of the VC unit is strongly strategic. "These startups should be far enough away from the core business, but they should definitely be working on a technology or a product that may well be relevant for DB in three, four, five years." (Visser, 2018). After three years of activity, the fund holds now a portfolio of 12 equity investments in new companies (Exhibit 16).

In August 2017, the introduction of *Beyond1435* adjusted the rail operator's OI ecosystem to its current layout. While *Mindbox* focuses on incremental developments to the core business, *Beyond1435* is a platform that monitors potential disruptive technologies (Froom, 2019). Together with the Swiss Federal Railways, Siemens and Bombardier, it both invites technology startups to pitch their products and partners with them to scale their ideas up. Startups that are deemed relevant to the rail operators or suppliers join DB's *Mindbox*, working with business owners to upscale their offers.

6. What is next for DB's Open Innovation?

Digitalization is transforming how businesses operate and how customers perceive value. For a large incumbent, having the widest pool of physical and intangible resources it not sufficient to protect its leading market position. DB has acknowledged the potential challenges of digital transformation in the mobility industry. The firm has shifted from being a comfortable incumbent to an old company being challenged by new business models. In the past five years, it has been exploring in practice a wide set of OI forms to reap the benefits of digitalization.

Now, in 2020, DB must critically assess the output of these initiatives. How could the company measure its OI success? Was it wasting resources on OI that could be best deployed internally? Were the different OI initiatives competing with each other for resources and management attention or were they part of a coherent ecosystem? How should this OI system be organized for a long-term, sustainable impact on the company's innovative performance? Should new projects be included in its portfolio of OI?

Teaching Note

On this teaching note, instructors will find a case synopsis, the target and suitable courses where it can be used, the learning goals, insights for case analysis as well as a teaching plan. The teaching plan is divided into two sections: the first consists of questions for individual assignments, requesting students to do further individual research; the second consists of a plan for class discussion. In both sections, examples of the case are used to apply relevant theoretical frameworks and concepts.

1. Case Synopsis

With a legacy that dates back to over 180 years ago, Deutsche Bahn AG, the leading state-owned rail operator in Germany and worldwide player in logistics services, was formally founded in 1994. After years of operational and financial growth, the incumbent has reached a tipping point. In 2015 the company has reported heavy losses for the first time in a decade. The group's debt piled up to over 20 B€. The promises to improve punctuality had fallen short. It has reached its operational limit and could not accommodate any further growth in demand.

At the same time, external forces add to the challenges the company is faced with. While DB has reached its full capacity, increasing environmental awareness is expected to increase pressure on the demand side. Policies to liberalize the market are being implemented and opening the way for international incumbents and new entrants to join the market. Enhanced by digital technologies, the use of new mobility modes is growing, meaning increasing competition not only from other railways, but also from new, digital-born companies that can quickly scale their business models.

With a business model based on scale and on the ownership of physical assets, the leading incumbent must find new ways to quickly expand its operational capacity and to cater to the customer needs in the new, digital economy. To address these challenges, DB is making significant investments in digitalization. The launch of the Six 4.0 Initiatives in 2014 set the pace for the digitalization efforts of the group. The organizational structure was reformulated and a CDO organization was created. Realizing that it did not have the speed and the knowledge

to become a digital innovator by itself, DB has created a comprehensive open innovation (OI) program, with several initiatives to quickly access and absorb external expertise. Now, in 2020, the company must appraise the contribution of each of these initiatives to its innovation ecosystem.

Starting from the company's operational and financial situation before describing the key trends in the industry's shift towards digitalization, this case depicts how a large, established incumbent uses different OI initiatives to accelerate its digital transformation. It will allow instructors and students to apply theoretical concepts of the OI literature in a real case.

2. Target, Courses and Previous Knowledge

Describing how an established incumbent in a mature industry launches an OI offensive to take advantage of digitalization, this case is suitable for Master-level students of *Innovation Management*, *Open Innovation* and *Digital Strategy*. It is recommended that students have been introduced to the concept of OI in advance.

The analysis of the case might as well be useful for Executives in established firms considering launching an OI program, as it covers a continuum of relevant management decisions when starting such initiatives – from assessing the suitability of OI to solve an innovation problem to how to evaluate its outcomes.

3. Learning Goals

Upon reading and discussing the case, students will be able to:

- Understand the changing landscape in the mobility industry, as well as its structure and competition trends;
- Assess the opportunities and challenges enhanced by digitalization for established, traditional companies;
- Discuss a traditional incumbent's strategic, alternative options to compete with digital-based new entrants;

- Compare different mechanisms of OI that firms can use and the challenges of its implementation by studying how OI unfolded through time in a single case;
- Apply the theoretical concepts of OI to a real case.

4. Case Analysis

New competition from liberalization

The political push for further liberalization of the European rail market has the potential to significantly transform the industry as it builds interest from incumbents to enter foreign markets and from new entrants to the industry to start operations in rail. For incumbent railways, it might be useful to consider the impact of market liberalization in adjacent industries. For example, rail holds important similarities with civil aviation. Before liberalization, civil aviation was dominated by national incumbents. Brand recognition was thought to be a relevant factor in customers' purchase decision. Incumbents believed high fixed costs and difficult access to infrastructure would protect them from new entrants. After liberalization, new companies joined the market with alternative, more agile business models. Taking advantage of standardized processes (using one single airplane model), they could improve performance (punctuality) and costs (cheaper tickets) (Bertele, 2019). Price became the key factor in customers' purchase decision and incumbents lost market share and are still struggling to create additional value for customers. This background can be insightful for railways as they prepare in forehand for how to address new entrants with innovative business models. Alternative strategies for incumbents might include expanding capacity in the most lucrative routes and developing personalized mobility services to enhance relationship with passengers.

Managing Digital Transformation through Open Innovation

Digital transformation has become promising for established companies as a means to gather customer insight, deal with disruptive competitors, introduce new products and services, rationalize costs and optimize operations. Nonetheless, incumbents with wide pools of

resources often fall short in maximizing returns on digital transformation. For DB, it will be critical to create an organizational setup that balances the tensions between OI and sustainable digitalization. First, while OI offers potential lower development costs and quicker paths to the market, sustainable digital transformation spans across departments and is lengthy (Bughin, 2017). Second, DB needs to develop a balance between the reduced research costs through OI, and the increasing transaction costs of implementing externally developed technology. Finally, outside-in OI (i.e. corporate accelerator) gives DB experience in co-developing prototypes and pilots. For its digital transformation it will need to develop tools that adequately scale the prototypes to the wider network of the company.

Implementing Open Innovation

As the case covers a wide range of initiatives launched by DB, it can be used to expose students to the different decisions managers should take throughout the life-cycle of an OI initiative. The framework developed by Wallin and Krogh (2010) might be used as theoretical guidance to replicate the management decision process (TNExhibit 1). Consider the different initiatives at *DB Mindbox* as an illustration. The company starts to internally ***i)*** *define the process steps*, that is, the different stages that will be needed to solve a given problem. These will usually range from ideation and development to prototyping and, if the piloting is successful, scaling. While *DB StartupXpress* covers the full spectrum from ideation until scaling in the DB operation, *DB OpenData* is more focused on ideation and concept development.

DB must also ***ii)*** *identify relevant knowledge* or, in other words, find where this knowledge is located. As contests under *DB StartupXpress* are publicly broadcasted, the company invites startups to self-select and apply, shifting the internal responsibility of search for knowledge to the external actors. Once knowledge is located outside DB's boundaries, it must ***iii***) *choose an appropriate integration mechanism*. The case provides evidence that DB relies on group problem solving – joint pilot development between startups and DB business units. A fourth

decision relates to ***iv)*** *governance mechanisms*. DB must decide which actors are allowed to participate, how are their outputs evaluated, to whom will the resulting intellectual property belong. Finally, DB must also ***v)*** *balance incentives and controls* to make sure that it both motivates individuals and aligns their expectations and goals with those of the company.

5. Teaching Plan

The suggested teaching plan is divided into two groups for instructors to make use of the case. The first group comprises individual assignment questions that target relevant theoretical subjects in the OI literature (absorptive capacity, business models and implementation approaches for open innovation) and demand further research from the students. In this group, the instructor may suggest theoretical readings in advance and use the case as practice example for students to apply theory. The second group consists of a guideline to use the DB case as an illustration for class discussions (TNExhibit 2).

Individual Assignment Questions

Digital Transformation and Value Capture

1. How do you assess DB's current digital transformation strategy?
2. Which companies will compete with DB as digitalization gains traction in the mobility industry? What will be the main forces driving their competition?
3. What mechanisms can the company deploy to ensure that it captures most value when competing with new digital entrants?

The instructor may recommend the following literature as guidance for students to understand the concept of "*strategic collisions*" (TNExhibit 3) between traditional and digital companies and discerning how digitalization is pushing incumbents to compete less on the basis of scale and scope and more to optimize the learning and network effects of their operating models.

1) Iansiti, Marco and Karim R. Lakhani. 2020. "Competing in the Age of AI". *Harvard Business Review*.

2) *Chesbrough, Henry and Christopher Lettl. (2018). "Value Creation and Value Capture in Open Innovation". Journal of Product Innovation Management, 35 (6): 930-938.*

Open Innovation and Business Models

1. How do you classify the current OI model (TNExhibit 4) of DB considering the direction of the flows of knowledge and technology?
2. Does DB have an open business model or a closed business model? Justify and describe the differences between a closed and an open business model.
3. In the long term, what might be the impact of the OI program in the DB business model?

The below reference might be used as a starting point for students to analyze the impact of Open Innovation on DB's business model. Gathering relevant information from the case, students will be able to assess the degree to which DB is opening up its business model and apply the framework developed by Vanhaverbeke and Chesbrough (2014):

1) *Vanhaverbeke, Wim and Henry W. Chesbrough. (2014). "A Classification of Open Innovation and Open Business Models". In* New Frontiers in Open Innovation*, Henry Chesbrough, Wim Vanhaverbeke, Joel West, 50-68. Oxford: Oxford University Press.*

Class Discussion Plan

(10 Min.) – Introduction – Summary of the Case

To start the discussion, the instructor can request students to briefly highlight the key aspects of DB's situation (TNExhibit 5) and emphasize its position as an incumbent monopolist, which has reached full capacity and is now facing growing competition. To challenge the students and set the pace of the discussion, the instructor may ask ***1.*** *What could an incumbent do, if it already reached its full capacity and cannot add new infrastructure in the nearest future?* Some options may entail:

- Introduce complementary mobility offers (e.g. bike-sharing, car-sharing); Offer add-ons to enhance customer-perceived value (e.g. real-time information); planning for growth in the long-term (e.g. working with suppliers to create technological advantage).

(15 Min.) – DB's Digitalization Endeavour

The instructor might invite students to discuss the impact of digital transformation on businesses by asking ***2.*** *Is the DB situation unique? Are there any other companies or industries that could learn from this experience?* Students' answers may focus on:

- Industries: with high fixed costs where market liberalization or digital-enabled business models have disrupted natural monopolies (aviation, utilities supply).
- Companies: state-owned, natural monopolies (flagship airlines, electricity network).

Once students recognize the generalizability of DB's situation, the instructor can ground the discussion on the company's digitalization efforts, by asking ***3.*** *What internal factors are leading DB to increasingly invest on its digital transformation?* Possible answers:

- Full network capacity; complexity of the operation: state-of-the-art material vs. 100-year old components to be managed; time: it is not able to build infrastructure to be ready in the nearest future; human resources: difficulty to hire new drivers.

As the key environmental trends are addressed, the instructor can shift the discussion to how DB is carrying digital transformation strategy. He can drive students to ***4.*** *Pinpoint the key aspects of DB's digitalization strategy* and, before introducing how DB is using open innovation, ask them ***5.*** *Do you think DB will be able to compete with the new smaller, more agile competitors that offer new forms of mobility?* Potential replies:

- Aspects of DB's Digital Strategy: Six 4.0 initiatives spread across company's departments; Two pillars of digitalization at DB: customer experience and operations.
- Yes: long experience in rail; network of suppliers; large pool of physical assets; brand awareness; large, existing customer base.
- It might*:* Strong traditional legacy; eroded brand due to weak punctuality; lack of operational and strategic agility; slow decision-making processes; lack of attractiveness in hiring new digital talent.

(25 Min.) – Implementation of Open Innovation

As students recognize the challenges behind digitalization for the incumbent, the teacher can redirect the discussion to how DB invested in open innovation. To open the debate on this topic, the instructor may mention that ***6.*** *In under two years DB launched several OI initiatives. What was the rationale behind all these activities in such a short period?* The students should observe that the different methods of search for knowledge fit different types of innovation. While *DB Mindbox* activities focus on core business/incremental innovation, *Beyond1435* and the CVC unit tap into potential disruptive technologies and startups. Analyzing the OI ecosystem built by DB, the instructor can use this question to review the OI paradigm with the students (TNExhibit 6) and to emphasize the management implications of building such an ecosystem. He can stress that "a company's performance is increasingly dependent on the firm influencing assets outside its direct control" (Iansiti, 2004) and that managing innovation includes not only administering an internal R&D capacity but also organizing networks of entities that fall outside the company's borders and integrating these entities' input to improve innovation performance. To foster discussion on the challenges raised by OI, the teacher may ask students ***7.*** *The potential drawbacks from the different initiatives*.

- Drawbacks from OI: Over-search: giving DB too many alternative ideas to manage; diversity of different ideas might decrease the attention needed for each one to be implemented (Laursen et al., 2006); DB has a limited capacity to broadcast problems and reach those who have needed knowledge (Felin et al. 2014); transaction costs.

The discussion may follow with the question ***8.*** *Why would DB invest in OI rather than on internal R&D? What are the advantages for a big firm?* Here, the students may pinpoint the convenience of OI over internal research:

- Advantages of OI: learn about technological opportunities (Chesbrough et al., 2006); cost reduction as it only has to pay for the successful projects (Terwiesch, 2008); enter new markets (Mina et al., 2012); create an ecosystem of external contributions (Dahlander et al., 2014); use passengers' creativity (Giannopoulou et al., 2010).

The instructor might highlight how the OI paradigm contrasts with the resource-based view (RBV) of the firm. While the RBV stresses DB legacy of formulating strategy around its own durable, costly to replicate resources (Grant, 1999), the OI paradigm underscores that DB's ability to develop competitive advantage depends on how it can leverage from other actors' resources to improve its own innovation performance (Chesbrough, 2011).

9.*Considering the different stages of the innovation process, where is DB using open innovation? Which examples can you draw from the case of DB's openness throughout the innovation process?* Examples across the different stages (Rohrbeck et al., 2009):

- *Idea Generation*: DB Challenges, StartupXpress, OpenData and Digital Ventures; *Research and Development*: StartupXpress, supplier partnership; *Commercialization*: Internal (DB Call-a-bike) vs. external (IOKI).

(30 Min.) – Different Mechanisms of Open Innovation

On this block the instructor might take advantage of the details provided in the case on the different open innovation activities launched by DB. He might follow the order of the case and start by asking ***10.*** *What goals is DB pursuing with its accelerator and what other goals might corporates have?*

- DB main goals: Introduce incremental innovations to the core business; learn about startups that could not be identified otherwise.
- Corporate Accelerator Goals: gather external ideas; build an ecosystem of innovation around the firm; gain knowledge of new markets and trends; refresh corporate culture.

11.*What incentives does DB offer for participants in its open innovation contests?* The students may suggest the below incentives (at this point the instructor may highlight the value of OI in accessing external knowledge and the need to motivate the best external actors to participate in DB's OI). DB incentives for OI include firm recognition (Dahlander, 2014) financial rewards; workspace; mentoring and coaching; real environment for prototype development (Chesbrough, 2018). Alternatively, the instructor might want to illustrate the startups'

perspective. TNExhibit 7 provides additional guidance to discuss the role played by startups in the firm's OI process. Discussing the incentives for innovation provides the instructor a good opportunity to review the paradigm of free innovation with the students. Take *DB Challenges*. While winners are rewarded, ideas and projects are firstly submitted for free, "at private cost by individuals during their unpaid discretionary time and also involves innovation designs that are not protected by their developers" (von Hippel, 2017).

One of the key elements in DB's openness is its CVC unit. Given the case description and its current portfolio (Exhibit 16), the instructor can ask students to ***12.*** *debate its role in the OI ecosystem*. The discussion might be grounded on two dimensions – corporate objective and the unit's link to the company's operational capabilities (Chesbrough, 2002). Potential answers are provided on TNExhibit 8.

Before concluding the discussion, the instructor can use evidence of the case to discuss different commercialization strategies of innovations. *If we look at how DB commercialized out-of-core services in the past, we find a difference between bike-sharing (under DB) and ridesharing (under IOKI). Why?*

- IOKI involves more technology uncertainty and DB might want to protect its brand from potential risks; Release the startup managing a disruptive technology from the burden of corporate rules; New brand might be more attractive for early adopters (link with Roger's and Moore's innovation adoption curves).

(10 Min.) – Conclusion

To conclude, the instructor can challenge students to provide their own view on how DB is strengthening its digital transformation with OI and ask them which metrics the incumbent can use to analyze the success of its endeavor.

- **Metrics**: % of projects that were commercialized out of total of projects started; % of implemented innovations that have been sourced externally; Number of contest participants vs. number of selected participants (Chesbrough, 2004).

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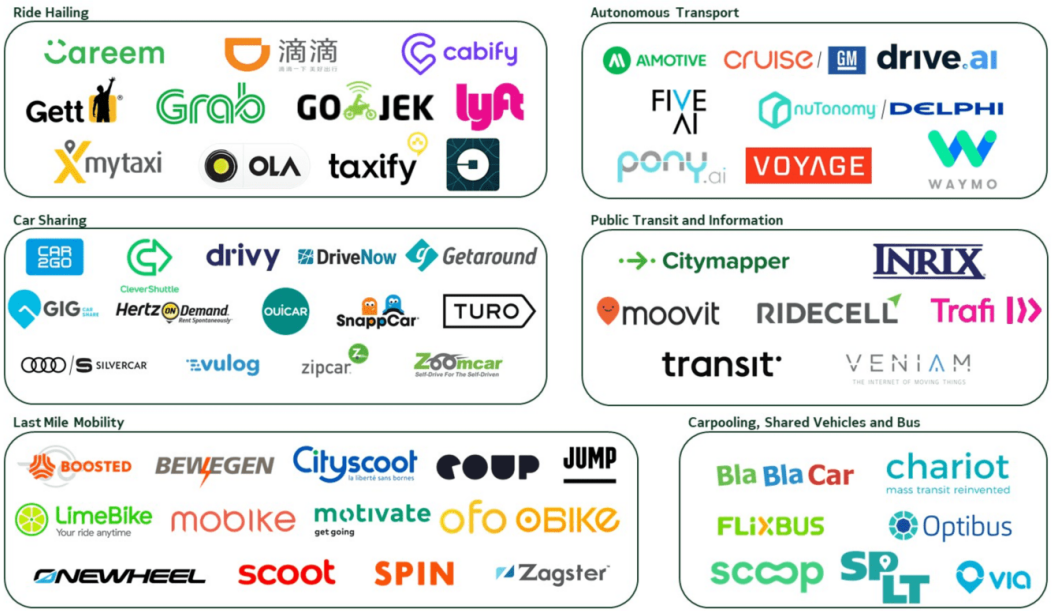
Case Appendix

Exhibit 1 – Selected figures in DB Financial and Operational Performance (2005-2018)

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	
Revenue (in M€)	25055	30053	31309	33452	29335	34410	37979	39296	39107	39728	40403	40557	42693	44065	**Revenue (in M€)**
Inventory (in M€)	-	-	-	-	-	-	-	-	-	2694	2699	2741	2900	3091	**Inventory (in M€)**
Other Operating Income (in M€)	-	-	-	-	-	-	-	-	-	2824	2772	2834	2954	2998	**Other Operating Income (in M€)**
Cost of Materials (in M€)	-	-	-	-	-	-	-	-	-	-20250	-20208	-20101	-21457	-22258	**Cost of Materials (in M€)**
Personnal Expenses (in M€)	-	-	-	-	-	-	-	-	-	-14919	-15599	-15876	-16665	-17301	**Personnal Expenses (in M€)**
Other Operating Expenses (in M€)	-	-	-	-	-	-	-	-	-	-5057	-5750	-5677	-5890	-6088	**Other Operating Expenses (in M€)**
Depreciation (in M€)	-	-	-	-	-	-	-	-	-	-3190	-4471	-3017	-2847	-2688	**Depreciation (in M€)**
EBIT (in M€)	1352	2477	2895	2593	2208	1817	2177	2529	1767	1830	-154	1461	1688	1819	**EBIT (in M€)**
Net Income (in M€)	611	1680	1716	1321	830	1058	1332	1459	649	988	-1311	716	765	542	**Net Income (in M€)**
Debt (in B€)	19,7	19,6	16,5	15,9	15	16,9	16,6	16,4	16,4	16,2	17,5	17,6	18,6	19,5	**Debt (in B€)**
R&D Expenditures (M€)	-	-	-	-	16	35	44	61	57	80	74	180	226	318	**R&D Expenditures (M€)**
Research Expenditures as % of Revenues	-	-	-	-	0,05%	0,10%	0,12%	0,16%	0,15%	0,20%	0,18%	0,44%	0,53%	0,72%	**Research Expenditures as % of Revenues**
DB Market Share (Regional Passenger Transport)	94%	91%	91%	88%	87%	85%	83%	82%	81%	81%	78%	74%	74%	-	**DB Market Share (Regional Passenger Transport)**
DB Market Share (Rail Freight)	-	-	80%	79%	75%	75%	72%	70%	67%	64%	59%	54%	53%	-	**DB Market Share (Rail Freight)**
Number of Employees Worldwide (in M)	216,4	229,2	237,1	240,2	239,4	276,3	284,3	287,5	295,7	295,8	297,2	306,4	310,9	318,5	**Number of Employees Worldwide (in M)**
Number of rail passengers Germany (in M)	1785	1854	1835	1920	1908	1950	1981	2152	2235	2254	2251	2365	2564	2581	**Number of rail passengers Germany (in M)**
Number of seats in DB fleet (in T)	1403	1348	1311	1287	1270	1294	1314	1297	1317	1379	1378	1454	1356	1425	**Number of seats in DB fleet (in T)**
DB Cargo Sales (in M€)	-	-	-	-	-	-	-	-	-	4517	4417	4230	4209	4177	**DB Cargo Sales (in M€)**
Length of Network (in Km)	-	-	33978	33862	33721	33723	35576	33505	33448	33426	33332	33380	33488	33440	**Length of Network (in Km)**

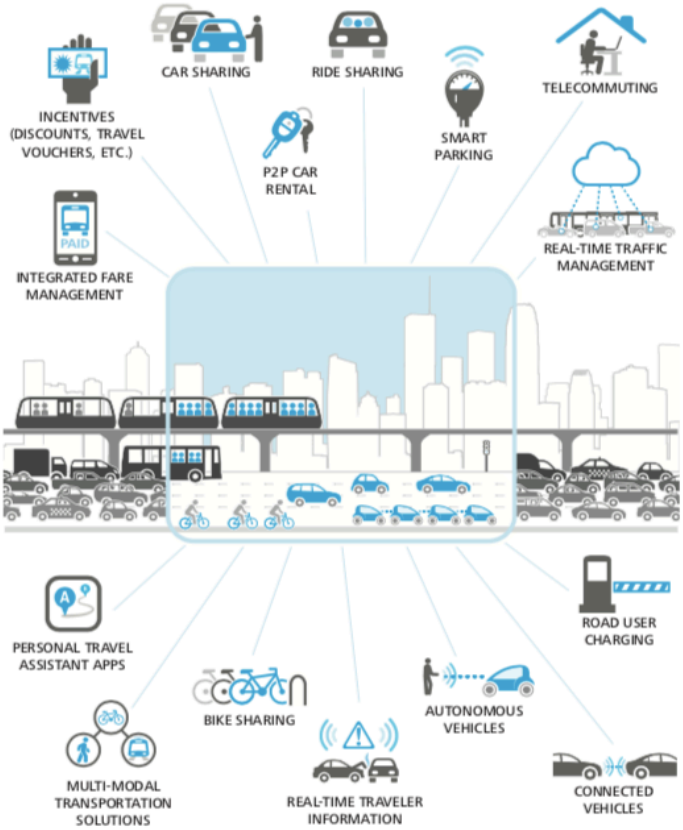
Source: Adapted from Statista (*Deutsche Bahn in Germany 2019* – Retrieved from https://www.statista.com/study/58598/deutsche-bahn-in-germany/ on the 21st April 2020), European Commission (The EU Industrial R&D Scoreboard - Retrieved from https://iri.jrc.ec.europa.eu/scoreboard on the 21st April 2020), and the company's integrated reports (2014-2018).

Exhibit 2 – New (Digital) Entrants in the Mobility Services



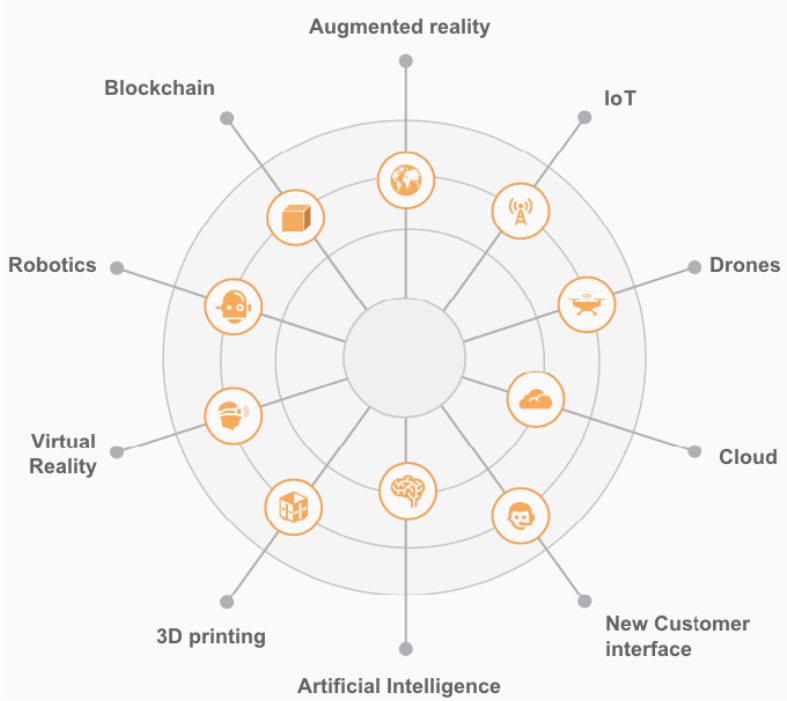
Source: CB Insights. Transportation-As-A-Service: The future of Smart Commuting. (Retrieved from https://app.cbinsights.com/research/transportation-service-smart-commuting/ on the 21st of April 2020.)

Exhibit 3 – New, digitally-enhanced Forms of Mobility



Source: Deloitte (2012). *Digital-Age Transportation: The Future of Urban Mobility*.

Exhibit 4 - Emerging Technologies and their impact on railways



Predictive Maintenance	Predictive maintenance (PM) is an MRO strategy that uses sensors and data to predict maintenance requirements before they occur, thus significantly decreasing stoppage times and costs. The efficiency gains from PM are expected to be **between 15% and 25%** for rail operators.
Smart ticketing	Smart ticketing is the use of contactless debit/credit cards instead of traditional paper tickets. In London, the leading city for the use of smart ticketing, **only 56%** of all passengers use a dedicated smart card as of 2017.
Drones	Aerial data acquisition conducted by specialized drones equipped with sensors followed by data processing and analytics by PwC Drone Powered Solutions Centre can decrease capital projects costs **by up to 12%** and maintenance costs **by 17%.**
Customer experience	AI and facial recognition can revolutionize the rail industry. Already operating in China's Wuhan Railway Station, the facial recognition device identifies passengers before boarding a train and has a potential to end railway ticket barriers and rush-hour queues.
The internet of trains	Spanish train operator RENFE uses a Siemens IoT system that allows 300 sensors of train components to continuously communicate. This has helped services become incredibly reliable – **only one of 2,300 journeys** has been noticeably delayed (by 5 minutes or more).
Big Data	Big-data is the new frontier for collecting and analysing data and for turning it into usable information. A Swedish train operator developed a predictive algorithm from big data allowing to forecast delays. Traffic controllers can be alerted to possible delays, **2 hours** before they occur.
Simulations	Digital Twin technology allows railway manufacturers and operators to maintain an exact digital copy of their rolling stock on computers. Simulations carried out with these twins can indicate how equipment may act in certain scenarios. GE is implementing it in nearly all their products
Creative disruptions	The current trend in disrupting innovations is an ability to leverage spare capacity, monetize it and then expand quickly without large investment. Digital lies at the forefront of disruptions in railway.
Automation	GPS, LIDAR technology, AI (alternative intelligence) and Big Data will work together to automate rail traffic and increase safety and reliability. In Kuala Lumpur, Dubai, Tokyo and Copenhagen, fully automated metros have been running for several years, Others will follow as the scope and reach of automation increases.

Source: Guglielminetti, Paolo and Baiba Alpine and Torsten Thieme. 2018. Innovation for Railways. *PwC*.

Exhibit 5 – Selected Events in DB's History

DB Key Dates		
	1835	Inauguration of the 6-Km Track between Nürnberg and Fürth In the following years, the state and private companies start building tracks in major commercial and industrial cities.
The German Railway Operators association is founded To establish common technical and cooperation norms between the public and privately operated companies.	**1847**	
	1886	The prussian State takes over the Rhein Railway Most of the rail network becomes nationalized
A national company replaces private and local operators After WWI, the Deutsche Reichsbahn employs a million people, becoming the biggest employer in the country.	**1920**	
	1930	Deutsche Reichsbahn acquires the logitics operator Schencker With the ambition to profit from worldwide freight transportation
Deutsche Reichsbahn is fully integrated in the Nazi regime The Transport Minister leads the company to the war crimes using the rail system to deport millions of people.	**1937**	
	1949	Deutsche Bundesbahn is founded in the West In the the East, the railway continues to operate under the name Deutsche Reichsbahn.
Deficit of Deutsche Bundesbahn increases reform debates The company takes over the Saarland Railways, which were still under control of local authorities.	**1957**	
	1990	After German Reunification, both companies become service providers in the new German State Management in both companies is requested to jointly coordinate technical and organizational aspects of the operation
Deutsche Bahn AG is founded 352 000 employees with two different cultural and economic backgrounds are now working under the same roof. In the following years, local authorities beome responsible to decide the rail operators authorized to operate in each state	**1994**	
	1998	Worst High-Speed Disaster in History Derailment of an ICE train kills 101 people near the village of Eschede
With the offer "Surf&Rail", passengers can buy online tickets for the first time Online offer at bahn.de is expanded in the following years	**1999**	
	2002	Acquisition of the logitics operator Stinnes AG Launch of DB Schenker, with the ambition to profit from worldwide freight transportation
DB broadens its mobility offer with "Call-a-bike" and "Carsharing"	**2005**	
	2007	DB expands internationally with acquisition of foreign companies The company acquires Pan Bus (DK), Transfesa (ES) and Laing Rail Ltd (UK)
Partial privatization of the company fails The privatization agreed by the German Parliament and Senate is postponed due to the financial crisis.	**2008**	
	2010	Acquisition of Arriva is completed and DB Navigator App reaches 1M downloads DB is now transporting passengers in 13 european countries
DB2020 Strategy is presented All companies of the group will be evaluated for their customer, employee and environmental performance.	**2012**	
	2016	Starts the program "Future Train" With investments in confort and cleanliness in stations, punctuality and client information systems.
The track for high-speed trains between Berlin and Munich is complete The project was included in the biggest construction project of the company after the reunification.	2017	
	2018	The "Agenda for a better Train" is published It includes wide investments in infrastructure, train fleet and digital products.

Source: Deutsche Bahn. (Adapted from https://www.deutschebahn.com/de/konzern/geschichte on the 21st of April 2020)

Exhibit 6 – DB Organizational Structure: Business Units

Category	Business Unit	Core Activities	
Infrastructure	DB Netze Track	Track Maintnance	
	DB Netze Stations	Passenger Stations development and maintenance	
	DB Netze Energy	Supplying Energy to DB operations and other clients Management of Energy Networks Procurement of Energy	
Logistics	DB Schenker Logistics	Worldwide logistics operator for goods transported via land, ocean and air.	
	DB Cargo AG	Europe-wide rail freight operator	
Passenger Transportation	DB Arriva plc.	Bus, Train and Demand-Responsive Transport Operator in 15 European	
	DB Bahn Regional	Bus and Train Operator that links conurbation with rural areas in Germany	
	DB Bahn Long Distance	Germany and Cross-Border long-distance rail and road transportation	
Services/Administration	DB Services	DB Vehicle Maintenance	Revision and mainteance of rail components and vehicles;
		DB Fleet Management	Supplies 26000 vehicles across Germany; Fleet Management services for external companies; "DB Carsharing" and "Call a Bike";
		DB Systel	IT and Telco provider for DB Group Provides full range of solutions, from consulting to support
		DB Services	Technical facilities management in commercial, administration and industrial buildings; Cleaning services for passenger cars;
		DB Communication Technology	Management of passenger information systems; Maintenance of IT and Networks;
		DB Security	Safety services for travelers and real estate (stations, railway property).
	DB Systemtechnik	Engineering tests and trials of technical systems Engineering services for vehicles and infrastructure interaction	
	DB Vertrieb	Ticket Sales and Business Development for Passenger Transport Services;	

Source: Adapted from Deutsche Bahn (Business Units – Retrieved from https://www.deutschebahn.com/en/group/business_units on the 21st of April 2020)

Exhibit 7 – Breakdown of Revenue per Business Unit: Logistics as the main revenue source

Revenues per Business Unit (2018)		
Business Unit	Revenues (in M€)	Revenues (in % of total)
DB Long-Distance	4682	9%
DB Regional	8968	18%
DB Arriva	5441	11%
DB Cargo	4460	9%
DB Schenker	17050	34%
DB Netze Track	5511	11%
DB Netze Stations	1314	3%
DB Netze Energy	2850	6%

Source: Deutsche Bahn AG. 2019. "Deutsche Bahn 2018 Integrated Report".

Exhibit 8 – Weak Punctuality Performance across Business Units

Punctuality (%)	2018	2017	2016
DB Group (rail) in Germany	93.4	93.9	94.3
DB rail passenger transport in Germany	93.5	94.1	94.4
DB Long-Distance	74.9	78.5	78.9
DB Regional	94.0	94.4	94.8
DB Cargo (Germany)	72.9	73.4	76.2
DB Arriva (rail: Great Britain, Denmark, Sweden, the Netherlands and Poland)	89.8	92.3	91.0
DB Regional (bus)	91.0	90.5	90.6
DB Cargo (Europe)	72.8	72.7	75.6

The punctuality of our rail products in Germany showed an unsatisfactory development in the year under review. Both passenger and freight transport saw punctuality fall significantly below the values of the previous year.

Punctuality suffered from a higher utilization of the infrastructure. Further growth in rail transport combined with the expansion of the construction program and the associated reduction in network capacity had negative impacts on the development of punctuality. In contrast, it was possible to further reduce construction-related delays (delays that can be clearly linked to a construction site). The increasing traffic volume caused bottlenecks in both the infrastructure and with regard to staff and vehicle availability.

Source: Deutsche Bahn AG. 2019. "Deutsche Bahn 2018 Integrated Report".

Exhibit 9 – Customer Satisfaction across Business Units

Customer satisfaction (SI)	**2018**	2017	2016
Passengers	75,1	75,8	76,0
DB Long-Distance	77	77	77
DB Regio (rail)	66	68	69
DB Regio (bus)	74	74	75
DB Arriva (bus und rail in Great Britain)	79	80	81
DB Netze Stations (passengers/visitors)	68	69	69
DB Sales	82	82	81
DB Connect (car-sharing)	79	78	76
DB Connect (Call a Bike)	79	79	77
Freight transport and logistics [1)]	65,5	70,5	-
DB Cargo [1)]	60	67	-
DB Schenker [1)]	71	74	-

Source: Deutsche Bahn AG. 2019. "Deutsche Bahn 2018 Integrated Report".

Exhibit 10 – First steps towards digitalization: The Six 4.0 Initiatives

Six 4.0 Initiatives	
Mobility 4.0	"Development of products along the travel chain and redesign of customer interfaces"
Logistics 4.0	"Complete digitalization of the customer interface, the systematic expansion of Web-based production processes and, in the railway area, automated train operation"
Infrastructure 4.0	"Networking of all assets and capturing of movement data" "Development of products that enable more automated and more efficient maintenance of timetables"
Production 4.0	"Higher degree of automation in controlling, driving and dispatching trains and on condition-based maintenance"
IT 4.0	"Capable of capturing storing and analyzing the increasing amount of information that will be received from the different units"
Working Environments 4.0	"Illuminate the effects of digitalization on the people in DB Group"

Source: Deutsche Bahn AG. 2016. "Deutsche Bahn 2015 Integrated Report".

Exhibit 11 – Areas of Intervention of DB StartupXpress at the Corporate Accelerator Mindbox

Areas of Intervention	Sub-areas of intervention	
Maintenance	Smart Infrastructure	Real Time Information; Predictive maintenance; Wayside monitoring;
	Intelligent Trains	Real Time Information; Predictive maintenance; Track Monitoring;
	Innovative Workshops	Work Support; Communication; Logistics;
	Modern Tools	AR/VR; Simulation; Communication Infrastructure
	Video, Image and Sensor Analysis	Material supervision; Passenger flows; Track / Train condition
Logistics	New Products / Business models	Market platforms; Free capacity exchange; New Sales Channels; Logistics Integrator;
	New Services	Estimated Time of Arrival; Integration in Supply Chain; Decision support; Digital consignment note;
	Communication	Dashboards; Feedback/Complaint Management Track and Trade
	Modern Sales Tools	Blockchain; API; CRM; Big Data;
HR	Big Data	People Analytics; Matching; Competency management;
	Engagement Tools	Feedback and participation; Digital Learning; Knowledge Management;
	Digital Assistance	Health management; Time tracking; Workflow Management;
Construction Tech	Smart Planning	Technical Risk Analysis; Document Management; Collaboration & Communication;
	Project Progress Analysis	Real Time Monitoring; Predictive analysis; Data visualization;
	Construction Logistics	Workflow Management; Data Analysis;
Sales and Marketing	Customer Intelligence	Robotics; Ticketing; Human Machine Interface;
	New Services	Navigation; Shopping; Entertainment; Data-based Services;
	Customer Retention	Comparability; Loyalty Programs; Gamification; Crowd Based Services;
	Information Management	Real Time Information; Processing; Routing; Analytics.

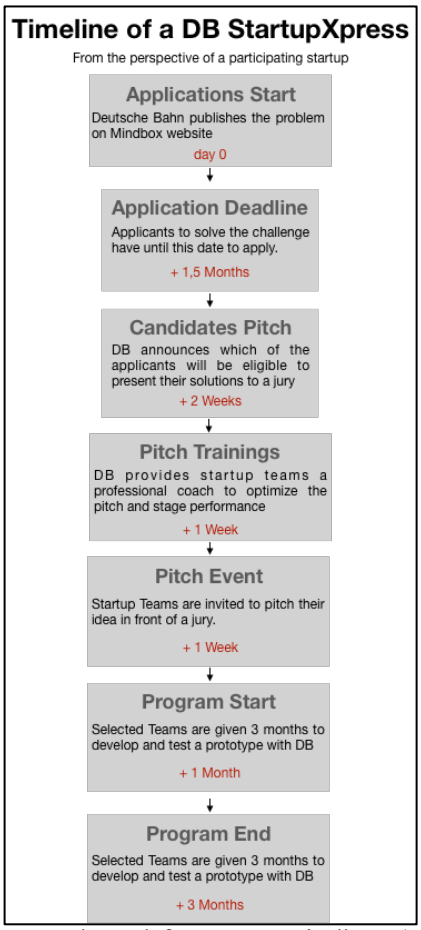
Source: Adapted from DB Mindbox (Retrieved from https://dbmindbox.com/de/dbstartupxpress/ the 21st of April 2020)

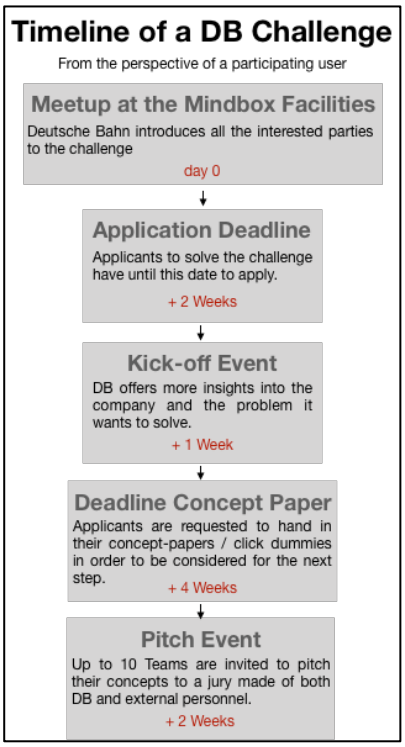
Exhibit 12 – Areas of Intervention and Selected Startups in previous rounds of the DB accelerator

DB StartupXPress			
Date	**Area of Intervention**	**Date**	**Area of Intervention**
October 2015	Sensors for the Infrastrcture	*July 2017*	The Smart City Tech Batch with Plug and Play
May 2016	Innovations for the Infrastructure	*August 2017*	Innovative Ideas for the Stations
August 2016	Next Station 2016	*Januarty 2018*	New Era of Construction Tech
January 2017	New Hardware Solutions	*February 2018*	Future of Customer Interaction
August 2017	The Future of Maintenance	*June 2018*	The Future of Maintenance part II

Source: Adapted from DB Mindbox (Retrieved from https://dbmindbox.com/de/dbstartupxpress/ the 21st of April 2020)

Exhibit 13 – The accelerating process from a startup's perspective





Source: Adapted from DB Mindbox (Retrieved from https://dbmindbox.com/de/dbstartupxpress/ the 21st of April 2020)

Exhibit 14 – Areas of Intervention and Previous Editions of the *DB Challenges*

DB Challenges		
Date	**Topic**	**Description**
December 2015	DB Information:challenge	"*we want to improve the facilities, design, working equipment, processes but also* ***the scope of services that are provided.*** **" at information corners** in stations, with a balance between a digital offer and personal interaction
April 2016	DB Information UX:challenge	"**optimizing queueing** as well as processes, creating a user interface-design, **improving the interaction between employees and customers**"
May 2016	DB Digital Header:challenge	"The Deutsche Bahn has a multitude of plans and sketches depicting our infrastructure, i.e. all of our buildings and technical installations. The goal is to **digitalize and automatize these plans in order to transfer them into our database**"
February 2018	Automatic Cleaning:challenge	"DB Services wants to **incorporate cleaning robots** as a new efficient and cost-effective advanced technology to further their cause of providing utmost **cleanliness to the railway environment**"
July 2018	DB Location Based Services at Stations	"Use localization technologies (e.g. beacons, QR codes and NFC tags) to include local points such as platforms, DB services, restaurants and shops or other important train station facilities. Combine this with relevant information (e.g. open data and DB data) to **offer station users new services in real time**."
July 2018	Challenge Confort Check-in and Location	"We are looking for new ideas and use cases do **digitize the self-service check-in** in long-distance trains"
November 2019	Digital Information for the Tourism of the Future	"**Our goal is to achieve visible improvements for our travelers and visitors at the train station and on the way there.** In particular, tourism highlights, products and services at/around the stations, improved information services for travelers".

Source: Adapted from *DB Mindbox*

(Retrieved from https://dbmindbox.com/de/db-challenge/#past-records on the 30th of April 2020)

Exhibit 15 – Selected Editions and Areas of Intervention of *DB Open Data*

DB Open Data		
Date	**Topic**	**Description**
May 2015	Track Position Errors	Participants invited to develop models that find **correlations between external events and technical defects on tracks**.
December 2015	OpenData@DB Infrastructure	DB provides **real-time data on the condition of elevators at train stations**. Participants invited to develop solutions on how that data could be used.
September 2016	Hackathon 5: The Internal hackathon	Invites all DB workers who work with Data to come up with **new types of analysis, vizualization and uses for the data** from DB Open Data, internal data from the company and relevant external data
December 2016	Hackathon 6: OpenData	Participants invited to provide ideas on how DB Open Data could be used to **advance a digitalization agenda**.
May 2017	Hackathon 7: OpenData	In **partnership with JR East (Japan)**, in light of the 2020 Olympic Games, participants are asked to use open data to **help tourists, develop efficient routes, support transformation in the mobility sector**.
October 2017	Design the Smart Mobility – ITS Hackathon Hamburg	Participants challenged to develop na integrated mobility system for Hamburg, focusing on **mobility for families and travellers, improved commuting and smart inner-city logistics**.
May 2018	Three-countries-hack	In **partnership with SBB** (Switzerland) and **ÖBB** (Austria), employees from the three operators are asked to analize data under the main topics of **digital stations** and **chatbots**.

Source: Adapted from *DB Mindbox*. (Retrieved from https://dbmindbox.com/de/db-opendata-hackathons/#past-records on the 30th of April 2020)

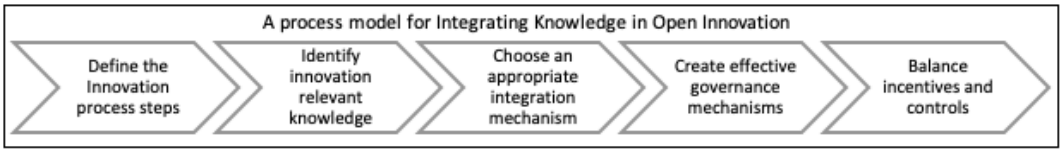
Exhibit 16 – DB Digital Ventures' Current Portfolio of Equity Investments

DB Digital Ventures - Portfolio				
Company	Country	Founded in	DB invested in	Business
RIDECELL	USA	2009	2018	Intelligent Software for Mobility Services Management
Connected Signals	USA	2010	2017	Traffic Light Data Prediction and Connection with Smart Vehicles
TALIXO	Germany	2012	2017	Booking Platform for Taxis and Limousines
TERALYTICS	Switzerland	2012	2019	Transportation Network and Infrastructure Analytics
what3words	Great Britain	2013	2017	Geospatial Referencing and 3 Word-based Addresses
CleverShuttle	Germany	2014	2016	Door-to-Door Mobility - Ridepooling Service
Trillium	USA	2014	2018	Authentication-encryption and Firmware Authentication for Connected Vehicles
KEPLER	Canada	2015	2018	Sattelite Communication Technologies and Space-based Connectivity
COORD	USA	2016	2018	Curb Management Platform with tools to digitally price, allocate and manage curb
gokid	USA	2016	2018	Carpool Schedule Management for Schools and Families
Skyports	Great Britain	2017	2019	Landing Infrastructure for Cargo Drone Deliveries and Air Taxis
MANIV MOBILITY	Israel	2015	2019	Venture Capital for New Mobility Solutions

Source: Adapted from DB Digital Ventures (Retrieved from https://deutschebahnventures.de on the 21st of April 2020) and Deutsche Bahn AG. 2019. "Deutsche Bahn 2018 Integrated Report".

TN Appendix

TNExhibit 1 – Management Decision Process in Starting an OI Initiative

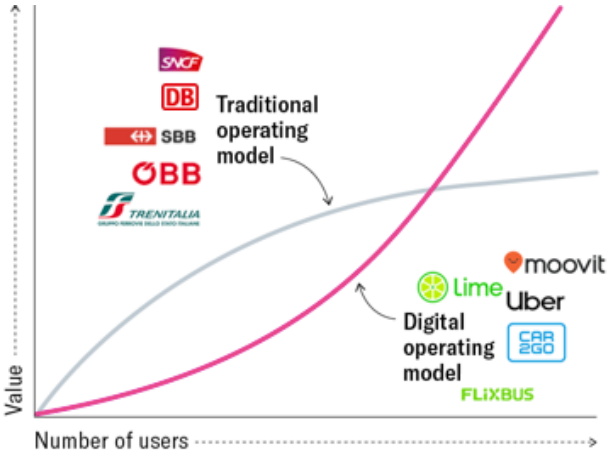


Source: Adapted from Wallin and Krogh (2010)

TNExhibit 2 – Class Discussion Summary: Questions and Covered Subjects

Open Innovation at Deutsche Bahn - Class Discussion Plan
10 Min. - Introduction - Summary of the case
Case Summary with Input from students
What could an incumbent do, if it already reached its full capacity and cannot add new infrastructure in the nearest future?
15 Min. - DB's Response to the External Environment
Is the DB situation unique?.Are there any other companies or industries that could learn from this experience?
What internal factors are leading DB to increasingly invest on its digital transformation?
Pinpoint the key aspects of DB's digitalization strategy
Do you think DB will be able to compete with the new smaller, more agile competitors that offer new forms of mobility?
Topics Covered: Digital Transformation; Market Liberalization; Monopolist Innovator
25 Min. - Implementation of Open Innovation
In under two years DB launched several OI initiatives. What was the rationale behind all these activities in such a short period?
The potential drawbacks from the different OI initiatives.
Why would DB invest in OI rather than on internal R&D? What are the advantages for a big firm?
Considering the different stages of the innovation process, where is DB using open innovation? Which examples can you draw from the case of DB's openness throughout the innovation process?
Topics Covered: Pros/Cons of OI; Role of OI in the overall innovation process; OI against internal innovation
30 Min. - Different Mechanisms of Open Innovation
What goals is DB pursuing with its accelerator and what other goals might corporates have?
What incentives does DB offer for participants in its open innovation contests?
What goals do startups pursue in these programs? and What relations can DB establish with the startups once the acceleration program is over?
What role does DB CVC unit play in its open innovation ecosystem?
If we look at how DB commercialized out-of-core services in the past, we find a diffeence between bike-sharing (under DB) and ridesharing (under IOKI). Why?
Topics Covered: Corporate Accelerators; Role of Incentives in OI; Corporate-Startup Relations; CVC; OI Commercialization
10 Min. - Conclusion
Students Critical Assessment of DB's use of OI for digital transformation
Performance Indicators for OI
Topics Covered: **OI Performance Metrics**

TNExhibit 3 – "Strategic Collisions": Traditional Rail Operators and the Digital Economy



Source: Adapted from Iansiti and Lakhani (2020)

TNExhibit 4 – Open Innovation and Business Models

Business Model / Open Innovation Model	**Closed/Stand Alone Business Model** ("Companies market a product using their own assets")	**Open/Linked Business Models** ("Company relies on its partners to jointly create value for customers")
Outside-in Open Innovation	3. Use others' knowledge to develop a new offering: "The company is now looking for external knowledge which can be used in developing its new products or services within its own business model".	6. Use others' knowledge to develop a new BM: "A company sources knowledge from other organizations to set up a business model that is linked to business models of other (partner organizations).
Inside-out Open Innovation	2. Unused knowledge used by others: "The firm who originally developed the technology is no longer involved in the commercialization"	5. Internal knowledge accessible to others to develop a new BM: "Companies can outsource internally developed knowledge not to monetize on it, but to create a platform"
Closed Innovation	1. Closed Innovation Model: "The company markets it through its own sales channels".	4. Search for assets owned by others to develop a new BM: "Companies can develop new technologies mainly in-house. Still, the business model requires na open approach to create and capture value"

Source: Adapted from Vanhaverbeke and Chesbrough (2014)

TNExhibit 5 – Case Outline to Organize Discussion in class

	Open Innovation at Deutsche Bahn - Teaching Case Study
1.	Deutsche Bahn AG from 2014 to 2020 Financial Performance: rising debt; heavy decreases in cash flows. Operational Performance: weakening punctuality; weakening customer satisfaction.
2.	The Environment **Competition Structure** — **Industry shift towards digitalization** -Monopolist in long distance passenger transport — - From Station-to-Station to Door-to-Door mobility -Political incentives for increases in rail transportation; — - Digital platforms as new source of competition
3.	**Problem: How to increase capacity quickly in an infrastructure intensive industry?**
4.	What to do?
5.	Digitalization
7.	Six 4.0 Initiatives Organizational Changes for Digitalization: CDO Organization, CTO "*Digital Rail for Germany*"
8.	How to do it?
9.	Open Innovation
10.	Corporate Accelerator; O.I. Platform; Open Contests; CVC; Spin-offs

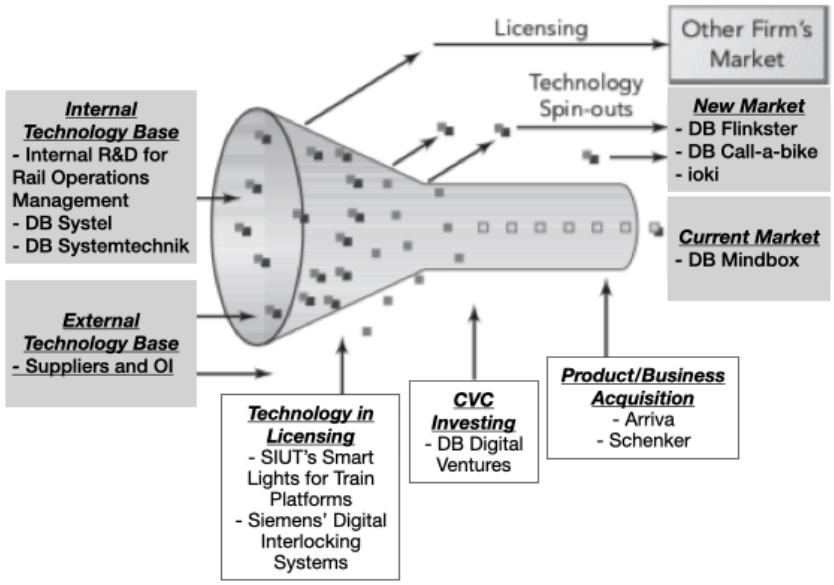
Source: OI at DB Case.

TNExhibit 6.1. – DB Open Innovation Ecosystem (according to innovation type and stage in the innovation process)

	Stage in the Innovation Process			
Type of Innovation	Ideation	Research	Development	Commercialization
Continuous Innovation	**Corporate Accelerator** (StartupXpress) **User Contests** (DB Challenges and DB Open Data)	**Corporate Accelerator** (StartupXpress) **User Contests** (DB Challenges and DB Open Data) **Supplier Innovation**	**Corporate Accelerator** (StartupXpress) **User Contests** (DB Challenges and DB Open Data) **Supplier Innovation**	**Supplier Innovation**
Disruptive Innovation	**OI Platform** (Beyond1435)	-	**CVC Unit** (DB Digital Ventures) **OI Platform** (Beyond1435)	DB Call-a-Bike *ioki* DB Flinkster

Source: OI at DB Case.

TNExhibit 6.2. – DB's Open Innovation Ecosystem (according to the OI paradigm framework veveloped by Chesbrough)



Source: OI at DB Case. Adapted from Chesbrough (2011).

TNExhibit 7 – The startups' perspective and future relations between startups and corporations

While the literature on OI tends to highlight one focal firm as the unit of analysis, the instructor might use the evidence from the case to discuss with students the goals and options that other participants in the OI process might have. Grounding the discussion around some of the startups mentioned in the case, he can ask students ***1.*** *What goals do smaller, newer such as SIUT companies pursue other than getting funded?*. The students' answers may point out that startups also approach established companies to gain visibility and credibility or to access the resources and markets served by the incumbent (Kohler, 2016). In the case of SIUT, the cooperation with DB allowed the small firm to test-market its technology in a real-life setting. This discussion might be an opportunity for the instructor to introduce students to the different types of collaboration that DB could establish with startups after the accelerator program. Taking the example of SIUT, the incumbent firm can continue assisting in the pilot project, become its customer or even investing and acquire the startup (Kohler, 2016).

TNExhibit 8 – The Role of the CVC Unit in the OI Ecosystem

When asked about ***1.*** *What role does DB Digital Ventures play in the DB's OI process?*, students should be able to identify that the firm makes use of venture capital not only to 1) align its own goals with those of the companies it invests in (Kohler, 2016), but also to 2) take a stake in promising, potentially disruptive businesses. Students should also notice 3) how DB uses its venture capital arm to invest in disruptive businesses, in contrast with the purpose of the corporate accelerator which is to find continuous innovations related to the core business.

To encourage students' strategic thinking, the instructor could ask ***2.*** *Does it make sense for a company to launch a corporate accelerator for continuous innovations and a separate VC unit to find disruptive innovations? Can you think of any risks this strategy might pose?*

- **It does**: lack of knowledge and resources to support and mentor potentially disruptive startups in developing prototypes; wide network of assets; proprietary rights over new technologies.
- **Possible risks:** Selecting wrong firms to invest due to lack of knowledge and experience in new technologies; corporate culture imposed on startups with disruptive business models.