Leveraging Digital Innovation

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Lessons for Implementation

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ubiquity press
London

Published by
Ubiquity Press Ltd.
6 Osborn Street, Unit 3N
London E1 6TD
www.ubiquitypress.com

First published 2024

Cover design by Jens Weinmann
Cover image: Incremental deformation of Penrose (1974) tilings, inspired by Welberry (2019)

Print and digital versions typeset by Siliconchips Services Ltd.

ISBN (Paperback): 978-1-914481-52-9
ISBN (PDF): 978-1-914481-53-6
ISBN (EPUB): 978-1-914481-54-3
ISBN (Mobi): 978-1-914481-55-0

DOI: https://doi.org/10.5334/bda

The full text of this book has been peer-reviewed to ensure high academic standards. For full review policies, see https://www.ubiquitypress.com/

Suggested citation:
Burger, Christoph & Jens Weinmann 2024. *Leveraging Digital Innovation: Lessons for Implementation*. London: Ubiquity Press. DOI: https://doi.org/10.5334/bda. License: CC BY-NC 4.0

To read the free, open access version of this book online, visit https://doi.org/10.5334/bda or scan this QR code with your mobile device:

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Acknowledgements

The authors are deeply indebted to the continued commitment and dedication of their interviewees, without whom this research would not have been possible.

They also want to extend their gratitude to Prof. Sir Roger Penrose at Wadham College in Oxford and Prof. Richard Welberry at the Australian National University in Canberra for the inspiration and Prof. Welberry's kind permission to build upon his aesthetic experiments on deformed Penrose tiling and quasicrystals for the cover image of this book.

PART I

Introduction

CHAPTER 1

The Challenge of Digital Transformation

Towards the end of the first quarter of the 21st century, technological change is happening at a faster pace than ever experienced before. With ChatGPT, Generative Artificial Intelligence (GenAI) moved from a scientific lab context to widespread commercial dissemination reaching a hundred million users in just two months, according to the World of Statistics (2023). By contrast, it took the mobile phone 16 years to obtain the same user base. Another disruptive technology, the World Wide Web, still needed 7 years to reach a hundred million users (ibid.).

Why does technological change accelerate? Intrinsic and extrinsic factors may contribute.

Intrinsic factors for the acceleration of technological change include, for example, the pace of progress in applied R&D. Based on a meta-dataset of the world's three most important producers of graphics processing units (GPUs), Hobbhahn and Besiroglu (2022) estimate that the processing speed of IT hardware components doubled every 2–3 years between 2006 and 2021. This exponential growth has allowed for increasingly complex applications, such as large language models (LLMs).

Since the financial crisis in 2007, the world has also witnessed numerous *extrinsic* factors that acted as catalysts for an accelerated development and dissemination of disruptive digital technologies. The long lockdown periods of the COVID 19 pandemic led to leapfrogging into home office work and remote operations, with video conferencing and the paperless organization (Amankwah-Amoah, Khan, Wood, & Knight, 2021) emerging much faster than anticipated. After the Russian attack on Ukraine, global military expenditures rose by 3.7 percent to record investments in 2022 (Pollard, 2023), trickling down to R&D budgets and «potentially producing revolutionary new

How to cite this book chapter:
Burger, C. and Weinmann, J. 2024. *Leveraging Digital Innovation: Lessons for Implementation.* Pp. 3–25. London: Ubiquity Press. DOI: https://doi.org/10.5334/bda.a.

technologies» (Hashim, 2022), as digital warfare will increasingly determine the fate of adversaries.

These extrinsic shocks revealed a «digital divide» among organizations, more specifically between the digital-first companies and more reluctant players, especially small and medium-sized enterprises and large, traditional corporations with legacy information systems and a high degree of procedural complexity. For the case of the global Corona pandemic, Amankwah-Amoah et al. (2021) identify several constraints on the organizational level that impede fast digitalization. These include a lack of technical expertise, missing awareness of latest technologies and potential gains from digitalization, as well as organizational inflexibility and unwillingness to change, as typified by «hard-to-change organizational routines, process and traditional ethos of the organization» (ibid.).

Those companies that hesitate to move from products to solutions, platforms or X-as-a-Service business models are potentially left behind their faster-moving competitors. They might fail to acquire the necessary capital on financial markets and might lose the trust of their investors and shareholders. As Grigory Shevchenko, Senior Account Manager at German mid-stream energy company Uniper, coins it in Case 8 of this volume: «The rationale was better to deal with disruption before disruption deals with you.»

Notwithstanding, digital transformation requires a decisive vision of top management and division leaders to invest money and human resources into new business models. Yet, digital transformation typically does not occur as a Big Bang that catapults the existing organization like a sub-atomic particle on the next quantum level. It rather consists of small, labor-intensive, and often tedious improvements of the existing IT legacy infrastructure, a bottom-up movement with each functional unit identifying opportunities and use cases for process optimization and efficiency gains.

The change in corporate culture and organizational configuration starts with the mindset of each individual employee, willing to embark on a life-long learning journey, coping with new software interfaces and acquiring the necessary skillset to filter, channel and deploy an ever-increasing amount of information in daily routines.

The fundament of a digitally-affine organization is data. However, establishing a data lake does not suffice for a company to succeed in digital transformation. Novel digital technologies are necessary to harvest insights and generate value added.

How to implement these new technologies and leverage digital innovations? How to overcome organizational hurdles? How to convince top management, or – conversely – how to take executives and middle managers on board? This book presents best-practice cases, which may serve as concrete pathways and inspirations for «rainmakers» and corporate ambassadors of change.

Digital technologies as Strategic Enablers in the Strategy Pyramid

Compared to many other books on digital transformation, the ambition of this compilation of interviews is narrow and modest. It does not aim to provide a framework for a fundamental strategic reorientation or business model transformation. Most of its cases start with a hands-on initiative of individuals in a progressive business unit and derive insights from the experience of implementing a disruptive digital technology in a given corporate context.

The focus of this book can be best illustrated by using the metaphor of the so-called «Strategy Pyramid», as suggested by Thompson and Strickland (2001). It typically contains various horizontal layers. For this book's purpose, we assume a prototypical Strategy Pyramid with three layers.

The top level of the pyramid formulates the abstract vision of the company's desired future. It can be identified as the Strategic Intention, that is, what an organization wants to achieve, often also called its vision or mission. This level obviously differs from company to company. German technology company Siemens Energy, for example, «is determined to become the world's most valued energy technology company» (FPSO Network, 2022). Cosmetics and adhesives company Henkel intends to «win the 20s through purposeful growth» (Henkel, 2022). US American retail platform and cloud provider Amazon wants to become «the Earth's most customer centric company» (Amazon, 2022), while Berlin-based fashion retailer Zalando intends to «digitize fashion» (Cadieux & Heyn, 2018). Level 1 might entail elements of a digital strategy, but typically focuses on the most important, overarching strategic objective of the firm.

By contrast, the Strategic Priorities on level 2 are tasks that need to be performed to fulfill the higher-level intention expressed on level 1. Priorities among companies tend to show communalities and may include elements such as customer centricity, the move from products to services and solutions, an increase in process efficiency connected to cost-cutting and optimization, or – on an ecosystem level – becoming a platform provider in the respective market. On the second level, digital transformation often plays a key role. For instance, Siemens Energy considers «digitalization as a value driver» and defines three priorities in its mission of «digitalizing the energy transformation» (Siemens Energy, 2022):

- «New digital revenue: We create new revenue streams by offering software as a service seamlessly across our product range;
- Increasing the value of our offering: We combine our domain expertise with our digital expertise to differentiate our value and offerings for our customers;
- Internal digitalization: We automate our internal processes and build the necessary digital infrastructure to react to rapid changes of the digital world.»

In level 3 of the Strategy Pyramid, a company defines the means to implement and operationalize the Strategic Priorities. They can be called the Strategic Enablers and are the technical and organizational prerequisites necessary to accomplish the overarching objective or vision of an organization. These can be projects or tasks, but also functional capabilities, resources, or technologies that must be acquired. Again, depending on the company and its respective industry, Strategic Enablers may be defined in different ways.

This third level of the Strategy Pyramid is the focus of this book. With respect to digital transformation, two Strategic Enablers will be analyzed in greater detail:

- *Technological Enablers:* On the one hand, a company needs the (digital) technological equipment to pursue its Strategic Priorities. These include algorithm-driven tools, particularly the usual data analytics toolkit, including resources to undertake descriptive, predictive and prescriptive statistics, customer segmentation and cluster analysis, various types of regressions, risk analysis with Monte Carlo simulation and Decision Trees, corporate dashboards, and the like. More advanced algorithm-driven tools include Machine Learning and Artificial Intelligence (AI), Robotic Process Automation (RPA) and Blockchain/Distributed Ledger Technologies (DLTs). On the other side of the spectrum of enablers are device-driven technologies. They are characterized by hardware requirements that exceed the typical binary computer systems, such as Additive Manufacturing (3D printing), Augmented Reality/ Virtual Reality applications, drones, and – in the near-term future – Quantum Computers.
- *Organizational Enablers:* Beyond the technological endowment, a company is likely to adapt and revamp its organizational setup to initiate and sustain the digital transformation process. This may include introducing a new position of a «Chief Digital Officer» (CDO) directly reporting to the CEO, a strengthening of the role of the information technology (IT) department, or an internal, cross-departmental task force that identifies processes and use cases prone to be digitally transformed. It also encompasses the human resources aspect of digital transformation, such as the training of the existing workforce, the identification of deficits in the current spectrum of organizational capabilities, and potentially hiring of new (digital) talents. However, the organizational implementation may also imply broadening the perspective beyond the traditional boundaries of the firm – by tapping into the larger innovation ecosystem, establishing Joint Ventures (JVs) or collaborations with startups, or joining consortia and platforms.

The following figure illustrates the Strategy Pyramid, adapted to the digital transformation of a company.

Figure 1: Strategy Pyramid with Strategic Intention, Priorities, and Enablers. *Source:* Own illustration, adapted from Thompson and Strickland (2001).

The remainder of this introductory chapter zooms into the two dimensions of Strategic Enablers. First, it introduces the most relevant Technological Enablers, based on the results of an international survey on disruptive digital technologies. Second, it provides a conceptual framework to characterize pathways of organizational implementation, serving as a bridge towards the subsequent best practice cases, sketching how companies have successfully accomplished the hurdles of technological and organizational implementation of disruptive digital technologies in their respective corporate context.

Technological Enablers

Which disruptive digital technologies are most relevant for executives in their digital transformation strategy? As a first step of the analysis, an international survey was conducted. It comprised a total of 609 upper management executives from IT, manufacturing and service industries (finance, healthcare, legal, logistics, real estate, public administration and infrastructure), with around 55 percent of participants residing in Europe, 41 percent in North America, 2 percent in Australasia, and the remaining respondents in Africa, South America, and Asia[1].

[1] The survey took place in mid-2020 and was conducted by a commercial provider (Prolific). The authors obtained the original data and performed the descriptive statistics and analysis.

The aim was to explore how executives currently deploy the above-mentioned digital technologies in their business practice.

The survey includes three device-driven and three algorithm-driven digital technologies. The following two sections of this chapter are dedicated to presenting these six technologies, with a short description and some illustrative use cases.

Device-driven digital technologies

The following device-driven technologies are part of the survey:

- **Additive Manufacturing**, more colloquially called 3D-Printing, transforms a digital, three-dimensional model of an object, typically programmed in CAD (computer-aided design) software, into a haptic artefact. The most common technology is sintering, adding layer by layer of a metal-based or plastic-based granulate on top of each other, until the object is completed. Additive manufacturing has become commercially attractive in three key areas (Attaran, 2017; Khorram Niaki, Nonino, Palombi, & Torabi, 2019; Lacroix, Seifert, & Timonina-Farkas, 2021):
  (1) Rapid prototyping and innovation, for example for printing new shuffles of gas turbines in R&D departments;
  (2) Printing spare parts and rare components for manufacturing and infrastructure operations, especially in remote locations where ordering and delivering a spare part may take weeks or even months;
  (3) Mass customization, for example by printing individualized tooth replacements or in-ear headphone plugs.

  More exotic applications include printing entire houses with fast-drying concrete as the raw material (Valente, Sibai, & Sambucci, 2019), or food items, such as Japanese Sushi (Watkins, Logan, & Bhandari, 2022).
- **Augmented Reality** (AR) is a technology that extends reality with additional visual information, combining the actual camera view of a handheld device such as a tablet or smartphone with a digital projection of certain features on the visual environment. Most prominently, Nintendo's mobile game «Pokémon Go» received worldwide attention in 2016 when literally millions of digital natives all across the world used their phones to chase Japanese virtual mini monsters in real urban settings. Companies like Ikea use Augmented Reality apps to become more user-centric, helping their customers in choosing, for example, the right furniture for their interior design by projecting digital sofas or wardrobes into the camera footage of their living rooms. German original equipment manufacturer (OEM) Bosch supports garage technicians in repairing combustion engine, for example by pointing to the location of hidden components, thereby allowing for time savings of around 15 percent in the repair processes

(Waldmann, 2019). Bosch also uses the technology for educational purposes, in which trainees can follow the actions trainers perform on their own devices. ARtillery Intelligence, a specialized consulting practice, estimates that mobile AR had more than one billion users worldwide in 2022 (Alsop, 2022). Beyond handheld devices, AR also extends to glasses to be worn like normal glasses just in front of the eyes.

Popular devices are «Google Glass» and Microsoft's HoloLens. After a PR disaster related to privacy and data protection issues following the launch of «Google Glass» in 2012 (Klein, Sørensen, Freitas, Pedron, & Elaluf-Calderwood, 2020; Nunes & Arruda Filho, 2018), Google re-released its AR headset as an «Enterprise Edition» targeted at workers on construction sites or factory floor (Statt, 2020). Mixed-reality devices, such as Microsoft's HoloLens, are in use, for instance, by the UK's National Health System NHS to support consultants reviewing COVID-19 patients via live streaming to the remainder of the medical team (Levy et al., 2021).

– As opposed to AR, **Virtual Reality** (VR) «kidnaps» the user into a hermetically closed view of a virtual space, often in three dimensions. Despite having been in use for quite some time in computer games, virtual escape rooms and other entertainment activities, VR attracted global attention when U.S. American platform corporation Facebook renamed itself in «Meta» in late 2021, proclaiming the future rise of «Metaverse» and releasing the collaborative VR platform «Horizon Worlds» on Oculus (Heath, 2021). CEO Mark Zuckerberg's vision of providing a full-fledged parallel universe, in which users navigate between games, live concerts, social gatherings and business events with a variety of personalized avatars, may still be at its infancy (Stern, 2021), but other companies have been successfully deploying VR in numerous business applications. Already in 2014, hotel chain Marriott introduced a VR simulator called «Teleporter» to let potential hotel guests digitally immerse into places like Hawaii or London (Fisher, 2014). The industrial design studio at British premium car manufacturer McLaren use VR headsets to switch between 2D and 3D models of their digital prototypes and accelerate the design process (Ekströmer, Wever, Andersson, & Jönsson, 2019), while shifting clinical training of medical students into the virtual space makes it more cost-effective, repeatable, and standardized (Pottle, 2019). In early 2024, US company Apple launched a VR headset called Vision Pro that might increase the appeal of AR and VR gadgets beyond gaming and niche applications.

There are numerous other device-driven, disruptive digital technologies that start gaining commercial traction beyond niche markets. For example, manufacturing companies invest into robotics and cobots, smart sensors and other Internet-of-Things (IoT) applications, while grid-based infrastructure providers, such as electricity and gas utilities, but also corporations operating in offshore wind farms or exploration and production (E&P) of oil and gas start

deploying drones for unmanned inspections of their facilities (Javaid, Khan, Singh, Rab, & Suman, 2021). Beyond the short-term and medium-term horizon, quantum computing is likely to exceed the binary calculation capabilities of conventional computers and revolutionize processing power, especially in areas such as optimization, cybersecurity, and forecasting (Bova, Goldfarb, & Melko, 2021; Hidary & Hidary, 2021).

Algorithm-driven digital technologies

In contrast to device-driven digital technologies, potential applications of algorithm-driven technologies have been observed across almost all industry verticals. They range from corporate dashboards and the existing statistics and data analytics toolkit to completely new and disruptive technologies, in particular Machine Learning / Artificial Intelligence (AI), Blockchain and other Distributed Ledger Technologies (DLTs), and Robotic Process Automation (RPA). They have in common that they do not require the installation of a new hardware system but can largely rely on the existing IT infrastructure – although, of course, certain applications require a faster processing power and are typically computed on customized chips and cards.

Analogue to the previous section, it may prove helpful for a common understanding to clarify the terminology and exemplary use cases:

- **Artificial Intelligence** denotes a computational algorithm that imitates synaptic processes of a human being. Most generally, AI algorithms can be classified as either «Generative» or «Discriminative» (Gm, Gourisaria, Pandey, & Rautaray, 2020). ChatGPT by OpenAI or Llama by Meta belong to the category of Generative AI, because they create new content, for example text, images or computer code, whereas Discriminative AI typically is trained for classification and analysis of existing data. One of the most common methods of Discriminative AI is called Deep Learning, which is used, for example, for recognizing cancer cells in visual body scans like mammography (Kim et al., 2020) or detecting moving objects in autonomous driving (Muhammad, Ullah, Lloret, Ser, & Albuquerque, 2021). Random Forests are a statistical method for categorizing information, for example separating regular emails from spam, or predicting the purchasing behavior and preferences of individual customers on marketplaces such as Amazon (Al Amrani, Lazaar, & El Kadiri, 2018). AI can also be used for language recognition, in which the algorithm improves its performance incrementally by a method called Reinforcement Learning (Sharma & Kaushik, 2017). Business processes can benefit from AI all along the corporate value chain, ranging from logistics and optimization to forecasting, cybersecurity and end-user communication. Even in HR (human resource) management, AI can contribute to improve, for example, the selection

process of new employees, or develop personalized learning journeys (Tambe, Cappelli, & Yakubovich, 2019). The comparison with conventional statistical methods reveals why AI has been successful in business applications: Statistics aims at aggregating information from a large body of observations into simpler yet meaningful and interpretable indicators, for example the mean income or carbon footprint of a population, or the relationship between the percentage of vaccinated persons in a region and the respective rate of occurrences of a disease. By contrast, AI allows for a reversal of that simplification: Given the processing power of computers, predictions on certain actions can move from the abstract and statistically aggregated «customer segment» back to a differentiated prediction for each individual within the customer segment. AI can accomplish data mining at a pace and precision which is unprecedented and would require an immense human effort to be rivalled.

However, the technology comes with two important caveats: First, it requires enormous amounts of clean and well-structured data to produce meaningful results, following the classical «Garbage in – Garbage Out» problem in data processing (Lew & Schumacher Jr, 2020). Second, there is still a trade-off between its predictive power and causality. Especially in Deep Learning the algorithm's selection and decision mechanisms are not transparent, because they occur in so-called Hidden (intermediate) Layers. Methods such as Heat Maps are used to better understand the algorithm's internal «reasoning», but especially in clinical medicine and life sciences a new «interpretability gap» may occur (Ghassemi, Oakden-Rayner, & Beam, 2021).

Lastly, it is necessary to mention that anything described in this book as «Artificial Intelligence» should rather be called «Machine Learning». Marvin Minsky, one of the hosts of the famous Dartmouth Conference in 1956, which became the birthplace for the phrase «Artificial Intelligence», defined in 1970 an Artificial Intelligence as «a machine with the general intelligence of an average human being, a machine that will be able to read Shakespeare and grease a car.» (Borchers, 2006) In comparison, the wording «Machine Learning» has a more modest ambition than a computer fully imitating a human being: A Machine Learning algorithm specializes in one relatively narrow task, for example, playing Chess or Go, and learns how to excel in this task. Practically all AI applications that currently exist in the world should hence rather be called «Machine Learning.» For the sake of simplicity and convention, this book reverts to the wording of «Artificial Intelligence», even though it actually means Machine Learning.

– Originally, **Blockchain** was invented as a distributed ledger to facilitate peer-to-peer transactions in the cryptocurrency Bitcoin – without any intermediaries such as banks or financial brokers. Since then, numerous other Distributed Ledger Technologies (DLTs) and so-called «Tokens» have been developed and released in Initial Coin Offerings (ICOs). Most

importantly, DLTs like Ethereum have extended its functionality from a cryptocurrency-based financial instrument into a multi-purpose toolkit for automatically executed and recorded Decentralized Applications (DApps) and Smart Contracts, which are used in gaming, lotteries, trading and prediction markets, and many others (Mohanta, Panda, & Jena, 2018).

While Blockchain and DLTs have not (yet) revolutionized financial markets, as many market observers predicted in the first peak of Bitcoin-mania in 2015/16 (Tapscott & Tapscott, 2016), it proves particularly successful in three emerging niche markets and use cases: First, Decentralized Finance (DeFi) builds upon the initial idea of Blockchain as a means for peer-to-peer financial transactions. With the promise especially to individuals who have no access to a commercial bank account, a thriving FinTech startup ecosystem has emerged that offers services in lending and borrowing, pooling, bonds, portfolio management and investments. In 2021, the total value of DAO (Decentralized Autonomous Organizations) treasuries, which are community-owned and a democratized decision-making process in their governance structures, increased to $16 billion (Slavin & Werbach, 2022). The second Blockchain application that is worth mentioning is Non-Fungible Tokens (NFTs). These tokens assign an asset a unique NFT, which then can be used in various digital processes and transactions. One example is digital artwork, which by and large evaded the conventional art market, a unique ownership by becoming part of a public ledger, typically Ethereum, thereby creating an artificial scarcity for an easily reproducible good (Rehman, Zainab, Imran, & Bawany, 2021). Platforms such as Foundation, SuperRare or NiftyGateway act as gatekeepers and allow for auctioning and trading of the NFTs.

Beyond the strategic positioning in newly emerging niche markets, one of the reasons for the success of DeFi and NFTs can be found in the quest to empower individuals – small-scale investors, people without access to banks, or artists. They are typically run on public chains, and anyone with a crypto wallet can participate.

By contrast, the third successful application of Blockchain technology follows a different logic: If many parties interact in the handling of a complex service, a Blockchain solution may enhance transparency and efficiency in the operation. The most prominent example for this type of use case was a consortium called TradeLens, founded by global logistics corporation Maersk with the support of IT company IBM, and halted in late 2022. With the objective of «digitizing global supply chains,» TradeLens acted as an ecosystem that was supposed to connect all major stakeholders involved in the handling of goods, ranging from ocean carriers and freight forwarders to port authorities and governmental customs agencies, and as a platform to share documents and data (White, 2018). In comparison to most applications in DeFi and NFTs, it did not have its own currency or token system, and it was an exclusive «members only» club that grants

permissions to join based on a combination of an applicant's role and its data types. From its official launch in August 2018 until December 2019, the consortium already attracted more than 175 unique organizations, and by December 2022 TradeLens claimed to have processed more than 70 million containers, published 36 million documents, and tracked 3.7 billion events (TradeLens, 2022). As a reason for the discontinuation of the venture, the founders Maersk and IBM state that «unfortunately, such a level of cooperation and support has not been possible to achieve at this point in time.» (ibid.)[2] A similar consortium-based approach is pursued by German car manufacturers and OEMs in collaboration with research institutions and telecommunication companies in the Catena-X Automotive Network, founded in May 2021 (Reed, 2021). In this book, case 9 on Chargeurs describes in greater detail how Blockchain can serve as a platform for data exchange.

– The name **Robotic Process Automation** (RPA) of the last disruptive digital technology presented in this short overview may be misleading. «Robots» in the context of RPA are not mechatronic artefacts with three-dimensional extensions and certain humanoid features. Rather, the terminology is meant in a metaphorical way: RPA's robots imitate actions that humans perform working with a computer. Preferred actions that RPA robots can execute are typically repetitive tasks that humans can do in around five to twenty minutes, but which do not require sophisticated intellectual input or reasoning skills, for example processing invoices, or transfer of data from a website to a spreadsheet application or database (Kroll, Bujak, Darius, Enders, & Esser, 2016). If the task is sufficiently standardized with a fixed sequence of individual steps, RPA can deal with these routine jobs much faster and more reliably than human beings who are prone to errors. RPA software by the leading providers, such as UIPath, BluePrism or Automation Anywhere, allows users to either define and program each step in a simple flow chart, or «show» the robot the steps to take in live action and record it. Most of the RPA applications are still rule-based, but advances in RPA are being made in the integration of AI tools, for example in the integration of algorithms that are capable of recognizing letters and numbers in handwritten notes (Alberth & Mattern, 2017). As opposed to most other disruptive digital technologies presented here, technical hurdles to implement RPA in back-office processes are minimal, and investment is modest. In one of this book's best practice cases, Turkish mobile phone operator Turkcell decided to develop internally its proprietary RPA system, rather than renting the robots of a commercial supply company.

[2] In 2023, a personal conversation with the head of IT at a Spanish port authority revealed that one of the reasons for the discontinuation might have been the fact that the information on the containers and transactions was not properly maintained and updated, and hence was not 100 percent reliable.

All six digital technologies would deserve a more detailed analysis of the competitive environment, growth forecast, innovation pipeline, etc. The grey literature, especially from commercial and academic industry observers and consulting practices with an interest to sell their services to business clients, provides regular and numerous technology and market updates, though, which can readily substitute further notes and comments of the authors. Instead, the focus is on the international survey conducted as a precursor to the qualitative research of this book.

Results of the international industry survey

The aim of the survey was to explore how the above-mentioned digital technologies are used in actual businesses – in terms of the frequency of deployment, and their main purpose. In addition, the authors' intention was to identify the interviewees' expectations by ranking selected digital technologies with respect to future business importance for their areas of responsibility. The survey was complemented by similar surveys among participants of selected executive education programs conducted by ESMT lecturers in the years 2020 and 2021.

The combined size of the sample was around[3] 655 respondents, counting all valid responses. In the surveys that were conducted in late 2020 and early 2021 the authors added «Data Analytics» as a benchmark that allows for a comparison with an already established business practice. A sub-sample of around 60 respondents from international executive education trainings provided their answers. This sub-sample may not adequately represent the broader population of businesses, but might provide some orientation about the use of data analytics in a comparable setting with respondents from higher management.

The first question concerned the frequency of usage of the above-mentioned digital technologies in a respondent's area of responsibility. Respondents could choose between three categories, «Frequently», «Rarely» and «Not at all».

Figure 2 shows the results, ranked by the digital technology with the highest percentage value in the category «Frequently». Artificial Intelligence ranks first, with more than a third of all respondents using this technology frequently. Virtual Reality, Robotic Process Automation and Blockchain are frequently used by around a quarter of the respondents, Additive Manufacturing and Augmented Reality by less than 20 percent.

On aggregate across all digital technologies, 46 percent of respondents do not use the selected technologies at all, and another 30 percent use them rarely. The results imply that less than a quarter of the respondents use these technologies frequently, while almost two thirds of the sub-sample use data analytics frequently.

[3] Some questions were not answered by all respondents.

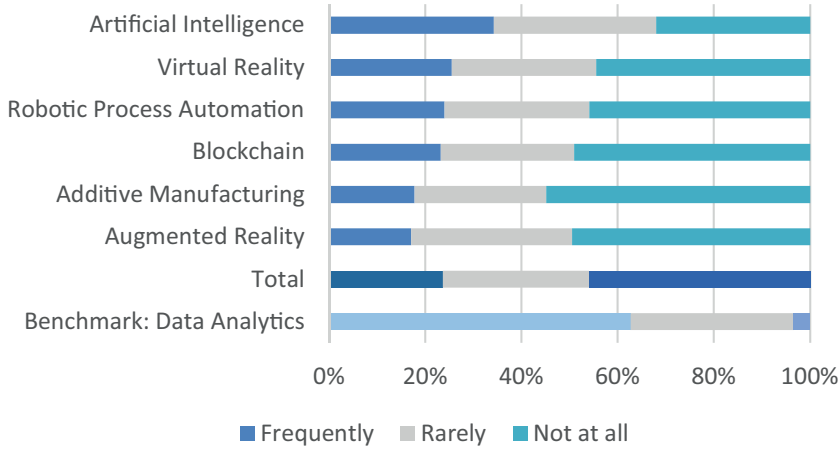

Figure 2: Frequency of use of digital technologies and data analytics.
Source: Own survey, n=655, Benchmark n=60.

The second question of the survey concerned the relevant use cases. In the next section on organizational enablers the authors will discuss use cases in greater detail, but in principle use cases can be divided into two categories: On the one hand, back-end solutions are typically introduced to achieve efficiency gains, optimize, or automate processes, and ultimately cut costs. On the other hand, digital technologies can be used to enter new markets, provide innovative products and services to B2B or B2C customers, introduce new business models that may turn into future pillars of growth for an organization, and ultimately generate additional revenues.

Hence, respondents could choose between three categories: «Process Optimization», «Revenue Generation» and «Other». On aggregate, around 43 percent of the answers were related to Process Optimization, 35 percent to Revenue Generation, and 22 percent to Other. Anecdotal evidence about the category «Other» suggests that survey respondents understand, for example, that this group was in the process of setting up data lakes, doing the groundwork of digitization.

Artificial Intelligence, Robotic Process Automation and Virtual /Augmented Reality were rather used for process optimization, whereas Blockchain and Additive Manufacturing had higher percentages in revenue generation.

On aggregate, use cases in the back office had a 10-percent margin compared to new business models with additional revenue generation. These findings suggest that a large part of the digital transformation of companies is still related to revamping the existing IT legacy systems and optimize internal processes. The comparison with data analytics showed that process optimization with almost 55 percent of the responses was the main driver for internal use cases, too.

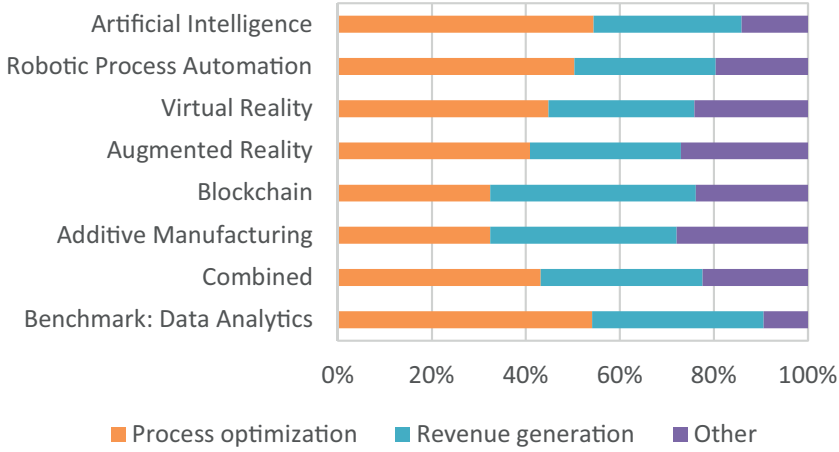

Figure 3: Use cases of digital technologies and data analytics.
Source: Own survey, n=655, Benchmark n=60.

For the third question, respondents had to rank selected digital technologies according to the future business importance for their areas of responsibility.

Aggregated across ranks 1 to 3, Artificial Intelligence was considered the most important technology with around 31 percent of the responses. Robotic Process Automation was ranked second, but with only around half the score of AI, followed closely by Additive Manufacturing, Blockchain and Augmented Reality. Virtual Reality was the least relevant digital technology with respect to future business importance.

Of course, preferences regarding the implementation of digital technologies varies across industry sectors. In a survey by PwC, a consulting practice, among around 50 operations and supply chain officers, AI scored highest among the disruptive technologies comparable to this book's survey, followed by Blockchain, Robotics/RPA and Augmented Reality adopted by 18, 16 and 14 percent of the respondents, respectively. However, the two top-scoring technologies that were applied within their supply chain operations were cloud-based data platforms as well as Internet of Things and connected devices with more than 50 percent adoption rates (Waco, 2023).

A survey of around 500 C-suite executives and senior leaders in financial services companies, conducted by consulting practice Broadridge, suggests similar preferences with respect to the digital technologies discussed in the case studies of this book: When asked about their firms' plans to increase their investments over the next two years, AI led again with an average of 21 percent increase, closely followed by Blockchain/DLTs with 20 percent. RPA was expected to experience a 14 percent increase of investments, whereas metaverse/VR and AR would see only one percent increase (Soto Sanchez, 2024).

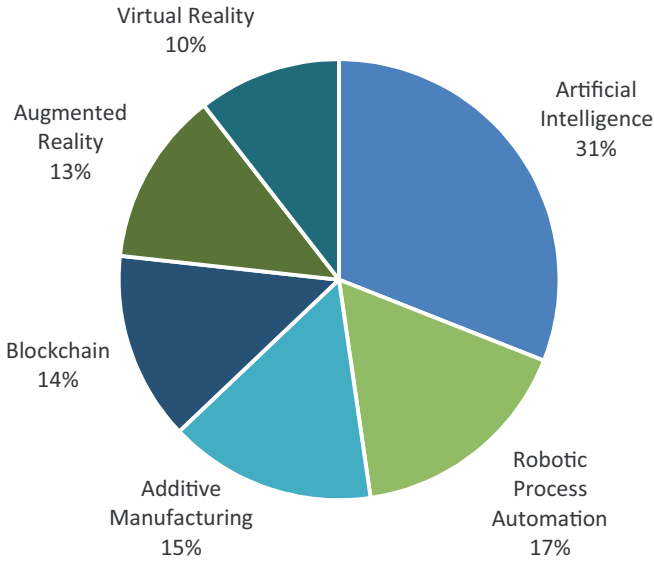

Figure 4: Future business importance of digital technologies.
Source: Own survey, n=655.

Across various industries, the survey results consistently demonstrate the significance of AI, with subsequent emphasis on the technologies of Blockchain and RPA. Triggered by OpenAI's ChatGPT in late 2022, the global momentum of Large Language Models and GenAI has most likely consolidated the leading position of AI and machine learning in the preference set of disruptive digital technologies (Writer, 2024).

The three most important findings of the quantitative analysis can be summarized as follows:

Artificial Intelligence is by far the most important digital technology in future business applications;

Robotic Process Automation and Blockchain also remain relevant across various industries, ranging from supply chain and operations to financial services;

Evidence from more than 600 upper management executives suggests that most digital technologies are primarily used for process optimization rather than revenue generation.

Organizational Enablers

Digital technologies are the essential prerequisite of digital transformation. For each of those technologies, leaders, and department heads must decide how to implement them – with external expertise, acquisitions and joint ventures, internal training of the existing workforce, or via consortia, platforms and industry collaborations.

Who should take over these tasks? Is it the IT department, or the personal responsibility of the Chief Information Officer of a company? Should it be the newly appointed Chief Digital Officer since many companies are establishing this role in the C-suite? Is the top-down approach sufficient to change the corporate culture of a company? Or should the deployment of digital technologies be initiated as a grassroots movement, mushrooming all over the departments according to the actual needs of a team?

Many non-«digital native» corporations struggle to master the digital transformation of their organizations. They depend on legacy IT systems, which often cannot be easily replaced by up-to-date software due to company-specific customization and cannot be transferred easily to any new software or platform due to interrupting continuous operations. Data is compartmentalized, incompatible with other internal databases because of differing interfaces and programming tools, without any stakeholders or experts from other departments having access or even information about its existence.

In some cases, only very few internal IT specialists can curate and oversee the complexity of the software, the so-called «Last Man/Woman Standing» phenomenon. In other cases, the lock-in of being the last customer on an expiring solution with an external service provider induces a dependency and correspondingly high costs. Information is messy, that means, labelling and tagging are inconsistent over time and, for example, geographical regions, which implies that humans can decipher patterns within a dataset, but machine algorithms would not be able to use the inputs efficiently, the so-called «garbage in – garbage out» phenomenon, which was already mentioned in the introductory notes on Artificial Intelligence.

Under these conditions, digital transformation becomes a threat rather than an opportunity. Korotov and Sack (2019) call this «Digital Anxiety.» Executives hesitate to tackle the challenge, but they are aware that their future competitive advantage will depend on the intelligent use of data. Ultimately, corporate survival hinges upon a successful digitalization of their businesses.

A matrix of models for organizational implementation

But how can this transformation be implemented from an organizational point of view? Which resources should companies deploy? Should they team up with external consultants to accelerate the adoption process, hire IT experts or

students, or build up and rely on their internal expertise as a source of longer-term competitive differentiation?

The following framework sketches four alternative pathways that companies can choose. In its dimensions, it is based on Christoph Räthke's Corporate Entrepreneurship Matrix (Burger, Räthke, Schmitz, & Weinmann, 2021). In this conceptual framework, the vertical axis depicts whether a digital innovation project solely relies on internal resources, such as the IT or the R&D department or integrates capabilities from outside the organization. By contrast, the horizontal axis differentiates according to novelty regarding the existing skillset of the firm. Starting on the left side, the degree of innovativeness is low and close to existing use cases – only with a digital twist. Often, these digitalization projects are launched to increase process efficiency and cut costs in the back office. Moving further to the right, the degree of disruption increases: New business models and use cases may lead to yet undiscovered digital pillars of future growth, but they face the trade-off of high uncertainty about their chances of success, the necessity of transformational leadership, with a mind-shift towards experimentation, a culture of psychological safety to accept failures, and – more generally – a learning organization that is willing to depart from existing paradigms.

Prototypical examples for each of the four quadrants will be explained in the following sections.

Model I: Nucleus

The top-left quadrant shows the nucleus model, coming closest to the conventional understanding of the IT department's role in facilitating the introduction of a new software solution or digital technology. Triggered bottom-up by business units or middle management, a local pain point is identified that can be resolved by deploying a digitally enhanced solution. Sometimes internal domain experts and IT representatives collaborate in dedicated teams to find appropriate technologies, in other cases the business unit hires students or postdocs from universities, IT specialists or engineers from the job market, always with the objective of replacing a locally established system with a more efficient solution.

For example, the procurement department of energy midstream company Uniper, headquartered in the German city of Düsseldorf with a workforce of around 12,000 employees, established a Center of Excellence (CoE) to promote using RPA in 2016, which corresponds to the nucleus in the terminology of the matrix in Figure 5. Even though the procurement department initiated the process, the CoE started operating as a «federated model» with «a group of business areas, called 'pioneers', namely, from procurement, accounting and back office operations.» (Seaton, 2019) In addition, Uniper standardized processes, for example an

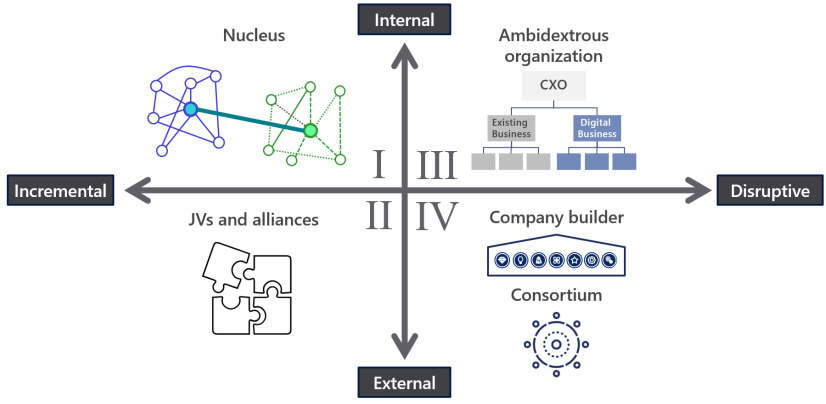

Figure 5: Four models of organizational implementation in the Corporate Entrepreneurship Matrix.
Source: Adapted from Räthke et al. (2021).

assessment for business teams how to identify the most suitable candidates for future automation. The Center of Excellence did not only coordinate the implementation of the robots, but it also took an active role in propagating the technology across departmental units and silos. Until 2019, it provided in-house RPA trainings for around 180 Uniper employees (ibid.). One of the lessons learned in the Uniper RPA rollout, though, was the continued importance of the IT department as an internal key partner in charge of security, support, and infrastructure.

In the book, best practice cases (1) to (4) provide individual narratives how data analytics, RPA and AI were implemented following the rationale of the nucleus model.

Model II: JVs and alliances

Setting up an internal unit like Uniper's Center of Excellence may lead to a trickle-down effect and fundamental cultural changes of the existing workforce. However, if a company does not perceive the need for a specific in-house expertise, because it may not be considered part of the desired, strategically defined core competencies, and a solution must be found quickly – then the bottom-left quadrant of the matrix with Model II «JVs and alliances» applies. External partners can be established players in the market with complementary resources and capabilities, such as IBM for Maersk in setting up the TradeLens platform, but also DeepTech startups concentrating on niche applications that are of value to larger companies.

These collaborations can materialize as projects with clearly defined objectives, milestones, and deliverables, with a start, an ending date and a piecewise

transfer of knowledge and technological training from the startup to the contractor. But they might also be implemented as a solution with continuous renewal of the business relation, for example via monthly or annual subscription fees, or an output-based or pay-per-use model.

For example, Swiss-based startup ITficient offers its expertise to create digital twins of physical components as well as predictive maintenance services to companies such as sensor manufacturer Phoenix Contact, Kaeser Kompressoren, one of the world's leading manufacturers and providers of compressed air products and services, or Austrian electricity utility Verbund. In the case of Verbund, ITficient developed a digital twin of the Rabenstein hydropower plant in the Austrian province of Styria: «All data is managed, analyzed and visualized by ITficient. A dashboard provides a complete overview of Rabenstein turbine in real time, including the data from sensors and virtual sensors as well as the remaining service life.» (Gebhardt & Alberts, 2019) For Verbund as a utility, the strategic objective was not only the reduction of downtimes due to predictive maintenance, but also the real-time optimization of plant utilization in balance with intermittent renewable energies, such as wind or solar power (ibid.).

Best practice case (6) of machine-translation services startup Lengoo describes the benefits of these partnerships from the perspective of the startup, whereas case (7) contains a dialogue of representatives of both partners, Allianz as an incumbent and Peregrine Technologies as the startup.

Model III: Ambidextrous organization

The third quadrant depicts a prototypical solution to how an organization can organize disruptive innovations internally. Building on prior works by March (1991), American scholars Tushman and O'Reilly introduced the concept of the ambidextrous organization in their seminal article in the California Management Review (1996). In their definition, organizational ambidexterity is the capability of a firm to simultaneously «explore», that is, finding new pillars of growth, and «exploit», which means securing revenue streams of the existing business lines. Based on a sample of 35 firms, they identified ambidextrous organizations as the most successful innovators, «where the breakthrough efforts were organized as structurally independent units, each having its own processes, structures, and cultures but integrated into the existing senior management hierarchy.» (O'Reilly & Tushman, 2004) In practical terms, this implies that the organizational setup to implement disruptive digital business models should separate between «explore» and «exploit» business units, so that the existing corporate processes, structures, and cultures do not «contaminate» the new organization. However, the support of top management ensures that the «explore» businesses have access to existing resources, such as «cash, talent, expertise, customers, and so on» (ibid.).

The idea of the ambidextrous organization came into existence before the current wave of digital transformation hit corporations. For disruptive digital business models, though, the hypothesis of two functionally and culturally separated entities for exploration and exploitation business lines seems even more relevant, because digital business models may require different skillsets than traditional operations. Moreover, the gap between the existing workforce and a new generation of «Digital Natives» may require a cultural split to become attractive for young talents.

One recent example illustrates how organizations can successfully implement ambidexterity in their day-to-day practice: Klöckner & Co is a producer-independent steel and metal trading company, present in more than ten countries with a six-digit customer base. Founded in 1906 in the city of Duisburg, right in the center of the West German Ruhr area with industrial heavy-weights such as ThyssenKrupp and a long tradition of coalmining. In 2014, the company's CEO decided to launch a steel-trading platform – in a first step for its own customers, but with the idea of evolving into the leading European marketplace. Instead of establishing the new digital unit on their compounds in Duisburg, the CEO Gisbert Rühl opts for the emerging startup hub Berlin: «The digital hub was envisaged to be 'far enough from Klöckner to act independently, yet close enough to leverage expertise as well as access to customers and suppliers'.» (Korotov & Sack, 2019, p. 5) The new subsidiary was called kloeckner.i and became a major success story for the company, with around 140 employees at the end of 2022 (kloeckner.i, 2022).

In the book, Brazilian business school Saint Paul chose the path of an ambidextrous organization when implementing its AI functionality, as well as the Schweizer Kantonalbank with its Innofactory. The two corporate narratives can be found in case studies 5 and 10, respectively.

Model IV: Company builder / Consortium

In the global village surrounded by a flat world, innovation has moved from hermetic, secretive R&D departments to Hackathons, Open Innovation platforms, crowdfunding, and crowdsourcing. Accelerators accommodate entrepreneurs and equip them with the skills and a network of mentors to let their visions materialize, makers experiment with digital technologies in fab labs and co-working spaces. Tapping into the larger innovation ecosystem and its workforce has never been easier than today, especially in hip and cosmopolitan hubs like London, New York, Shanghai or Bangalore.

In those locations, organizations can establish company builders or accelerators that attract millennials and founders, data experts, geeks, and nerds. One example for this strategy is German Hidden Champion Viessmann, a family-owned manufacturer of boilers for heating systems with a workforce of around 12,000 employees. Its headquarters are in a small town in rural

Western Germany, far away from any urban agglomeration. Max Viessmann, the 30-something family heir and CEO, realized that his company had to move towards Smart Home and digital solutions. In Berlin, he set up a company builder called WattX, a joint workshop for other high-end manufacturing companies called Maschinenraum (Schlenk, 2016), in addition to two Venture Capital funds, one of which is located in Munich, the capital of the Southern state of Bavaria .

Another path to digital disruption is via consortia. Many Blockchain applications follow the dynamics of platform economics, with the «winner-takes-it-all» tendencies. Setting up an independent Blockchain platform as a stand-alone product may suffer from a lack of traffic and lengthy financial investments before any reasonable financial returns arrive, whereas participation in an existing network with a proven IT solution and sufficient traction may be a less risky alternative for many companies. However, complex governance mechanisms of a multi-party platform may prevent rapid implementation, as best practice case (8) on Uniper's permissioned Blockchain solution reports.

In the previous section on Technological Enablers, TradeLens and the Catena-X Automotive Network have served as introductory examples. They will be complemented in the subsequent case studies by best practice case (9), which provides in-depth insights into how Hidden Champion Chargeurs established a Blockchain platform for luxury materials.

Scope of the book

The overarching objective of this book is to provide a hands-on toolkit for executives to leverage digital innovations amidst a societal and economic context of volatility, uncertainty, complexity and ambiguity – the so-called VUCA world (Taskan, Junça-Silva, & Caetano, 2022). Digital transformation is a highly dynamic process, which got even further accelerated by COVID-19 and the global lockdowns during the first waves of the Pandemic, forcing companies as well as individuals to switch to digital solutions much faster than previously anticipated. Suddenly, human interaction in many parts of the world was reduced to communicating in minuscule tiles with peers, colleagues and friends, hardly being able to decipher mimics and gestures. Documents and spreadsheets eventually started to get shared via cloud solutions, and companies had to adapt to a remote, dispersed and digitalized style of co-working.

This extrinsic shock proved to be highly disruptive. However, many organizational changes were reversed at the end of the Pandemic, with even the tech companies, such as Zoom, encouraging their workforce to at least partially return to their offices (Mahdawi, 2023). Organizational setups prove to be more resilient than anticipated during the lockdowns.

Digital innovations face a similar challenge of resistance to change. Often, they originate from intrapreneurs, rebels and «Pirates in the Navy»

(Viki & Pohl, 2022), leading to clusters and pockets of excellence, but small improvements in the larger scheme. The cover image of this book depicts that motive.[4]

The major intention of this book is to capture the qualitative insights of successfully implementing disruptive digital technologies in day-to-day practices. The subsequent case studies serve for leaders and executives as a source of inspirational input how to embark on a digital transformation journey in their respective business units or teams. They contain qualitative interviews with corporate executives, entrepreneurs and academics who were willing to share their experiences with the authors of this book, and were recorded, transcribed and edited for publication.

The authors have chosen the format of individual storytelling rather than quantitative analysis for the best-practice cases, because they can represent the complexities of implementing disruptive technologies in an organization – in a way that managers can learn most from the experience. In particular, stakeholder management and innovation narratives are more difficult to be captured by figures and numbers but require a subtle understanding of the corporate context, as well as the human need for stories (Shiller, 2019).

Of course, this book's insights do not take all failed innovation initiatives into account. Rather, they are characterized by a positive selection bias (Collier & Mahoney, 1996), because they only depict successful examples of change. However, they entail important insights into the practical logic how change initiatives may succeed, and therefore have important managerial implications.

Digital transformation encompasses multiple dimensions, and many taxonomies for consistent categorizations have been introduced in scholarly literature. In this book, the selection of questions closely follows the theoretical framework of Bumann and Peter (2019), which is based on a meta-analysis of digital transformation frameworks and not only focuses on technologies, but also on organizational aspects, such as culture, strategy, the employees' willingness to change, and the role of customers as active drivers of the transformation. The concept will be presented in greater detail at the beginning of Part 3.

It would be beyond the scope of this volume to cover all algorithm-based and device-based digital technologies that were presented in the section on technological enablers. In order to identify the most important technologies that drive digital transformation, the authors used the survey results and selected

[4] It is a visualization of changes of a given, complex geometrical structure morphing incrementally into a novel pattern, based on Nobel Laureate Sir Roger Penrose's seminal tiles (Penrose, 1974). The pattern was published by Welberry (2019) in the scientific context of quasicrystals and modifies two sets of ν_i, ϕ_i parameters with an incremental deformation pattern. The color-coding of the illustrator's interpretation is intended to suggest that some change initiatives fail, while others are carried further and become engrained in the corporate structure of organizations.

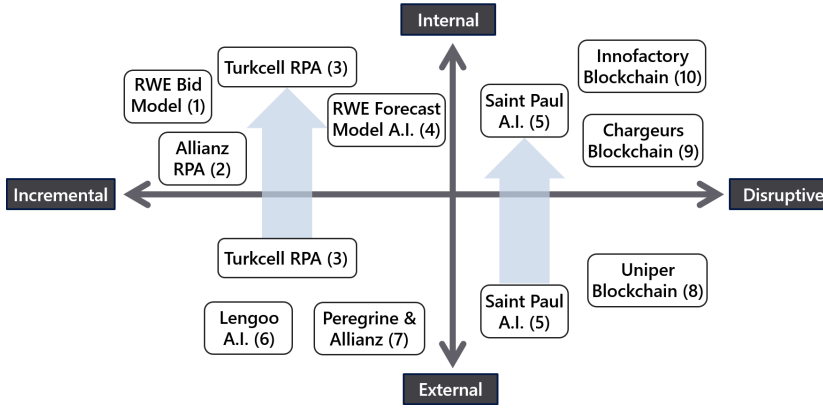

Figure 6: Positioning of case studies within the Corporate Entrepreneurship Matrix.
Source: Adapted from Räthke et al. (2021).

the interviews for this book based on the shortlist of the most relevant sector-indifferent technologies. These are – in order of hurdles of implementation – Robotic Process Automation, Artificial Intelligence, and Blockchain. Figure 6 provides a positioning of the respective case studies within the Corporate Entrepreneurship Matrix.

For the following four chapters of Part 2, the authors suggest moving gradually from the first quadrant of the matrix, with case studies (1), (2), (3) and (4) on the *nucleus* type of organizational dissemination to case studies (5), (6) and (7), which depict joint ventures and Saint Paul's case on an ambidextrous organization, whereas cases (8), (9) and (10) exemplify attempts to initiate more disruptive transformations.

Part 3 of the book distills the main findings from the interviews and corporate narratives. For readers with a limited amount of time, the authors suggest concentrating on the narratives of the best practice cases that are most relevant to them at the beginning of chapter 6, and then jumping directly into the analysis of future developments at the end of Part 3.

PART 2

Case Studies

CHAPTER 2

Data Analytics

1) RWE bid estimation model: Optimizing auction behavior

Dominik Felske, RWE

RWE is a German energy company active in electricity generation, building storage systems and energy trading. After the reallocation of its asset base with former competitor E.ON, the company specializes in generation. Its renewables business is expanding massively and is adapting to meet the new challenges that emerge within the existing, fossil fuel-based business.

This case demonstrates how to implement disruptive digital technologies without setting up an ambidextrous organization, but rather integrating it into the existing organizational context.

Background: We wanted a technology that could help us predict the results of wind and solar auctions

The technology we have is a bid estimation model, which helps us predict the results of wind and solar auctions. These can be governmental auctions, Power Purchase Agreements with direct consumers, or big off-takers of renewable energies who are auctioning long-term contracts in whatever area.

RWE used to be in a regulated business that was supported by the government with very few commercial risks. These fixed support levels were removed when deregulation started in 2010, not only in Germany, but in various European countries. After that the auctions took place on a large scale and the levelized costs of energy (LCOE) went rapidly down. To estimate these cost reductions, a company's internal perspective was not enough. What we needed was the market perspective. In order to turn this external knowledge into a structured and transparent system for our organization, we developed this tool.

How to cite this book chapter:
Burger, C. and Weinmann, J. 2024. *Leveraging Digital Innovation: Lessons for Implementation.* Pp. 29–32. London: Ubiquity Press. DOI: https://doi.org/10.5334/bda.b.

We use algorithms, but basically, it is a multi-regression model. Its estimates depend on previous auction results and the expected bid level for the next auction. Based on this our model evaluates the structural differences.

We started with a student project

We used one of the student projects of ESMT to kick-start this initiative and build up our database. We had five MBA students working on the topic for six to eight weeks. We employed them for conceptualization, but also to build up a first, excel-based model.

As with almost all algorithms, the database and the data quality is one of the main drivers and success factors of having a reliable tool and a functioning algorithm. Therefore, we hired external experts in our next step and brought them together with our commercial and IT people to develop and calibrate the tool and turn it into a format which allows people to comfortably use it. It's now part of our commercial analysis unit, which supports our board members to take solid commercial decisions. It is independent of the business units that bring the projects to the investment gate and start the stage gate process.

Later we went from excel to a proper database. At the moment, we are using different sources from global market analysis providers such as Bloomberg New Energy Finance and IHS Markit, who help us to get access to global auction databases. However, these are not always reliable. We have to tweak these data, before they go into our regression model.

The tweaking is done by a commercial analyst in my team. He checks the data quality, tests if there are outliers and helps with calibration. He does this needs-based, but at least once a month. However, since the number of global auctions increases, more and more data come in and our model gets more robust. So even if you check the data only once a month or every six weeks, you still receive robust results.

Convincing our stakeholders is a challenge

Our tool is in place and established within our organization – the latter was maybe the biggest challenge. To achieve data quality and robust results was not easy, but it was nothing compared to getting stakeholder acceptance. It took us months, before stakeholders started to trust our model.

To understand their attitude, you have to know where our business is coming from. We used to develop projects in order to maximize the output of an asset or project and ignored our external market. Therefore, our estimation model and its technology were something totally new and unusual.

However, we went with our stakeholders through all details of the model and were absolutely transparent. We explained how the regression model worked and discussed the results it produced. We made it clear that we did not have an algorithm providing us with perfect results, but would rather offer the basis

for a structured discussion and a sound comparison of auction results across global markets and technologies. We described how my team was going to interpret these results and deliver a value added.

In part, our stakeholders' questions helped to fine-tune our model. Plus, we learned from the auctions. It is a permanent updating and learning process, not only as far as the algorithm is concerned, but also how we interpret the results.

In practice, we have learning sessions after every auction and check if we predicted the bid range within the probability curve we have. This is usually followed by a discussion. Do we have to calibrate? Should we take some data out? Was it an auction where we could use our tool? Were there special effects, which made this tool in hindsight less useful. These could be regulatory changes in the auction that limited the comparability with the previous auctions. Afterwards we send a report to the board, describe the outcome of the auction and what we predicted. We explain what we have learned with regard to the next auctions.

By now we have been able to increase the acceptance of our model in our organization. People understand that we are actually enablers and support them in order to receive vital market signals. Based on our target pricing process we can give them a target price so that they can adjust their project design and be sure that the project they develop is actually marketable.

Our model turns into a support for our investment decisions

The application is a global database containing auction results. We document the bid prices and the patterns of an auctions. This includes the auction design, the size of the auction, the auction basket, the length of the contract, the commercial risks, plus the things that are not a direct part of the auction – i.e., whether it is a technology-specific or technology-neutral auction. In short, we collect and try to control a large number of factors in order to receive comparable bid results. This turns our technology into a major element of our investment decision process. And we are talking about investments from single-digit millions to single-digit billions, depending on the project, technology, and country, where our tool helps us to determine the bid level and then take the investment decision.

As our business is going more global, the complexity of our market increases. Consequently, we have to consider the structural differences of various markets. However, there is no other technology or tool in place offering a consistent view on different markets.

Boards want to invest their funds profitably into the most promising projects. They need an independent view on where the money should best go. We are a capital-intensive business and investment decisions always carry risk and the outcome is uncertain. With the help of our tool, we at least can offer an independent view, no matter if the project in question is located in South America, the U.S., Germany, or elsewhere.

In addition, we have by now developed a forecasting combination model. This is a sophisticated tool – a self-learning Artificial Intelligence – with which

we can discover patterns that help us to adjust our forecasts accordingly (see also Dominik Felske's contribution on the RWE Forecast Combination Model).

As you can see, our organization is getting used to sophisticated algorithms, and this is a plus.

It is still difficult to exactly measure the benefit for the organization

We can perhaps quantify the monetary results on the base of a single project. In order to win a bid, you want to bid the highest amount you can afford.

The value added is everything between our net present value and what we can gain in the market. We have used the tool in roughly 20 investment processes and made additional gains based on our tool. In a significant number of cases this meant a decision to not proceed with the bid. However, quantification is difficult.

We introduced our model 2016. Some projects are now basically going online, so there's still some kind of time to go when we see if it really turned out.

The interview was conducted in March 2020.

Dominik Felske
Head of Commercial Asset Optimization Renewables,
RWE Supply & Trading

Dominik has more than ten years of experience in management consulting and as executive within the energy sector with focus on renewables and commercial topics, and multi-stakeholder management.

Before he took over his current position in June 2022, he was Head of Commercial Optimization CE & APAC and Head of Commercial Analysis at RWE Renewables, working at the forefront of the energy transition by commercializing new and existing renewable energy projects across many geographies. Until 2019, Dominik was heading the Commercial Analysis at E.ON Climate & Renewables and responsible for the Carve-Out of the renewables business unit in the context of E.ON/RWE transaction.

Before joining the renewable business in 2016, Dominik did his MBA at the European School of Management & Technology (ESMT) with a focus on innovation and sustainability in Berlin.

Furthermore, Dominik has worked as management consultant at E.ON Inhouse Consulting focusing on business development and performance improvement and as economist in the energy department at the German cartel office. Dominik holds a Bachelor's & Master's degree in Economics from University of Mannheim & Cologne.

CHAPTER 3

Robotic Process Automation (RPA)

2) Allianz: Managing the lifecycle of RPA

Stefan Weih, Allianz Partners

Allianz is a DAX-listed insurance and service company. Allianz Partners is part of this group and defines itself as global experts in assistance, health, travel and automotive solutions offered around the world through the commercial brands: Allianz Assistance, Allianz Care, Allianz Automotive, and Allianz Travel. The Organizational Improvement and RPA teams are part of Allianz Partners with the mission to promote performance excellence by developing and implementing productivity, cycle-time, and quality enhancing process automation solutions. The interview partner is in charge of the global team responsible for the introduction and the roll-out of smart automation technologies.

While RPA is the least disruptive technology discussed in this book, this case outlines a best-practice approach of the implementation process using internal expertise.

Background: How we started

We began our RPA journey around four years ago. It was the starting point for new automation technologies other than beefing up and improving the core systems that we have as part of our overall IT landscape. The main reason for the need for this new, or any new technology, was to complement the classic automation as we are in a phase of transforming towards a new IT world and to accelerate change. Adjusting a core legacy system that is 20 plus years old is costly, time consuming, and mostly, you are even lacking the development resources. The backlog actually piled up rather than getting smaller. In addition, the business world is transforming, and we need to keep up with young,

How to cite this book chapter:
Burger, C. and Weinmann, J. 2024. *Leveraging Digital Innovation: Lessons for Implementation.* Pp. 33–40. London: Ubiquity Press. DOI: https://doi.org/10.5334/bda.c.

leaner competitors that do not have the challenges of a large grown group. RPA, by its nature, and being independent of the underlying systems, delivered what we were looking for. It was quite handy and fast to deploy. We also use it as a bridging technology to new systems. It bridges between the new target solution and the legacy systems; not only for pure data migration, but also to maintain the process in the time of transition.

We were among the first movers in our insurance group and in a way we were lucky to pick the right approach to create the operational impact that we were looking for and a new mindset, which is also required these days.

Implementing RPA: The three step approach

Right from the beginning, we were confident that this is a technology to stay. We did not want to rely on external resources. While we relied on external consultants in the beginning to speed up our learning and to leverage experiences from other industries, we aimed for transferring knowledge and training people on automating applications. Luckily, or you might say due to the character of this technology, within an intense one to two-week training, you achieve a lot if you have the right skilled people that you feed into such a training program.

We started with a brainstorming and a small pilot, a very easy case, to obtain the buy-in of the local units. We achieved the proof of concept and with it the proof that it is working and delivers benefits to local business. Then we had the two other components. We had the training so that right after the pilot the local team did not rely on some remote central team to help continue the journey, which often is a reason for failure of innovation projects. As a last piece during the implementation of that first use case, we already had created a prioritized pipeline of potential new applications with the local experts. Thus, the business, right after the pilot, was ready and knew exactly what to do next.

From single applications to a portfolio of bots

We started with projects that promised an early win. Let me give you two examples. One is that our customers send us requests via email. What happened in the past is that a human colleague had to go into the email program, read it out, and key it manually into the system, or maybe even writing back. Now, we automated that part of the process for any standard templates that we received. We used the RPA bot as a kind of distribution mechanism for incoming emails. Another example is to support the automation of part of the processes such as invoice checking. While in some countries this is already a fully automated process, in others, it was still largely manual. Here also the technology helped us to bridge local proprietary solution with the core

system on checking between what the invoice actually told us to pay, and what we had calculated, and finally, based on some matching, approve it and directly automate it.

Right at the end of the pilot, local management was very impressed of what you can achieve within only two or three weeks. Some of our countries really surprised us by growing their portfolio within one year from zero to 30 plus bots that delivered a sustainable business impact. Marketing by itself, therefore, was not so necessary. It was a kind of a wildfire spreading by itself. There were only very few which, for other reasons, have been reluctant to do it.

Within four years, we grew our fleet from zero RPA bots to a nice midsize three-digit number of bots.

Managing over the lifecycle

Concerning the organization, we relied for the pilots and the roll out on external resources to speed up the whole process. Right after the pilots, it became less and less. At the same time, we established a central competence center, which for some core application was in charge of the RPA bots used across a wider range of business units/countries, and which could help the more remote business units with expertise on certain use cases. Building up this community of now more than 80 developers around the globe in that space was very interesting to see because we were actively managing the community. In the beginning, and now it's kind of running itself because they reach out to each other asking for help.

We built up the developer pool largely internally. We met very mixed experience around the globe. In the beginning, we started with high skill internal people. They were really a great advantage. In Brazil for example, a former teammate wanted to involve himself personally. He took the opportunity, became a developer, and accelerated the journey significantly, as he knew the business processes by heart from his own experience. Thus, the documentation of the process and its feasibility for an RPA technology was done by one person.

Today, we are in a quite mature stage. Mature in terms of organizational size and expertise that is using this technology, but also in terms of further potential to harvest this technology. Due to the prioritization principle you maximize business impact right from the beginning. As you grow, you come to the smaller and smaller fish where you then have to decide on a case level. Is it really still worth? Is the maintenance effort bigger than the business benefit of automating that piece? Not every country in our global organization is at the same level though, but overall it matured.

Yet, while the transformation on the core system side is continuing, we might still see RPA as a technology to bridge systems. Some applications might be replaced, others added.

The interview was conducted in May 2021.

Dr. Stefan Weih
Head of Smart Automation Program and Advanced Data Solutions, Allianz Partners

As Head of the Smart Automation Program, Stefan was responsible for accelerating the digital transformation in Operations through the global rollout of smart automation technologies (incl. Robotics Process Automation, Chat/ Voice Bot, Claims portal, web app & Process Mining) across all lines of business (Travel Insurance, Roadside & Medical Assistance, Health, Automotive). He had end-to-end responsibility for defining and implementing digital roadmap with Group-internal and external development/ R&D partners and was Allianz Group-wide global product owner for Process Mining.

In his current position, he turns his previous role into line function, expanding the scope for Business Intelligence, Global Data Platform(s), and Global Telephony (comprehending conversational AI to truly omni-channel platform).

Before joining Allianz Partners more than 5 years ago, Stefan served as a Business Manager at German insurance group Allianz.

He received his PhD (Dr. rer. pol.) in Strategic Management from the university FAU Erlangen-Nürnberg.

3) Turkcell: Insourcing RPA as digital competence

Yeliz Gülmüş, Turkcell

Turkcell is a telecommunication and technology services provider, founded and headquartered in Turkey. It serves its customers with voice, data, TV and value-added consumer and enterprise services on mobile and fixed networks.

This case shows how executives can move from using external consultants for the initial implementation to an internal, proprietary and IT department-based solution provider.

Background: Starting RPA development

At Turkcell, we have two major projects. The first one is the digital transformation of our company and the second one is called Dynamics. Both projects have a common purpose, i.e., to digitalize our processes, simplify them, and structure our departments with the aim to increase our earnings. That's why we turned to RPA.

The search for our RPA technology took us more than one and a half years. We started with examining the tools available and worked with EY, the consulting company, to select what we needed and eventually implemented RPA.

In the beginning, our ICT teams used a trial version of UiPath. The team members taught themselves how to use UiPath and automatize their processes. In addition, we had people in Network Technologies who knew how to write Python and/or Selenium. Beyond that we had no RPA teams.

Where we use RPA

We have different scenarios: Our Finance Department will use RPA when dealing with banking, Supply Chain Management for trading issues, HR when entering CVs or to automatize their ERP (Enterprise Resource Planning), Network Technologies for change management, IT for their alarm mechanisms, which are huge operations.

By the end of 2020, we planned to have automatized more than 100 processes. This means that we will save more than 10,000 person hours per month.

Take the Finance Department. There people spend a lot of time manually entering data and sending them to banks. Automatizing these processes will make us much more effective. Also, the number of operational mistakes will be reduced. Overall, we want people to work on strategic questions rather than invest time in operations.

However, we are still new in this field. We are learning, extending our infrastructure, trying to encourage people to use robots and manage them effectively. Right now our main target is to make the whole infrastructure work

smoothly and create an internal RPA culture. After that we will concentrate on cost-saving opportunities.

By now we have developed our own RPA software

For the implementation process we used internal and external resources, including support from EY. At that time, we still needed to discover our roles and responsibilities. What should we do to construct the necessary infrastructure? How should we train our employees in order to expand RPA and how would we benefit from this technology? So we created a small organizational development team with people from different departments – from IT, Board of Directors' office, HR, Network Technologies – plus the external EY consultant. Our next step will be to hire a number of RPA developers.

In the end we were able to create our own RPA software called Ghost, which Turkcell Global Bilgi developed. We still need to expand its features, but in the future Ghost may be one of the RPA tools globally available. Right now we are teaching Ghost to our people who already know UiPath, Automation Anywhere, etc. They adopt very fast to Ghost.

In addition, we proceed to develop scenarios for Ghost, discuss new features with Global Bilgi, who will then add these features to Ghost and continuously improve it. It is a co-creation process.

So far Ghost has some AI features, such as image processing, but we still need to extend them by adding more advanced tools and web services. For example, we already have OCR (Optical Character Recognition), but the situation could be better.

We know that UiPath and Blue Prism are working with additional features, which are AI-based in order to decipher a text but also to move more flexibly across web pages that change their design, so that the robot is not lost when there's a design change but automatically finds the right field by itself.

We still have some problems when web pages are changing and our robots register errors, but we plan to overcome them with image processing.

From the organizational development team to our center of excellence

Our organizational development team now works with each department in order to select process experts. These experts are familiar with RPA and know the needs of their department. Combining these two aspects, they decide which scenarios should be developed for RPA. Then we at the center of excellence of our AI team will start the development.

As I mentioned above, we have two big projects in Turkcell. The first one is the company's digital transformation process, the second one is called Dynamics. The office of our Board of Directors manages Dynamics, of which the RPA project is one part.

To introduce RPA internally, we went to each department manager, explained RPA and described how their department would benefit from it, presented the advantages and disadvantages. We also use our internal communication channels to send infographics to all employees in order to familiarize them with RPA and increase their knowledge about this tool.

RPA champions and the challenges of governance

For now, we have 42 robots and 32 developer scenarios. We are still working on the infrastructure, because it is vital to have robot users establish their own virtual machines and manage them. Moreover, we (i.e., the Center of Excellence) determine «RPA champions» and train them so that they introduce RPA in their departments. Right now we have more than 30 RPA champions in five departments, namely Finance, Supply Chain Management, HR, and Network Technology.

In addition, we are working on RPA governance, as people in ICT and Network Technologies want to develop their own scenarios using Ghost. There we may face difficulties as they will prioritize their scenarios and develop their own robots. However, we have established control mechanisms in order to evaluate their plans by asking is it really worth to spend efforts on a scenario? As a center of excellence team, we need to successfully deal with all Ghost-related issues.

Practically, we have two options. One is that the RPA champions name the specific process they want to automatize and we develop the scenario. The second option means that the RPA champion, who already knows how to use UiPath etc., learns how to use Ghost. Then their department can try to develop their scenarios by themselves. Sometimes it is difficult to manage people, in particular, when you cannot monitor them. That's the way it is when you have individual processes which have been initiated in a decentralized way.

Some people say RPA is just a tool to preserve legacy IT systems and that it may be more efficient to have one unified software that combines different functionalities rather than, say, two legacy softwares and a robot in between that transfers data from one to another.

We, too, are aware of these difficulties, but we are still learning. And learning means to improve and solve problems, but also to sometimes make mistakes. For example, we spent almost one week to develop one scenario and then found out that the platform in question will change at the end of this year. So all our efforts could be trashed.

The future of RPA in our company

Currently we are working on the infrastructure and improve Ghost by continuously adding new features. We have established a community platform where

our RPA champions communicate with each other, ask questions and receive answers. In addition, we continue to encourage people to learn RPA and implement Ghost in their department.

Furthermore, we work with our Turkcell Academy and design RPA training programs. So far we already have an online training program. The subjects include the basics of RPA, digital transformation, its advantages and disadvantages. There are also videos on how to use Ghost. And, of course, we support our RPA champions, because we know that they will drive RPA adoption within our organization.

In the long run, we believe that we will be able to compete with professional providers such as Blue Prism and UiPath. If we need a specific feature, we contact our technical team. They analyze the feature in question and quickly develop it. At the moment UiPath has some features that are better than Ghost, but in the future Ghost will compete with all tools that are currently on the market.

The interview was conducted in March 2020.

Yeliz Gülmüş
Master Expert AI Technical Product Manager, Turkcell

As a resident of Istanbul, Yeliz has been with Turkcell for more than 8 years. Before her current position, she was Senior Artificial Intelligence Technical Product Manager and Learning Solutions Specialist in the company.

She holds a Bachelor's degree in Computer Education and Instructional Technology of Orta Doğu Teknik Üniversitesi / Middle East Technical University.

CHAPTER 4

Artificial Intelligence (AI)

4) RWE Forecast Combination Model: A model to predict renewables

Dominik Felske, RWE

RWE is a German energy company active in electricity generation, building storage systems and energy trading. After the reallocation of its asset base with former competitor E.ON, the company specializes in generation. Its renewables business is expanding massively and is adapting to meet the new challenges that emerge within the existing, fossil fuel-based business.

This case depicts how incremental rather than disruptive innovations can be integrated into core processes, thereby serving as a role model and enhancing financial performance while maintaining the overall organizational configuration.

Background: We need a model to improve our weather forecasts

I am responsible for the short-term commercialization of the renewables portfolio. We have to nominate and forecast our short-term production of renewables one day before delivery to the power exchange, and every 15 to 30 minutes before delivery. Since solar and wind are intermittent renewable technologies, we depend on actual sun radiation and actual wind. Other than conventional generation technologies such as gas or coal, solar and wind cannot be steered. Therefore, we have to deal with both a certain random factor and structural forecast errors.

What did we do? We looked at various weather forecast providers who offer wind forecast on a granular level for wind farms. In order to minimize errors, they use different weather models and algorithms for different countries and regions. This is their main Unique Selling Proposition. The problem for us was how to identify the best forecast. What we needed was an algorithm helping us

How to cite this book chapter:
Burger, C. and Weinmann, J. 2024. *Leveraging Digital Innovation: Lessons for Implementation.* Pp. 41–70. London: Ubiquity Press. DOI: https://doi.org/10.5334/bda.d.

to find this out. Since we are in very short-term transactions, we don't have a lot of time to think. Thus we had to include intelligence into the algorithm. In addition, the model would have to run automatically and purely data-driven as there is no one who can decide every 15 minutes what would be the best forecast for more than 100 wind farms.

We decide to apply AI to improve our forecasts

Forecast errors have been a problem since renewable technologies exist. You always try to use the best technology available. But now renewables take bigger commercial risks, margins get tighter, price swings and potential costs increase.

With the emergence of Artificial Intelligence and digitization we decided to find out how we could apply AI tools to forecasts. We hired a Master's student from the university of Duisburg-Essen. In his thesis, he developed a concept how to apply AI to choose the best forecasts by combining different forecasts – a concept we refined with him. After that he started to test his concept and implemented it in a monitoring tool.

Currently we have 5 weather forecasts running in parallel and are able to check the forecast for a wind farm in the course of the next half hours and the next day. Then we do a split by percentages and can say, for example, that the combination of 20 percent of this forecast, 30 percent of this, 40 percent of this, and 10 percent of the other one will be the best forecast and minimize the expected forecast error for a wind farm at this point in time.

If you have a reliable weather forecast you will make money

Forecasts are a cost factor. You have to pay if there is an error and you are not able to deliver the energy you have predicted. These costs are significant and can make a difference in markets with tight margins. So the forecast combination model can be used to further enhance the revenues in the short-term marketing of renewables.

We reduce costs, and if you are doing it correctly and have a more reliable forecast than others, you will profit. If you help to stabilize the system, the system operator will remunerate you for your input.

The main challenge is to reduce forecast errors

Errors differ depending on country and locations. You have forecast errors about 10 to 12 percent, which sounds high, but is actually very low, as they can go up to 40, 50 percent. Of course, you try to reduce forecast errors as a risk mitigation strategy. If you rely on the wrong forecast, you either under-produce or over-produce. In most countries, under productions means that you have to buy back the volumes you have not produced. With more intermittent renewables production,

intra-day or imbalanced prices are getting more volatile. In some markets you pay €1,000 per megawatt hour. If you are forced to buy back volumes on that price level, even a small forecast deviation can have an impact regarding profit and loss.

We develop the model internally

Since our model required the handling of huge amounts of real-time data, we collaborated with our IT department. They are responsible to maintain and organize our assets and have all the data available from the various wind farms, but the software, or the tool itself was developed by us. And we started from an abstract concept, which we developed for our use cases.

As trading in real-time data processing is a very sensible topic you have to be confident to use it, since there is always the risk of losing money. Therefore, we did a lot of dry runs and back-testing before we implemented our model for a single wind turbine. In case the algorithm would not perform or we would have problems with data processing, the harm would be limited.

Our learning costs were the opportunity costs of having used external forecast providers instead of our combination model. However, given our step-by step approach these costs were low. We were lucky, from others we know that using the wrong forecast provider can easily result in costs of €100,000 in just one or two days.

We implemented our model with the help of Agile project management. We did several sprints with other departments using internal resources only. We met every 1 to 2 weeks to jointly review the accuracy of the algorithm prototype and to decide on very actionable implementation steps with short feedback loops.

Only in the beginning we had the «external» support of our Master's student who was coached by his professor, whose research area is the connection of the energy market and AI. We met with him several times to receive conceptual input, but we never established a dedicated organizational unit. We brought our student in, who started in my team as an external analyst. By now he is fully integrated in our team. I think you should always incorporate the person who developed a model into your operational processes.

The development costs of the algorithm comprised the man hours of IT, who had to put the functionalities of the model into our automated data flow for the wholesale market, plus those of the analysts in my team to further enhance the algorithm. In total, we have invested low to mid six digits EUR.

Our rate of errors is down to 10 percent

What is AI other than a self-learning algorithm? There is an objective function for the algorithm, and there are certain rules and boundaries. Our algorithm had to learn from certain situations we had in the past, recognize and remember these situations and draw conclusions regarding a new forecast. Currently we use an online machine learning algorithm – if it is active, we use it every half hour.

Let's take Italy as an example. Italy is very hilly and has a long coast. Normally, it is a low wind country. There are forecast providers who are experts for low-wind situations, others for high-wind situations, hilly areas, or sunny regions. Our algorithm combines these factors and understands, okay, we now have a temperature of x degrees, in a low-wind situation for wind-farm x. Let's use the combination of previous forecasts for the next forecast.

So far our algorithm is able – just by a simple combination of previous forecasts – to beat the best forecast providers in the market. At the moment we are improving our algorithm further and expect it to reduce errors to 10 percent which is very good when we talk about forecasts.

We use portfolio theory

When it comes to forecasting for utilities, you are always faced with the question whether you want to do it internally or externally. Most utilities came to the conclusion that in-house forecasting means high fixed costs. External forecasts are cheap. It makes more sense to buy them, find out how best to combine them and benchmark them against each other. There are many weather forecast providers, typically small companies with 20, 50, or 100 people. You could buy one of them or even five, but then you may lose when a different company has the next innovation. We do an annual benchmarking and pick the best forecast providers for us.

One interesting detail: All weather forecasters rely on the same global weather models and are connected. And as we know from portfolio theory, it may be wise to add one source – in our case a forecaster – who on average may not have the best forecast, but is not related to the others. That's why we have a forecaster who relies on a different weather model than the others. This enables us to strengthen our forecast combination. It's just a matter of statistics.

Company-wide we are now a positive example of digitization

By now our model is well-perceived within RWE. It is one of the examples to show that we are becoming more digital. People know that we have a «Forecast Combination Model», but only a few understand what it does. Our internal marketing helped to present our model to our board – as a positive example of digitization – which then helped us to increase our research budget.

From Europe to the U.S.

At the moment, we use our model for Europe, but we are rolling it out for the U.S. as well. However, we are still in our testing phase trying to reduce forecast errors. Next we'll be looking at AI in trading. There the new buzzword is «algo

trading.» We need to find out how to improve our revenue at a certain time combining forecasts with pricing. If we can observe certain patterns in the market, we can use them for trading. There are patterns showing that 6 or 12 hours ahead there will be a high-price situation, which would mean a high risk in case we under-produce and thus would be forced to have costly buy-backs. If we see that confidence intervals are widening or discover a certain wind- or solar-feed in in different market zones, the system could be long or short. We could also take price signals into account and include them into the algorithm. But this is on our agenda for the next 12 to 18 months.

Ramping up

We need to become more confident that the combination of forecasts and our learning algorithm will actually perform across different countries and conditions.

Our key challenge right now means to ramp up our model and to know when we are comfortable enough to remove restrictions from our algorithm so that it has a higher degree of freedom to optimize and self-learn which will reduce the number of our interventions. After that we'll see what happened.

Currently we are monitoring our model on a daily basis. If there are high-risk events or events where the forecast did not do its job, we have the option to intervene and switch from the Forecast Combination Model to the simple forecast we used before.

The interview was conducted in April 2020.

Dominik Felske
Head of Commercial Asset Optimization Renewables,
RWE Supply & Trading

Dominik has more than ten years of experience in management consulting and as executive within the energy sector with focus on renewables and commercial topics, and multi-stakeholder management.

Before he took over his current position in June 2022, he was Head of Commercial Optimization CE & APAC and Head of Commercial Analysis at RWE Renewables, working at the forefront of the energy transition by commercializing new and existing renewable energy projects across many geographies. Until 2019, Dominik was heading the Commercial Analysis at E.ON Climate & Renewables and responsible for the Carve-Out of the renewables business unit in the context of E.ON/RWE transaction.

(Continued)

Before joining the renewable business in 2016, Dominik did his MBA at the European School of Management & Technology (ESMT) with a focus on innovation and sustainability in Berlin.

Furthermore, Dominik has worked as management consultant at E.ON Inhouse Consulting focusing on business development and performance improvement and as economist in the energy department at the German cartel office. Dominik holds a Bachelor's & Master's degree in Economics from University of Mannheim & Cologne.

5) Saint Paul Escola de Negócios: Individualizing online learning and making it affordable for all people

Adriano Mussa and Bruna Losada Pereira, Saint Paul

Saint Paul Escola de Negócios is one of the most innovative Brazilian business schools, located in São Paulo, with different branches to enhance learning and generate positive impacts on the market and society.

The business school has the mission to transform the world through the training of ethical, creative, innovative and change agents, by offering pioneering programs for executives that generate a positive impact on society, leading the industry in creating trends and promoting integration between the market and the academic world.

This case demonstrates how an ambidextrous setting can be successfully established if the institutional framework of the organization substantially diverges from the strategic requirements of the digital innovation.

Background: We met Watson and discovered ways to reinvent education in Brazil

We started our AI project in 2016, after I attended an IBM conference where Watson, the IBM supercomputer, was introduced. During the IBM presentation everything seemed easy and practical. We realized that AI - or some fields of AI – could be used in education, especially when it came to revising and reinforcing our students' learning.

We talked to IBM, told them we saw the opportunities Watson offered, but did not yet know how precisely we were to use it. We made it clear that we needed to learn more about the technology and its applicability for our business school. After all, we cannot afford to harm the reputation we are building. We have 15,000 students per year, which is good. However, Brazil is a huge country with a population of 220 million, most of whom are too poor to pay BRL 6,000 for high quality education. We hoped that AI would enable us to reinvent education in Brazil and make it affordable. At that time AI was available as a SaaS (software as a service) model, thus we decided to found the digital platform LIT as a startup. Our School was and is doing well, so we thought, let us be creative, and if we make mistakes, we'll learn from them, just as we'll learn from the mistakes other business schools made when they started their online courses. The main thing was to use the opportunity the market offered.

As soon as we understood what we could do with Watson, we started thinking of our faculty, their knowledge, and their classroom experience. They knew how our students' mind worked and how they learned. What we had to find out was how to take this knowledge and combine it with AI.

We developed «Paul» as a new way of learning

A student can learn reading a book, watching a video class, attending an academic session. We are providing a new way of learning, which starts by talking to our supercomputer named Paul. In the process we have developed, our best professors transmit their knowledge to Paul. Then Paul will transmit this knowledge to our students using our chat bots. So the final feature is a chat bot, but, of course, there is a neural network below the surface.

The best part of this AI journey is not just that our professors teach Paul, and Paul teaches the students. The best part is that when our students are talking to Paul, asking questions, they are teaching Paul their ways of learning, which we transmit back to our faculty. In fact, we train Paul continuously, and Paul is improving every day. Since we have a large student body, we can iterate. We can start to sync up the cycle. This is the AI part below the surface, which is very important for us.

Our expertise and curatorship are assets

Paul does not teach whole classes. We divide what we are teaching to Paul according to our classes. We taught Paul five of our best courses, i.e., Basic Accounting, Financial Analysis, Innovation, Creativity, and Entrepreneurship. These courses had to be split into small parts. We developed a specific algorithm, which we built with IBM. We had a lot of challenges. For instance, I can teach Paul, what is an interest rate? But what kind of interest rate? Are we talking about interest rates that the ministry of economics of a country defines, the interest rate that we use in a valuation process, or the one we use when a credit card company charges us?

By now our AI platform LIT has a number of other learning units as well, such as video classes, case studies, a forum. Paul is an additional option. The advantage of Paul is that you can talk to him anytime, anywhere. Say, you have a meeting this afternoon, and your boss announces that one of the topics will be the company's EBITDA, but unfortunately, you have no idea what EBITDA is. Even worse, you cannot wait for the third lesson of our Financial Analysis course to learn about EBITDA. However, you can talk to Paul and ask: «Paul, what is EBITDA?» Paul will find a professor who knows the answer. They will explain what EBITDA stands for and suggest that you familiarize yourself with depreciation and amortization. The student will see the field – the neural network – and can start their conversation with Paul. One has to know a lot before understanding what EBITDA is, but after the student has acquired some basic knowledge, they can go deeper into the topic and learn, for example, why we use EBITDA in a valuation process or in compensation.

Curatorship is a key aspect of our digital platform. This platform is a core element for all the reasons mentioned above, but, from a student's point of

view, you could still wonder, «Well, what's the difference if I ask Paul or go to Google and ask the same question?» Here our curatorship comes in. First of all, using Paul you'll know that he'll give you the correct answers, as it has been curated by trusted faculty members who have a solid academic background. Secondly, you are not just getting an answer and that's it. Instead you can enter a comprehensive network of various concepts that are related to your question. Or, we could say, that you start a learning process – a real thought process – which makes Paul so much more valuable than just entering a question into a search machine and receive answers that are isolated from their larger context.

Another advantage of Paul is that he is much faster than reading a book. Often you have to read an entire book to find the answers you were looking for, and still might discover that it's not quite what you wanted as the learning process when reading a book is not always built in a linear way. Overall we can state that Paul is extremely good for our students.

The difficulty of creating a new habit

By now about 40 percent of our students are using Paul frequently. If a student does it once, it's rare that they'll stop. In fact, people who use it, use it a lot.

For most of our students, AI is a new concept and explaining it to them properly is a challenge. After all, our students are adults who have studied and learned a lot, but never talked to a robot in order to learn. Therefore, we have to create a new habit, which is difficult.

The 40 percent of our students who are talking to Paul to learn, use him mostly when they have an assignment or before a test. Others ask questions that are not related to their coursework. They may be studying the budgeting process but won't ask about the budgeting process. Instead they may go into topics that they inadvertently thought were related to their course.

Students using Paul have a grade average that is two points higher than students who don't use Paul. Maybe it is not only because of Paul. It could very well be that students using Paul are really dedicated to their study. We are dealing with this question to achieve more clarity.

From error and trial to success

At the beginning, our team consisted of Bruna and myself. We knew that we had to start small. One reason was that the world is not synchronized. Another was, that at the beginning, most of our faculty were afraid to transfer their knowledge to a robot, which we understood. However, by now – after 2–3 years – almost 70 percent of our faculty are working with Paul; but in the beginning, it was hard.

Only Bruna and myself were aware of the fact that we would enter a trial and error period and had thus to accept that we would make mistakes. For months we worked very hard, had to throw away our results and start again. We knew that no member of our faculty would be willing to spend time on a project like that. Also we needed total confidentiality. We were developing an algorithm. Not developing from scratch, but customizing an algorithm with IBM. Bruna and I are professionals in business, education, and finance, therefore, we needed the help of IBM professionals.

Eventually, our CIO joined us to integrate what we and IBM had created with LIT using the APIs (application programming interface) needed to connect all parts.

After we had succeeded to map the algorithm – which basically means building a map of knowledge that can be processed by programming and Artificial Intelligence – a large number of our faculty started to be involved and ended up being fully engaged teaching and re-teaching a robot.

Onboarding others went better than we expected

We didn't force anything. Most of our faculty said, «That's a beautiful project. I can create my content in LIT … but as to AI, I need to understand a bit more.» In the end they wanted to be part of the project. By now we have a number of professors waiting to participate and teach Paul new content. Many professors are conservative when it comes to new technologies, therefore we gave them time to understand Paul and answered the questions they had.

A key factor of success was that our academic team is very innovative and young in spirit. This was necessary in order to get the faculty involved. Fortunately, our key people are open to innovative ways of doing things, contrary to a large part of the educational industry. It is not judgmental to say that it is a fact. However, we were convinced that in order to make Paul work, to become early adopters, we could rely on the innovative spirit at our School. In the end, though, feeding knowledge into a robot depends on the involvement of teachers. So after a while, after the initial barriers had been overcome, our faculty came on board.

Students need to learn to ask Paul questions

We think that Paul is a success. IBM used Saint Paul for a global case study in education, as Paul was the first «professor» using IBM Watson. In 2019, we were number 1 in McKinsey's digital maturity ranking for Brazil. This external recognition is very important, as it shows that we are on the right track. However, we are just starting. So far we have taught five courses to Paul, even though we have more than 100 to offer. We are still trying new things and will face more challenges. But we know that we will participate in the future of education.

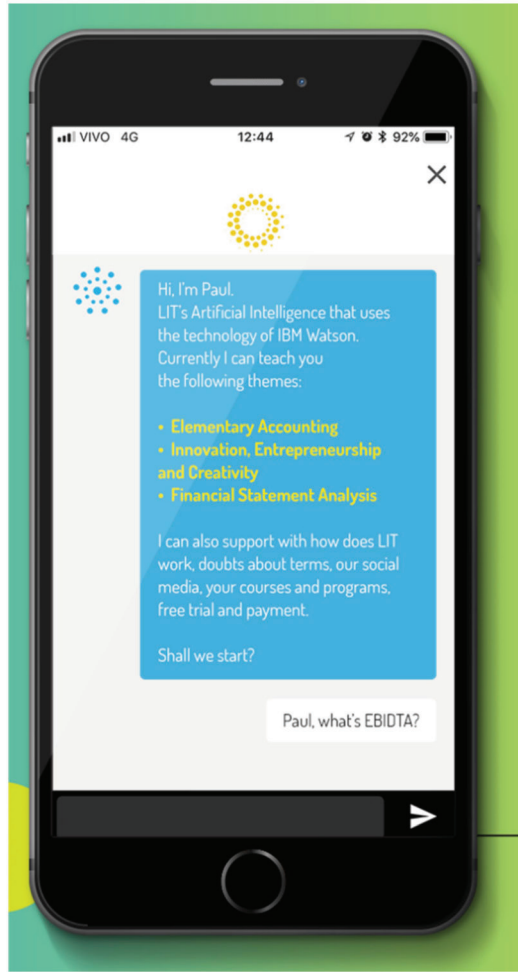

Figure 7: Screenshot of a conversation with AI-based learning tool «Paul». *Source:* Losada Pereira and Mussa (2022).

We still need to make more people use LIT. We have to make sure that neither faculty nor students are afraid to use AI. It's not easy to change habits. In addition, we still need funds to scale up the offer. As with any AI project it was scary at the beginning. It was a shock when we analyzed the time sheet for the first course: We had invested 1,500 hours only on our side, IBM probably even more. But we were working on this project every month. Now we can teach a new course to Paul using only 16 hours of a faculty member.

However, given that we offer 100 courses, there is still a lot of work ahead. Our artificial neural networks are becoming more and more complex; when we add new content, we have many overlaps and different points regarding a topic. Take the example of «interest rates» mentioned above.

However, our main challenge is communication, since we have to convince our students of the benefits using Paul. This means to help create new habits, which is a major task.

At the moment, if a student is to use Paul, they have to start a conversation – and ideally be interested in continuing this conversation. This requires the drive to communicate with Paul and to formulate a question. Even if it's not the right question, you have to ask something. Since Paul is not a real person, you don't have to be ashamed or embarrassed of what you ask, still a student may be reluctant and ask themselves «Oh my God, what should I ask?» This is a tiny little detail, but we have to deal with it. The student has to be comfortable when interacting with Paul even when they don't know yet what they don't know.

EOCCS is the first online certification of EFMD. We have become certified, but the members of the group evaluating us, concluded that Brazilian students don't interact enough and don't like to ask questions. They were right. We are waiting for the professor to tell us what they know. It is part of our culture and we have to deal with it. However, we won't be able to solve this problem within a year. It may take a generation to change this cultural attitude.

We split school and platform operation

I am sure that many of our people perceive both LIT and Paul as very innovative, whereas others may still see it as a waste of time. Therefore, we decided to separate LIT and the School. LIT still provides its services to Saint Paul, and vice versa, but people now either work for LIT or Saint Paul.

We needed to do that since the philosophy of LIT and Saint Paul differs. Saint Paul is a traditional business school, whereas a learning platform such as LIT is a disruptive element. It is based on AI which needs a large number of interactions and A/B testing. In addition, it is a subscription service. These concepts cannot be applied to Saint Paul.

Most of our employees supported us when we trained and retrained Paul. They helped us to map different ways of asking the same question. They were our first users and our primary source of testing. And they saw and appreciated the results. Nevertheless, we decided to separate the operations. We could not have the same people working for both, the philosophy and the culture of the two are too different.

Paul will be given a voice

We have started new features, such as using AI to personalize the learning process. For this purpose, our students go through the Big Five personality assessment and we work with three outputs. The first one is the Big Five

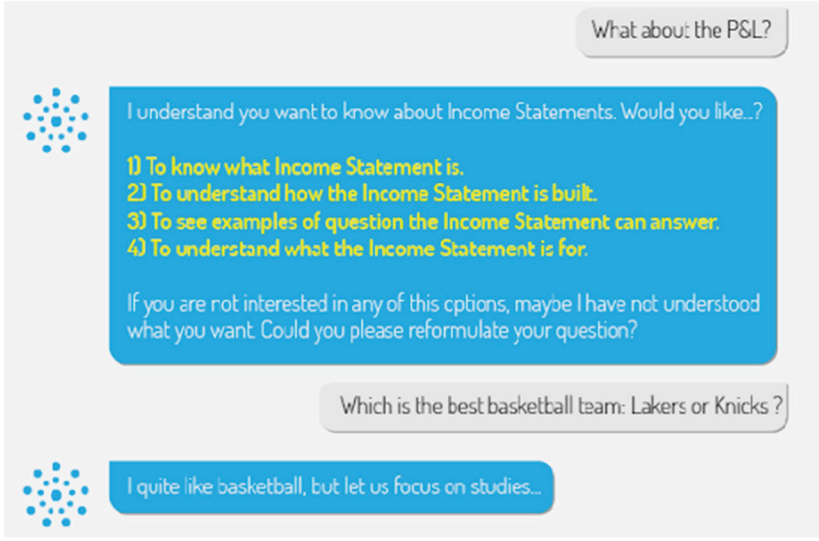

Figure 8: Screenshot of a conversation with AI-based learning tool «Paul». *Source:* Losada Pereira and Mussa (2022).

report. For the second output we connect a student's personality traits with our learning objectives. The third output means to select the best learning methods for them, i.e., videos, podcasts, cases study sections, texts, etc.

However, the main advantage of AI is hidden below the surface: The LIT platform is proprietary, this means that every second we receive data students are generating. We are using data analytics to enhance the learning process, finding patterns of behavior, discovering problems. For example, we discovered that on LIT extroverted people learn less than introverted people. So we encourage the extroverts to participate and to join the group discussions. Furthermore, we discovered that if a student does not start a LIT-course during the first 2.5 weeks after subscription, they will probably cancel the subscription. Therefore, we need to help our students when they select a LIT course.

Also, AI presents a fantastic opportunity to support our faculty. Already now they have a high level of understanding and realize how AI can influence and transform our business. AI is part of our MBA program, executive education programs, and BA programs, and we are proud to offer this advanced technology to our students, our alumni and our community.

We certainly will continue testing new AI possibilities. So far Paul communicates in writing and does not yet talk, but we are in an advanced stage giving him a voice. At the moment Watson still has problems dealing with Portuguese. Therefore, we are developing a voice for Paul, giving him the specs IBM applies while enhancing Watson's Portuguese.

We are also starting with a sentiment analysis to help our faculty answer student questions quickly. We have an SLA (service level agreement) to respond within 40–48 hours to questions. For a question such as «What is EBITDA?», 40–48 hours response time is enough. However, when our students complain about something and there is a danger of them becoming disaffected, they need to receive an immediate answer. Therefore, we are testing sentiment analysis with IBM to accelerate our responses in these cases.

Students, faculty, and companies perceive Saint Paul as an innovative business school

Concerning benefit, it was important for us to have the public perceive Saint Paul as an up-to-date, technologically advanced business school. We thus were very pleased when we won the digital maturity premium award from McKinsey & Company in Brazil. It showed us how positively the public regards our use of AI.

It was not easy to shift from being a typical business school to a truly innovative institution, using a technology that is not part of our core business. We certainly benefited from introducing AI to Saint Paul, as we are now perceived as an innovative School by all members of our industry – not only our students, but the companies in Brazil and the Brazilian public as well.

This is the advantage that we discussed with our board members. If you start a project as we did, you traditionally think about budgeting, financial viability, ROI. If we had just focused on these aspects, we would have given up after two or three months. However, we agreed to shift our focus. In the long term, we would like to break even, but in the short and middle term, we are concentrating on the exponential curve regarding our users.

The interview was conducted in February 2020.

Prof. Bruna Losada Pereira, PhD
Deputy Dean of Saint Paul, and one of the team leaders who implemented Artificial Intelligence in Saint Paul's distance learning

Bruna Losada is a consultant at McKinsey & Co, professor, speaker, mentor and passionate about entrepreneurship and finance. She has published the book «Finance for Startups», which was the result of her post-doctorate studies at Columbia University (NY). She lectures at MBA Programs and innovation forums, such as the Consulate General of Brazil in NY, Coworking Programs, Conferences, innovation hubs, among others. In addition, she holds a PhD and a master's degree from FEA-USP, and in the past she held positions of Deputy Dean and COO at Saint Paul Business School.

(Continued)

Prof. Adriano Mussa, PhD
Partner, Dean and Academic & Artificial Intelligence Director
at Saint Paul Business School and LIT

Adriano did his PhD in Business Administration from University of Sao Paulo, followed by postdoctoral studies in Artificial Intelligence from Columbia University, NYC.

For more than 15 years, he has been a professor of finance and AI for Saint Paul's MBAs and Post-MBAs programs. He was a professor at other major Brazilian business schools such as FIA, Insper, HSM and Fundação Dom Cabral, receiving more than 30 awards as honored teacher / best teacher of the programs in which he taught.

He is the author of scientific articles published in periodicals and annals of congresses specialized in Finance, AI and Education, including the book «Inteligência Artificial: mitos e verdades».

6) Lengoo: Automating individualized translations

Christopher Kränzler, Lengoo

Lengoo is a Berlin-based company comprising of engineers and language enthusiasts focusing on professional translations. With their HALOS framework, they custom-train neural machine translation models and pair them with skilled and experienced translators.

Being an early adopter of the GenAI algorithms, Lengoo was a global pioneer of customized adaptation of machine learning models that enable their customers to move from human translators to IT-based tools. In the age of Large Language Models, they retain a competitive advantage via their sophisticated algorithms and ultra-customization of machine translation models.

This case not only portrays the perspective of a startup disrupting an established market, but it also describes a pathway to take a key stakeholder group – the translators – on-board.

Background: How we started

We started the company while we were still at university. Besides studying, I was working for an IT consultancy as a localization manager whose job it was to hire and lead external freelance translators. At that time these processes were handled manually. We took this as the starting point for our company and built a platform to automate the translation process.

At Lengoo customers can upload their documents on our platform. The documents will be automatically analyzed regarding language and word count. The customer selects the target language and receives a fixed price for the translation. They click «order« and we will send the text to a translator. After the translation has been completed, both document and invoice will be sent to the customer.

Initially, though, there was one part that we were not able to automate with rule-based programming, i.e., matching translation and translator. The problem was that in most cases the translator had to be a native speaker and a subject matter expert as well. If you have a legal document to be translated from German into English, you need a native speaker of English who both knows the terminology and the form legal documents require. This level of complexity was too high for a classical rule-based software.

Therefore, we looked into machine learning. Essentially, we analyzed how a human project manager would approach this problem. This meant to analyze both document and content, and find out what type of text it is. If it is an employment contract you match it with all past translations on your platform to find the translator who has done similar translations and received good ratings from the proofreaders or the quality assurers. The more documents a specific expert has translated, the more experience they have, the better you

can match them to new jobs. That was the first step how we got into machine learning. We approached it with process automation.

Becoming faster and better than others

From there we moved to machine translating. When you deal with translations and machine learning, it's not far-fetched to look at providers such as Google Translate, Microsoft Translate, and others who deliver generic machine translations. However, these technologies don't work when it comes to professional translations.

We defined the quality of our machine translation-technology based on how fast a professional translator could process a raw translation into a high-quality translation to the extent that an independent professional translator would not know whether it was done by a human or a machine.

We found out that, theoretically, if someone like you and I were to translate a document, we would come up with a speed of 300–350 words per hour. If we were to use Google Translate or any of the other generic machine translation tools, we would reach 550–600 words per hour.

Reality looks different, though. There are efficiency-gaining technologies on the market. For translations this would be a technology called «translation memory», which is widely used. It basically says if you have translated a certain sentence before, the second time it appears in any document you don't have to re-translate, you can just reuse it. Think about manuals, where you have a large number of sentences that are always the same. If your translation tool automatically inserts the previous translation for you, it accelerates the speed of your translation – but you again will come up with approx. 600 words per hour. This meant that generic machine translation solutions didn't yield efficiency gains or improvements for us.

The question was, how to move the technology of machine translation into a setting where the machine translation would be so good that it actually helped the professional translator? That's how we came up with our customization technology for machine translation models. Since we work with our customers directly, we have their past translation data and can use these data to automatically train customer-specific or use case-specific machine translation models by selecting the right data depending on what type of translation needs to be done.

Machine learning models behave the same way as humans. If you have a generalist, who is very good they'll have answers no matter what question you ask. However, in most cases the answer will not be detailed or in-depth enough that it can solve your problem. So you will go to an expert.

The same happens with machine translation models. The models used by Google Translate and others have been trained on very broad data sets including law, finance, mechanical engineering, etc. This enables them to translate whatever you paste into the textbox in real-time.

In contrast, we only give the machine a specific type of data so that it can specialize in this area. This way you reach a quality level that's roughly three times better

than the results you get from generic models. This also meant that our translators could work roughly three times faster and deliver 1,500 words per hour, which is a significant increase compared to the 500–600 words of existing technologies.

We automated the entire training process behind our models, because you don't want to have an army of data scientists to do this for every customer, for every department, for every use case.

Our ultra-customization of machine translation models

I wrote the initial machine algorithm as part of a university project in the U.S. Luckily, by now, we have an in-house team that is much better equipped to deal with research topics. But we have always done everything in-house. After our first funding round in 2017, we applied for a European Union funding program to develop our technology, which we called «ultra-customization of machine translation models.» Funding was approved and we received about 1 million euros that we used to build up our research team. Initially, they operated separated from the rest of the company, figuring out how we could get the project up and running. Once we had proven that it worked, we focused on further development. We spoke to other companies that are active in the field of machine learning. We spoke to companies that develop machine learning applications and to companies that have successfully integrated machine learning into their business processes. That was the most important factor: Integrating machine learning into your entire business, not just within your IT team. Embedding machine learning technology in your own IT team is fundamental, but for most of existing machine learning solutions, the human input is still inevitable. In our case, this input comes from the translators with whom we work. Our technology makes them more efficient, but does not aim at replacing them. In fact, this would be impossible as of today.

Putting the end user first is paramount. When you start to develop machine learning applications, you must keep the people in mind that will be using the technology. When you move your idea from research into the real world and put your technology into production, you have to make sure that you include your user in every step of the way. In our case, we assembled a product team with people from our IT team, research team, and a translator. Additionally, we built our own software to interact with machine-translated content, a tool that is designed specifically to post-edit machine-translated output. We are working very closely with our translators and continuously collect feedback in order to make sure that the software really makes their work easier, not harder or more complicated.

We still need humans in the loop

Let's take a translation order worth EUR 1,000 of a traditional translation service provider. Typically about EUR 450 would go to the translator, EUR 100 to

the proofreader, and EUR 350 would be used to cover the cost of project management. Project management here includes the people who deal with a client's requirements and communicate with the translator. The remaining EUR 100 are the margin for the translation service provider.

By automating these processes with rule-based applications, including the automation of the translator allocation, we were able to reduce the cost of project management to almost Zero. The translator allocation is a major component of project management, since here human expertise comes into play. The longer you work as a translation service provider, the better you know the translators, find the right translator, thus increase the quality of a translation and make the customer happy.

By turning this part of the process into a machine learning model, we were able to reduce the cost of translations for our customers by about 30 percent. However, this part of the process automation is peripheral.

Far more interesting is the translation part. When we start working with a new customer and the customer is able to provide us with sufficient past translation data, we can save the customer money. Our value proposition is that we deliver the same translation quality as their previous providers but faster and at a lower price. So from a sales perspective, this is working very well.

Let us look at the learning component of machine translation models.

Unlike generic machine translation models, we use a human-in-the-loop approach. Every translation produced by a custom machine translation model is proofread and polished by an expert. Thus our output is constantly being improved. This also means that we have a constant pipeline of highest quality training data available from which the machine translation models can pick. Using this data to permanently retrain our models, the machine translation models become better and better and the translation quality continues to improve. For some of our customers who have been working with us for more than a year, we already have become six times faster than traditional providers and can process up to 3,000 words per hour. So this setup is working and adds real value.

Our advice: never implement machine learning in your core business first

Unlike many other industries, the translation industry has already had a fair share of experience with machine learning technology. The rise of generic machine translation, such as Google Translate, has caught major attention, even though the response was mainly negative. And rightly so: Early versions of Google Translate delivered very low quality. Some translation service providers implemented post-editing flows to poor machine-translated output, which did not help much. Among language experts, all this has led to a low acceptance rate of the technology.

We were in the advantageous situation that machine learning technology had already been in use in our company for peripheral processes – such as

the allocation of translation jobs to translators. Hence our translators had been familiar with the technology and open to using it further.

I would advise everyone, who plans to get into machine learning, to never start implementing it in their core process, but in a peripheral process first. Winning acceptance for a technology is a fundamental success factor and it is a lot easier to achieve this if you start with a process that is not essential to the user's everyday performance but ultimately has a positive impact on them.

The algorithm we use in allocating translation jobs to translators helps us to find specialists. It tracks the evaluations of translations performed in specific subject areas and calculates a score that indicates how well a translator fits a specific translation job. This score is the most important figure in identifying the most qualified translator for a given job. We provide our translators with a profile website, showcasing their respective languages and subject areas. This website is their tool for self-marketing, especially since it is based on data, not on mere words. It shows exactly how many words each translator has translated in which field and how their performance has been evaluated by proofreaders. Hence, they receive more jobs in their field and can become still better and faster. And if you are able to translate faster than others, then you earn more. Our translators have all seen the positive impact machine learning can have and are open towards it.

So one might ask, why do our translations cost «only» 50 percent less than those of other providers? We believe that it is absolutely necessary that every stakeholder will benefit. That's why we make sure that in all projects where clients provide us with sufficient language data for the custom-training of our machine translation model, the translator ends up with a higher hourly wage. I think that's how you should apply efficiency gaining technologies. For us, this is working very well.

We didn't do any social media promotion. But we have a community management team that makes sure that everybody understands that we apply our technology not to replace humans but to make them more efficient and increase their income.

Human experts are essential but scarce. In other words, there are not enough skilled human translators on the market to cover the demand. Thus it is a necessity to use machine translation to deal with the demand due to increasing globalization. With fewer people being trained as translators, you need this technology to fill the gap.

The next steps of the machine

The product team, which includes product design, machine learning, and IT, makes up for half of the company. The other half is evenly split between

marketing, sales, finance and operations. Operations delivers customer support and liaises with our translators and proofreaders.

The next logical step would be to automate proofreading as well. What does this mean? I think it's best explained looking at the tool we built for post-editing: You have the original text, the translation and the person correcting words or grammatical constructions, etc. to produce a perfect final text. We track all of the actions that it takes to make the machine-translated text perfect. Now we plan to use the data we're accumulating to train models that support proofreading. We can use the data from the correction of the machine translation to show the translator where to go to so that they don't even have to look at the entire document anymore, just at those sentences where the machine isn't sure whether it did a perfect job or not.

Further, we are currently working on making the interaction with the machine better. You know the function that, for example, Google's email service Gmail offers: it predicts what the next word in a sentence will look like while you are typing. This technology is called «predictive typing» or in the case of translations «adaptive and interactive machine translation.» Here we want to make use of the data of all our customers. Currently, we are working in silos as customers do not want to share the information of their translations with others. Still, there is a meta-level, where we can learn how to automatically build a model from one customer's data and use it to build a translation model for a new customer without violating confidentiality. «Transfer learning» is the keyword, and that's where we are going to expand our technology.

Right now we can only apply our technology to large enterprises. But we would like to make it available for small and medium-sized businesses as well. In order to achieve that, we need to transfer learning from larger companies to smaller ones and see if the learnings we have already made with large clients, can also benefit smaller ones.

The question of intellectual property

The data is always owned by the customer. They are paying us for our work and for the right to use the translation. Our customers are also the sole owners of all past translation data.

Concerning the specific machine translation models that we are training based on this data, things get a bit more complicated. Technically it is a machine that trains a machine and we own the machine. But it doesn't matter so much since we work in silos, as I just said. We want to learn based on the translations for a specific customer. We want to train the model on how this specific company expresses itself in certain cases. Which terminology does it use? Which style? Formal or informal way of addressing? These kinds of things are company-specific, even department and use case-specific.

We translate anything you would be able to think of

The possible number of application areas is infinite. If you are producing a technical medical device and are located in Sweden but your target market is East Africa, you may want to translate your specifications into Swahili. If this Swedish company had enough past translations done, we can build a nearly perfect model for Swedish to Swahili.

So much as to the machine translation part of the process. As I said earlier, we don't deliver just raw machine-translations, but include humans. The value we deliver means that our final texts are ready for publication. So we have to consider our available pool of experts. We are currently focusing on Germany, Austria, and Switzerland. The translation demands across all industries in these countries are very similar, the majority being translations from German to English, followed by German to French. Recently, we also have seen an increase in the demand for translations into Arabic and Chinese.

As to subject matters, we translate anything you would be able to think of that falls into the realm of professional translation. Essentially, I would say you can break it down into two types of customers: We have customers that either produce a physical or service product. In the case of physical products, about half of the translations will be marketing texts, the other half technical documentation. Service-oriented businesses demand translations of marketing texts and customer support documentation. About 10 percent of our translations are financial and legal documents.

Our model is our competitive advantage

There are large translation service providers such as Lionbridge, TransPerfect, Acolad, among many others. Ten, maybe even 20 of them occupy most of our market. Then there are smaller translation agencies, who are mostly specified, but would not be able to handle the demand of large companies. We are dealing with the incumbents. However, most of them have not focused on machine translations. In terms of technology, we are one to two years ahead of them.

There is another startup in the U.S. which is similar to us. They built a tool for translators to increase their efficiency and just recently switched to becoming a full-service provider offering translations to end customers.

We could apply for a patent, but our technology is evolving so fast and we are continuously adjusting it and improving our framework that by the time we would get the approval for a patent, it might not be relevant anymore. And even if we wanted to get everything patented, we simply do not have the financial resources to fight for it. So our approach regarding our technology is very simple: We are trying to always be one step ahead of others and are continuously improving our model so that nobody can catch up. This is a very common approach now in the startup scene. The process to obtain a patent is simply too slow to cope with the rapid development of technology, especially in machine learning.

Looking into the future

We just closed our large growth round last September[5]. We have hired a chief sales officer. We are building up our salesforce and will start internationalizing next month. We expect to triple our growth rate this year and will hopefully do the same each coming year. Our board is convinced that the best way to continue would be to go for an IPO.

The large incumbents we mentioned are struggling and won't have the money to buy us. As to companies such as Google and the large tech giants, we don't see them acquiring us either, since we have a human component in our technology. And we will need this component for a long time if not forever to do the final proofreading. This is an overhead these companies don't want to have.

Of course, we have backup plans and interesting exit candidates. IT consultancies and digital consultancies are by now less interested to partner with startups to provide services, but rather build up their own product portfolios. They have realized that technological tools are becoming more self-explanatory. So they start buying solutions. This would be a possibility for us, but our main goal is the IPO.

The interview was conducted in March 2020.

Christopher Kränzler
Co-founder and CEO, Lengoo

As founder and managing director of the AI company Lengoo, Christopher Kränzler has made it his mission to shape the future of enterprise translation. Lengoo has developed an EU-funded machine translation technology based on a highly innovative training approach for Artificial Intelligence. The AI-supported professional translations combine the precision of human creativity with the huge advantages of Artificial Intelligence. Due to the high degree of automation in project management and the translation itself, Lengoo's technology can significantly reduce the costs of professional translations.

Christopher Kränzler holds a Bachelor's degree in Industrial Engineering from the University of Karlsruhe (KIT) and a Master's degree in Data Science from Columbia University New York.

Since June 2019, Christopher Kränzler has been a member of the main board of Bitkom e.V.

[5] *Note from the editor: The interview was conducted in March 2020.*

7) Peregrine Technologies and Allianz: Autonomous driving and the integration of visual data

A dialogue between Stefan Sellschopp, Allianz Partner, and Jorit Schmelzle, Peregrine Technologies

Peregrine Technologies provides new solutions in computer vision and machine learning for a comprehensive understanding of the physical world in real time. The team maximizes the value of existing perception systems, for example in modern vehicles, and adds its own solutions for classification, data fusion, and scene analysis. This real-time visual context allows customers to rethink products and services in the domains of smart infrastructure, insurance, autonomous driving, as well as security. Instead of developing in-house expertise, German insurance company Allianz chose Peregrine to collaborate on autonomous driving.

Under certain circumstances, even an incumbent player in the industry prefers outsourcing the expertise on niche applications of disruptive technologies. This case reveals the benefits of tapping into the larger innovation ecosystem and building on the expertise of external suppliers.

Background: How we started

Stefan Sellschopp, Allianz SE: Allianz is a Dax-listed insurance and service company. Our department is working on B2B2C topics and providing solutions that our business partners will sell to their customers. I am in Automotive, where I work in Connected Cars and Autonomous Driving. There we deal with risk evaluation and an improved first notification of loss. If someone has an accident or the car breaks down, we help the customer settle the claim.

Autonomous Driving is related to Connected Cars, but it has its own specificities. Since 2017, we have been collaborating with various companies worldwide in order to provide them with insurance packages for each autonomous vehicle sold. For example, EasyMile is a French software company that sells bots for small buses that are driving on defined routes. In Germany, the Bavarian town of Bad Birnbach is one of these locations. In 2019, Deutsche Bahn launched a bus service from the train station to a community center. The bus covers two kilometers on a public road. It drives autonomously but still has a safety driver. Should anything go wrong, we handle the damage.

Interesting for us is the following: What kind of technology is in the vehicle? What kind of sensors are there? What is the safety level? What is its purpose? What are its surroundings? What is the traffic situation where the vehicle is deployed? In order to answer these questions, specialists go on-site and check out every curve, traffic light, traffic signal, signs, other objects, and so on. When we have the answers, we evaluate the risks and decide whether we want to insure the vehicle in question or not. And if yes, we determine the premium.

However, autonomous driving is still new, and we are suffering from a lack of experience, which makes it hard to evaluate risk. Therefore, I contacted Peregrine Technologies. The idea was to understand traffic situations and the many ways they can change. In order to find this out, we usually assess the road where the autonomous vehicle drives. But conditions on this road might change over time. After one year or two or three years, traffic flows may be different. Pedestrian walkways or the environment, such as traffic lights, may have been added.

Therefore, we had to be able to automatically detect changes and judge the risks involved. We had to compare both the vehicles and the different situations, thereby finding a solid way of measuring risk. We also wanted to be able to understand whether there is a risky situation before an accident happens. We wanted to measure both the distance and time to collision.

With the help of Peregrine, we are able to solve these problems. We use the data onboard a vehicle, crunch the data, recognize the objects that are in its way, and decide if these are critical. The resulting information is sent to a server.

Which is also to say that now we can properly evaluate the data we receive. We know which insights we can get and which tools and products we need in order to make the data usable. Currently, we are in the process of turning our knowledge into a product, which we will offer to our customers from the autonomous vehicles side.

Peregrine Technologies as supplier

Jorit Schmelzle, Peregrine Technologies: After my studies in physics, I collected industry experience. My last job was at an insurance company in Switzerland. From physics I had knowledge in machine learning, computation, and statistical physics. Eventually, I discovered that the insurance industry has an enormous amount of data that they do not use and that there was room for innovation.

Steffen Heinrich, one of our co-founders, worked for many years for Volkswagen – at first in the software development division for self-driving cars, then on the group level with the Chief Digital Officer on strategic questions and collaborations for autonomous driving. Our third co-founder, Naja von Schmude, studied computer science just as Steffen did. Naja is familiar with robotic systems. Already during their studies, Steffen and Naja were part of a team that built humanoid robots that played soccer and successfully participated in world cups.

Together we realized that we had been working on powerful technologies that were waiting for the revolution of autonomous vehicles. We wanted to make these technologies accessible to everyone so they could benefit from them now, independent of the vehicle type, manufacturer, or model.

So we founded Peregrine and implemented the perception stack of autonomous vehicles in a very simple way. We use off-the-shelf hardware such as smartphones or tablets and deploy our software on these. People can plug

in the hardware behind the windshield and turn on our software, which understands what is happening around the vehicle in real time. The software detects the road, the drivable area, and the corridor. It shows the other objects participating in the traffic scenery. Are these cars? Are these pedestrians, trucks, traffic lights? Last but not least, we try to foresee the intentions of other traffic participants and estimate the relation between relevant traffic participants and objects. We measure how our vehicle reacts to changes in the outdoor environment. In sum, this gives us a holistic view of the inherent risk of each situation.

All of the relevant data is collected at the edge, as it would not be feasible to send the whole video stream and analyze it in the cloud. This would be too expensive – in fact, it might not even be possible. The main analytics need to happen at the edge with the AI that we programmed into our perception stack. However, we play back the relevant information – an anomaly, a risky situation, or something else that is of interest – to a server and make it available to our customers on our platform.

Furthermore, customers may use the platform to access their metadata so that they can understand in greater detail what happened in a given situation. They get the location, they can look at the risk score, the velocities, accelerations, forces, and alternative options.

If you have a large number of data sources and fuse them, say, in Berlin, you will see risky and dangerous situations coming up. But the core – or what is really new and important – is that we understand image material. We gather visual context information from a car's environment. There were systems prior to ours that collected or tried to collect data on driver behavior from the dynamics of a vehicle. But just because you perceive a strong braking maneuver, you cannot judge the driver as long as you do not understand why they behaved that way. Maybe a child ran onto the road and the driver braked to save its life. However, if the driver was drunk and did not see the red traffic light or saw it at the very last moment, the braking might look the same, but the cause is quite different. So video traffic analytics is our unique selling proposition.

We support our customers with our platform based on a three-pillar approach. What happens in the car in real time provides the basic data. What we use of it and send to our server can be used for teaching, an improved understanding of risk, as well as for predictions and optimizations.

If we combine all the kilometers driven by our partners and customers, we have by now surrounded the globe approximately 10 times. And every 2 meters, we analyzed the situation and the surroundings of the vehicle. This resulted in more than 16,000 hours of driving and more than 300 million situational analyses.

Insurance companies can use the information we provide to understand what happened during an accident, how severe it was, to send help if it is needed, to give the user the option to interact with the insurer directly, and to protect themselves against fraud.

As to fraud, we are hearing quite frequently that people rent a car and crash it into their private car knowing that the rented car is well-insured. And then

they use the money from the insurance to refurbish their car. This is a problem, both for the car-sharing company and the insurer. In these cases, our system can easily help.

But more important is that we can enable a customer to sell usage-based insurance as a value-added service. With the help of our platform, they learn how their customers drive and can incentivize better driving with premium discounts.

Furthermore, we combine our solution with common telematics that try to assess risk in traffic situations but are based on pure dynamic values. We look at how many of these risky situations actually contain elevated risk levels. We can determine that driver X reacts the wrong way in 30 percent of all cases, but does well in 70 percent. We can say, here something happened that was not good, based on the visual context, for example driving through a red traffic light without braking, which would be missed by traditional telematics in 75 percent of cases. In short, we can show why things are happening, not just that something is happening.

Teaching the system

You need to establish a certain ground truth, similar to when you teach your children. Imagine telling your child, «This is a car. This is a truck. This is a traffic light» and showing the real items to them. We, in contrast, collect images and label them «car, truck, traffic light.» Then we let our AI try to assess the image. We feed an image to our algorithm. Our algorithm makes a guess, «This is a car.» We say, «Yes, you're right» and reward this behavior. If it is wrong, we say, «No, this is wrong. This is a car,» and the algorithm gets punished. By doing this millions of times, our system starts to learn.

Leveling the data

How do we level the data? For example, in the case of a near-accident, we would go into automation mode and then to a specific event. We would download everything related to the event – report and metadata – to understand how the car moved. What kind of objects were there? Then we have the video and the changes over time, such as the average number of objects detected in similar situations or on this stretch of the road.

Privacy

How do we deal with the privacy of other traffic participants? Potentially, we could see a lot of vehicles and people that could be identified in the videos that we store. However, we are not allowed to do that. In order to protect their

privacy, we anonymize image data. Before we store anything, number plates are anonymized as well as the faces of drivers and pedestrians. Only in the case of an accident are we allowed to store our raw material.

Take person X who must not be recognized. We can anonymize them by blurring or changing features automatically, but still keep valuable information, such as where was this person looking at each point in time?

Can the technology be applied to different environments?

Can it be repurposed, for example, to identify the biodiversity in a forest, such as plants and wildlife? The answer is yes, even though we would have to retrain the system.

We have a variety of use cases for smart cities and traffic infrastructure, to name only some. If you drive in a city and want to know where you can find a free parking space, we can answer that. For this, we just need to tell our system what we are interested in. The same applies to biodiversity in a forest, even though this is beyond our scope, since we focus on traffic and safety.

Collaboration with original equipment manufacturers

We will be happy to share our data with car manufacturers. The logic we use is based on the logic used by original equipment manufacturers. But they have been using this knowledge to better control their cars. What we are doing is attempting to retrospectively understand what happened while a vehicle was driving. In addition, we want to understand what could have happened. However, we are using standard hardware and standard software, that is, basically the same logic used in the embedded device in the car, even if we use it differently. Still, for vehicle manufacturers, it will be crucial to understand how we judge risk and how they can improve their technology. Therefore, we are advising them on how to do it.

Collaboration in general

Theoretically, we could collaborate with other companies that do what we do. However, the cameras are too different. We want to get as close with the system we train on the data. We want the data to be as close to the data that will come in later and have to be assessed. So there is a difference between what we do and our system compared to, for example, a camera that is mounted on the outside of the vehicle and has the windshield in between. When it rains, there will be droplets on the windshield. There might be dust or dirt. The light might come in from an unfortunate angle. That is why we use our own data and label our own data.

Another problem is that we always have new ideas regarding objects and events that we want to configure. We want to decide what is being recorded, find out which are the thresholds, what is considered risky, and when we want video footage. For example, do we want bikes, or pedestrians, or cars, or a combination of them? Say we find out that there have been a considerable number of accidents with e-scooters lately. But we have never discovered e-scooters and do not know what is going on. In this case we can tell our system, «I want situations that were dangerous and had an e-scooter involved. Collect the data.» And when we have the data, we can see what is typically going on in these situations.

Monetizing the data

Stefan Sellschopp, Allianz SE: This topic is of relevance for fleets, less so for retail. Some fleets, such as delivery services, have a hard time finding insurers. Using a risk-mitigation measure is a way to prove to the insurance provider that the customer who wants to be insured is a responsible driver. At Allianz, we have discussed how to leverage the Peregrine technology to insure fleets, thereby reducing the risk and making them more manageable.

For many insurers in Germany, Austria, Switzerland, and France, fleet insurance is not a profitable business. Insurance companies are spending 7 percent more for claims settlements and administration compared to what they earn in premiums. Usually insurers do not just take the risk, but they also have their specialists assess the risk and advise the customer how to mitigate it. That does not work in fleet insurance. The specialists from the insurance company would need to sit next to the drivers, assess their behavior, and tell them how to do things differently, if necessary, without being able to check on them all the time. However, with the Peregrine system, these controls are now possible.

The interview was conducted in March 2021.

Jorit J. K. Schmelzle
Co-founder, Peregrine Technologies

Jorit Schmelzle is co-founder and CPO of Peregrine Technologies, which uses AI to derive actionable insights from video and other data sources so their customers can better manage their vehicle fleets. These insights can be used for logistics, safety, mobility and other applications. Its two revenue streams include a licensable SDK as well as the sale of its data assets.

Jorit received his Master Of Arts & Science at the Swiss Federal Institute Of Technology (ETH) Zurich and his Bachelor Of Arts & Science at the Indian Institute Of Technology in Bombay.

(Continued)

Stefan Sellschopp
Senior Consultant Connected Car – Claims, Allianz Partners,
and co-founder e-REVOLT

Within his role at Allianz Partners, Stefan Sellschopp has been building Minimum Viable Products (MVPs) and turning the successful services into products. With his team, he did market studies to find possible partners. He did crash test with Allianz Center for Technology to find out how the crash detection solutions deliver and then launch the automated first notification of loss solution in the market, with an ambition to roll it out to other markets.

In his other role as a co-founder of e-REVOLT, he is responsible for the networking and connectivity part of the e-R3VOLT EV retrofit solution – upgrading an existing Internal Combustion Engine vehicle to enable a longer and carbon friendly life cycle.

Among many other things, Stefan spent several years on EV projects in Silicon Valley and supported the Audi e-tron IT development.

CHAPTER 5

Blockchain

8) Uniper: Dealing with wholesale complexity as part of a digital strategy

Grigory Shevchenko, Uniper

Uniper is a leading international energy company that generates, trades, and markets energy on a large scale. Uniper also procures, stores, transports, and supplies commodities such as natural gas, LNG, and coal as well as energy-related products. It is a reliable partner for customers planning and implementing innovative, lower-carbon solutions on their decarbonization journey. Uniper is a hydrogen pioneer, is active worldwide along the entire hydrogen value chain, and is conducting projects to make hydrogen a mainstay of the energy supply. The company is based in Düsseldorf and is one of Germany's largest publicly listed energy supply companies.

Disruptive technologies may still be in an experimental stage but may hold the promise of providing substantial cost savings. In critical infrastructures, regulatory frameworks may hamper or delay establishing open platforms and marketplaces, but novel technologies such as Blockchain may circumvent these hurdles.

This case is an example of how to use disruptive digital technologies to tap into new market segments, moving from bulk trading volumes to a fragmented customer base without jeopardizing profitability.

Background: We are looking for a technology to simplify our processes and find it

Energy trading is a market space with a large set of transactions, both financial and physical, happening and requiring reliable mechanisms of interaction. It is only natural that Uniper has followed this technology since early days of its inception. For some time, however, the application benefits and possible

How to cite this book chapter:
Burger, C. and Weinmann, J. 2024. *Leveraging Digital Innovation: Lessons for Implementation.* Pp. 71–89. London: Ubiquity Press. DOI: https://doi.org/10.5334/bda.e.

use cases especially given possible implementation and transformation efforts were not yet fully obvious to us. But we began to think about Blockchain and tried to find out what this technology might have to offer to us being an energy midstreamer planning to simplify our processes. We looked at the possibility of introducing a federated Blockchain. However, in the end we decided to – at least initially – use a proprietary, permissioned Blockchain application, as it was easier to roll out and control due to the fact that only permissioned members have access. In addition, we considered it to be the more successful and safer playground, which we needed. Coordination with dozens of other stakeholders during the initial phase could become difficult.

The reason to use a technology such as Blockchain was to simplify commodity flow management in a market characterized by extensive manual and paper-based transactions and high processing costs. At the same time, small-scale liquefied natural gas (LNG) was supposed to be developed as a new business. However, both these markets were comparatively small and complex for a big energy player such as Uniper. Thus it became clear that scalability and simplification were key and we saw a use case for the new technology.

It was a step-by-step approach. We wanted to start with the proof of concept (PoC), then implement the small-scale LNG platform as a minimum viable product (MVP). Further down the timeline, we planned to roll it out and onboard other market participants with the defined roles and possibly as node owners. The overall belief was that without Blockchain, the business model would not fly due to high administrative costs, because the commodity batch sizes were very small compared with the operational steps needed to process each batch. That was the main thing everybody agreed on. In addition, it was clear that this business model would be a lot easier to find both internal and external acceptance if it were made scalable and efficient.

The onboarding of people is not easy

For the implementation process, we combined internal and external resources. That included us, Uniper IT, and Wipro as the external IT / Blockchain architect and consultant. The in-house IT expertise at Uniper was an advantage, so that all three partners were on the same page when working together. At the same time, we felt that our commercial acumen and understanding of markets and customer behavior in combination with Wipro's Blockchain expertise have a very high potential for an interesting and exciting design thinking case.

Since we have an established regular Trading IT innovation round in which people talk about innovation and discuss how IT can enhance business processes, the Blockchain project became part of this round. This turned into a design-thinking process and a number of workshops.

The initial implementation of Blockchain took 2–3 months, which was fast. The necessary adjustments took longer. Rolling out required the onboarding

of people, which was a challenge. It was done with the help of a workshop. The IT stages such as PoC, MVP, and so on had to be combined with the commercial ones, such as small-scale LNG supply negotiations, selection of transportation partners and of course end customer approach. The phase of testing, of user acceptance testing, of bug-fixing, of responding to change requests was next. It took a lot of persistence and communication to turn the Blockchain-bases small-scale LNG platform into a success.

Combining test user accounts with our IT system is a challenge

It took us just under two years from the first steps to the rollout. By now Blockchain has turned into a support function for Uniper; in our business niche, it has become a core process. Traditional LNG trading is well-scaled and overhead costs are in healthy relationship with the margin. You have one cargo with the equivalent of roughly one terawatt hour of gas. The trade can be concluded within 5 to 10 minutes (provided of course there is an existing framework contracts) To ensure acceptable profitability, though, you need a large portfolio of supply contracts, shipping assets and terminal positions, which carries risks and must be built over time.

Established gas trading businesses rely on streamlined processes and substantial trading volumes to add value. At the same time future growth is expected to come from smaller-scale, more complex products. There, decentralization, disintermediation, customer orientation, and flexible, small batches of molecules will be the future. Thus, we have to guarantee that the reconciliation effort, idle times and idle times for each transactions are minimized traceability, and immutability are ensured. For large commodity transactions the current state is efficient enough – one can very quickly agree upon a trade of e.g. one LNG

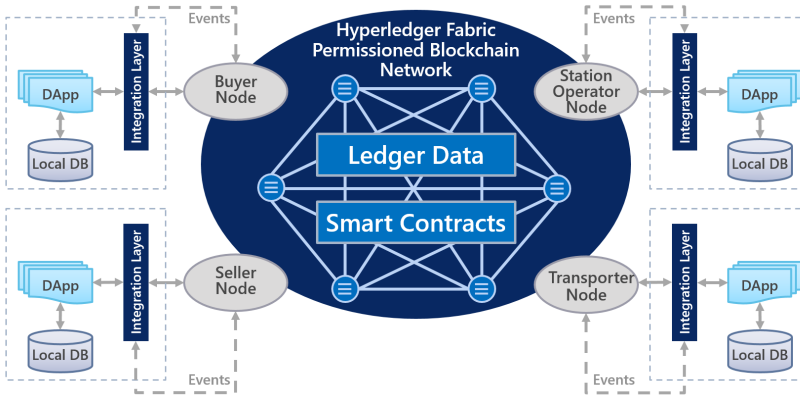

Figure 9: Small-scale LNG platform solution overview.
Source: Shevshenko (2022).

cargo carrying around one terawatt hour of gas. If we look at the delivery of one truckload of LNG, equivalent to roughly 30 megawatt hours, the effort is may not worth it. This has been one of the main considerations for Uniper's subsidiary Liqvis, which has been founded to develop the business of supplying LNG for LNG-fueled heavy-duty trucks via its network of fueling stations.

Entering the nascent market space involving many role interactions and manual transactions requires dealing with complexity early to ensure scalability and growth perspectives. You do not employ dozens of people on day one to track all the trucks, wait for fax messages and emails, compare the invoice with the bill of lading, and deal with customs / port authorities. At the same time, you need to establish commercial portfolio, which can be optimized to ensure that the most competitive source of commodity is tapped. In order to establish the flow of molecules from the source to the customer through efficient operation of the corresponding infrastructure assets, which is the ultimate mission of a midstreamer, we had to find a new way, and that is why we had a look at Blockchain as a supporting technology.

The platform addresses the existing pain points, impeding scalability and growth. It is supposed to transform the small-scale LNG flows into a proper market space, resulting in market efficiencies, easier optimization, significant cost savings for customers and stronger demand base for small-scale LNG terminals and producers. It is based on the distributed ledger that ensures all documentation and all information are on chain and interactions between value chain participants is done in an efficient way. The idea was that the external partners, such as terminal operators, transporters and eventually regulators or customs authorities become a defined access role and an option to host a node on their infrastructure should that become desired.

So far, we have introduced the MVP and talked about it with some of our external partners. We have given them a test user account and gathered and processed their feedback and. The challenge will be to have these request implemented. Such request range from interface requirements to and touchpoints with other systems.

It is better to deal with disruption before disruption deals with you

Our strategic target was to get the application to provide value and to enable a more efficient commodity flow. The first step was to build upon the value proposition of an energy midstreamer as such and to make it fit for a more decentralized fragmented commodity space. This meant developing new facets of the classical mission transforming large commodity positions into more complex flexible smaller customer products and thus earning an additional margin. We saw an opportunity for our company to test ways to expand traditional company strengths addressing global megatrends of digitalization, decentralization and decarbonization. The small-scale LNG platform has been concepted and

launched in a niche environment, nevertheless, it stood for disruption, which some people always consider to be threatening. However, the rationale was: Better to deal with disruption before disruption deals with you.

The organizational benefits included both the business model and the innovative edge that IT was able to represent internally. The same applied to our external IT partner, who was on the lookout for suitable Blockchain use case to showcase its capabilities.

Paving the way for us to create an attractive market space

Market response has so far been very positive. Market participants see the advantages of scalability and flexibility. The business potential is quite promising and we believe the small-scale LNG market growth can be capitalized upon and scaled.

Liqvis business is about marketing LNG as motor fuel through the fueling stations it builds. Procurement of commodity and its transportation is central for the profitability of the operations. At first, when the network is small, the optimization is quite straightforward – one negotiates the supply contract and starts the flows to several stations. Then the network grows and route and price optimizations become complex. If one starts sourcing in more places and plans to optimize the network of flows, it has to be done in a scalable way.

The platform implemented by Wipro enables demand and supply order placement with the corresponding documentation of loading and delivery of goods, the validation of the state of goods, and bill settlements. It further helps us to streamline trade by reducing turnaround time, effort, and inefficiencies. It creates scalability and brings visibility, transparency, and trust in all stages of LNG trade. Strategically, it paves the way for us to become the market maker for the low-carbon modern supply of alternative fuels and decentralized energy solutions.

In the future the platform can be expanded into other commodity markets. Any perspective market where transformation of commodity volumes and customers has hurdles and impedes optimization can benefit from frictionless flows and reduced reconciliation efforts.

IT was enthusiastic, Communications helped us

Uniper IT was very enthusiastic to work and learn while implementing the Blockchain solution. The use case presented a very good opportunity for a «sand pit» environment, where new relatively ringfenced business could be enhances with new digital. The hurdles we excepted to encounter were the stability of legacy systems offering an acceptable operational solution and the focus of our small-scale LNG business on the development of the customer base and on quick rollout of the fueling station network. This may have put the work on specification and testing of the Blockchain platform lower on the

priority ladder. These challenges never quite went away, but once the PoC and then MVP rollouts followed, the momentum was in place and the development process steady.

For business development purposes, visibility and communication are key We have been working with Communications to promote Blockchain internally, as well as externally. We also exchanged the experiences of our Blockchain journey with companies from other branches, which has been very helpful. Such discussions revolve around technology but are in fact about vision of the future of many industries.

Major lesson learned was how to balance strategic visionary development work with the day-to-day business priorities. Shorter term targets are often more critical and it requires constant communication and good arguments to get time and effort allocated where you think the company should grow.

Fortunately, energy industry more and more embraces the fact that adaptability and constant rethinking of the business processes are key success factors, something that ensures that companies will continue provide value for the customers. Creative energy and entrepreneurship have always been necessary in the pursuit of profitable position. The gas market is a living proof for that – the integrated business model had to evolve with the onset of liquid gas hubs and after that the megatrends of decarbonization, decentralization and digitalization needed to be addressed. Fortunately, Uniper possesses strong capabilities making success possible. Among them are customer-centricity, experience in energy asset operations, strong culture of innovation. The Blockchain project of small-scale LNG platform built upon these strengths and showed possible way towards growth in a new market space while addressing complexity.

The interview was conducted in November 2019.

Dr. Grigory Shevchenko
Senior Account Manager, Gas Supply & Origination, Uniper

Native of Saint Petersburg, Grigory has received his PhD in Bremen and applied his background in international financial markets in commodity business. Starting his European career at E.ON Ruhrgas AG, Grigory has accomplished many transformational and business projects around origination, portfolio management, commodity innovation, trading, new market entries, business and IT leadership. His current focus is in origination of gas structured deals and new business models in the low carbon space. Grigory builds his work upon front-to-end knowledge of trading environment, successful track record of profitable business streams, counterparty and customer relationships.

(Continued)

He sees his mission in generating and implementing trading business transformation ideas. He builds upon extensive network of industry contacts and bridges it with Uniper's strategy and capabilities with one goal to create a sustainable P&L flow. He innovates in all aspects of commodity space, including low carbon commodities working along Uniper's mission as a leading European midstreamer potentially bringing substantial value to customers pushing for sustainable, secure and economic energy supply. He is also active in academic aspect of energy marketing and trading academically. He was a frequent guest-lecturer at Gubkin State University of Oil&Gas (Moscow) and St.-Petersburg State University of Economics.

9) Chargeurs Luxury Materials: Looking for a technology to share data within the supply chain

Francesco Santoro, Chargeurs Luxury Materials

Chargeurs is a global, diversified group with leadership positions in niche markets, both in manufacturing and in services. It operates with four business divisions: Chargeurs Protective Films, Chargeurs PCC Fashion Technologies, Chargeurs Museum Solutions, and Chargeurs Luxury Materials.

Reporting on the origin of materials becomes increasingly relevant with the ratification of the Sustainability Directive of the European Union (CSRD) in early 2023. A platform-based approach to gather the necessary information via Distributed Ledger Technologies may be the most efficient way to handle the data.

This case serves as an example how digital technologies can extend the value proposition of already existing business lines, while perceiving stricter regulatory requirements in terms of reporting standards as a business opportunity rather than a threat.

Background: Looking for a technology to share data

Chargeurs Luxury Materials started its project with a preliminary study to assess the available data technologies that were suited to support the division's requirements in terms of traceability and supply chain transparency for itself, its customers, and its supply chain partners.

For this purpose, these technologies were divided into two groups, i.e., into widely used major technologies and new, disruptive ones. The best candidates in each case were selected with the help of a SWOT analysis.

From a technical standpoint, the division's main objective was to find a technology that allowed its teams, partners, and customers to easily and securely share data.

At first the traditional Salesforce-based solution came to mind. Eventually, though, the shortlist comprised only two candidates: an application backed by a decentralized Blockchain and an application based on Salesforce infrastructure and its Platform as a Service tools.

In the end, Blockchain made the grade due to its third-party auditability, decentralization, traceability, and non-repudiation of transactions. All these characteristics supported the division's demand to make their product traceable and transparent (as to ethical sourcing), and to use these assets in terms of a value proposition for their customers.

Of course, adapting a new technology can be risky; it lacks maturity, and the success stories as to its implementation are still rare. However, since Blockchain was the only technology to satisfy the division's requirements, Chargeurs Luxury Materials went for it. If it worked, the strategic and organizational benefits would be high.

Implementation

Chargeurs Luxury Materials belongs to Chargeurs Group. This structure enabled the division to use their own resources as well as those of the Group.

In order to prepare the project's implementation, the division built a diverse team including experts of the textile industry, who had been working with the division, and IT experts. The IT experts came from both the division and its partners. Their task was to design the data model. The technical development was externally handled by a startup.

In terms of project organization, Chargeurs Luxury Materials chose a project manager whose responsibility was to work both with the project team and the startup. The project manager came from the Group's corporate teams. He was only temporarily appointed to manage the Blockchain implementation process.

The task of the entire team was to define the planning process and the related business requirements. A functional specification document was designed for the startup team so that they would be able to implement the solution as requested.

The project manager had the necessary knowledge in terms of Blockchain technology.

Due to the way they organized the implementation process, Chargeurs Luxury Materials succeeded to produce the necessary documentation for the technical team to start the development in February 2018 and complete it in June of the same year.

Private Blockchain and Ethereum

Chargeurs Luxury Materials uses both a private Blockchain, that stores the supply chain data on a private decentralized infrastructure, and the Ethereum public Blockchain, that contains an anonymous version of this data.

This way the division can use a private Blockchain to keep their business data safe, and at the same time guarantee third-party auditability in the public Blockchain.

However, all partners of the division have access to the private Blockchain. If there are data modifications, they will appear in the public Blockchain as well.

What can be seen on the public Blockchain is a code calculated from the private Blockchain data that continuously changes as the data in the private Blockchain changes.

In other words, the public Blockchain is used to audit system changes of the private one and ensures the division's customers that data on the private Blockchain will be traced on the public one. Even if the private Blockchain were to shut down, the history of its changes would still be available on the public one.

However, the private Blockchain will protect the confidentiality of some information, such as the production volume information of a partner, to name just one.

The application as a core element

Since Blockchain is used to log the transfers of materials and their transformation into a product as transparent parts of the supply chain, it has become a core element of Chargeurs Luxury Materials. Another advantage of the visibility of the new platform has been the possibility to detect fraud. With the help of Blockchain, Chargeurs Luxury Materials has been able to observe, for instance, if the weight of goods that have been received is the same as the weight of goods that have been shipped. If not, the system will automatically generate a notification and thus serve as a prevention of fraud as well.

Customer participation

Chargeurs Luxury Materials is at the bottom of the garment production supply chain since the division only deals with a raw material (wool). However, thanks to their Blockchain platform, they are now also playing a coordination role for the entire supply chain, which means, that fashion brands have turned into their direct customers as well. These are renowned companies that decided to actively use the Blockchain platform of Chargeurs Luxury Materials, where they can check data coming from the division and its supply-chain partners. So far these are four big direct customers. Overall the division by now manages data coming from more than 20 partners.

It is worthwhile to note, though, that the system does not contain confidential and sensitive information, such as prices and financial transactions, to name only some.

Chargeurs Luxury Materials owns the platform and can monitor the access and the data uploads. In addition, the data within the Blockchain is connected (via an application programming interface) to a responsive website that final consumers can access by simply scanning a QR code.

As of today, the division does not yet have the exact information on how many people are scanning these QR codes. Monitoring the access of their customers and partners has shown about 80–90 uses per month. The division's own teams and partners add data on a bi-weekly basis.

Customers do not pay an extra fee for the transparency the division's Blockchain offers. Instead they pay a premium included in the product price to benefit from this service.

Next challenges

So far the platform has been regularly used by the division's internal teams, its supply chain partners, and its customers. Customers access the platform to obtain information regarding the products that they purchased from Chargeurs Luxury Materials and the respective supply chain. As of today, there are thousands of data available that increase weekly.

By now the division has integrated new features into its Blockchain to improve both the performance and the robustness of the application. One of the issues was the process of big data volumes, where the performance for users trying to retrieve the data had been below expectations. Changes were made to scale from hundreds to thousands of data.

As to next steps, Chargeurs has identified both technological and organizational challenges. Technologically, the system still needs to be tested with big data workloads. Performance and reliability will have to be checked under this condition as well.

Another challenge relates to the interface of the division's platform with the IT systems of its partners and customers. The division's Blockchain platform requires a large number of data from its partners and is currently working with them to create data exports that can be sent automatically to the division's platform thus making data extraction more simple and convenient.

Speed is another challenge. Chargeurs Luxury Materials is trying to provide its partners with an automatic tool to produce the necessary data faster than today.

Organizationally the division is faced with the challenge to transfer full platform ownership and expertise from the project team to the end users, including those who have little IT expertise. This is difficult as the project manager was hired only temporarily from the Group and the platform's technical development was outsourced. The division's plan is now to train the end users and make sure that they acquire new competencies in IT without having either to ask for experts from the Group or hire someone from the outside.

Business potential

Chargeurs Luxury Materials decided to use Blockchain because this technology provided a value proposition for its customers. In the fashion industry it was thus the first company to offer end-to-end traceability.

Due to this competitive advantage, the division gained new customers. In addition, it improved its standing in the fashion industry; according to market research results, this industry is now focused on product sustainability, traceability, and transparency. Therefore, Chargeurs Luxury Materials expects that it will acquire and serve even more customers in the future.

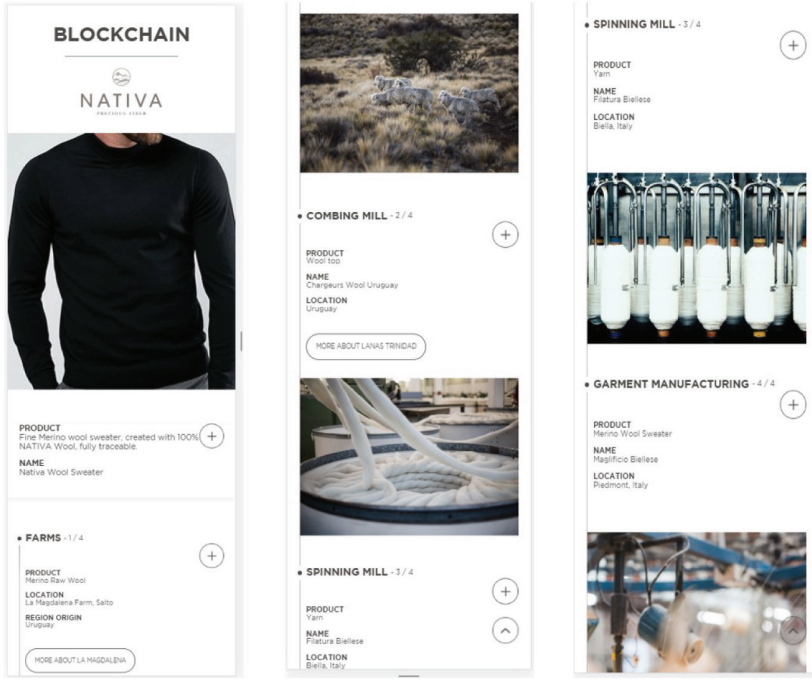

Figure 10: Screenshot of the NATIVA™ Blockchain Website.
Source: Santoro (2021).

The main business potential, though, is seen in the competitive advantage and in the platform's support of sales in the short and the long term.

Internal acceptance of Blockchain

Since the beginning, the project was perceived as highly innovative and disruptive. People were interested to understand how Blockchain worked and wanted to know what the division meant to do with this technology.

It was the first time in the history of Chargeurs Luxury Materials that such a project was undertaken –and the first for Chargeurs Group. So the questions were coming from within the division and from other business divisions.

While the project was met with considerable interest, people particularly wanted to know, what was the business potential, the implementation challenges, and the customer feedback.

Therefore, the division invested time to first present the Blockchain project to its own teams. For this purpose, it prepared presentations and demos with the help of its marketing experts.

In the beginning, the priority of these presentations was to align the division's operations and sales teams and instruct them as to the benefits and limitations of the new Blockchain platform. It was vital that they understood the system properly so that they could explain it to their customers.

Then the division provided information about the project to all teams and employees of Chargeurs Group using the Group's newsletter (sent on quarterly basis).

The information output regarding the Blockchain project and its main milestones continued during the whole process. This was extremely important as it was the first step to share the experience gained from this project with all other Chargeurs business divisions.

Next Blockchain users within the Group

Given the successful completion of the project, Chargeurs Luxury Materials received a number of internal requests for further information. They came from those business divisions that were willing to test the concept and see if the technology could apply to their own operations or product offering as well. The division Chargeurs Technical Substrates has by now decided to build a Blockchain platform for the traceability of technical textiles. This project started in June 2019. Their project team has been selected internally and they are working with the same startup for the technical developments Chargeurs Luxury Materials used.

The division Chargeurs PCC Fashion Technologies is also looking into Blockchain to answer questions from their customers in the fashion industry.

In short, the Blockchain project of Chargeurs Luxury Materials paved the way to adopt the technology on Group level for all cases where this technology will be advantageous.

The interview was conducted in November 2019.

Francesco Santoro
Digital Project Manager, Chargeurs

Francesco has been Project Manager at French company Chargeurs, a leading textile manufacturing group, since January 2018. Beforehand, he received a Master of Business Administration at the Collège des Ingénieurs.

In 2015/16, he held a position as Software Engineer at 6WIND, being responsible for the integration of 6WIND solutions with Openstack cloud orchestrator, managing technical partnership with Mirantis, and being in charge to develop new features to 6WIND products.

10) Innofactory: Creating a Blockchain hub for the Swiss banking industry

Mark Chardonnens, innofactory

The Berner Kantonalbank BEKB (Bernese cantonal bank) counts around 470,000 customers, mostly in the Swiss capital's canton, Bern, and the adjacent Solothurn region. Founded in 1834, the bank became Switzerland's first digital marketplace for tokenized assets in December 2021 (Frick, 2021).

Setting up a new venture within a traditional organization requires strong leadership skills and an awareness of the necessity of digital disruption, which is communicated by agents of change, and an institutional setting that allows for experimentation.

This case highlights the importance of integrating internal stakeholders, especially top management, and external customers into the innovation process.

Background: Digital innovation made in Switzerland

The Innofactory is a joint venture between Berner Kantonalbank, which is one of the largest banks in Switzerland, and the Hypothekarbank Lenzburg, one of the smaller banks in Switzerland. They are two of the most digitalized banks in Switzerland. The joint venture combines the different cultures of these banks: the small one that quickly brings innovation to the customer, and the larger one that tries to leave behind its conservative past and become more innovative. The Innofactory is somewhere in the middle, trying to create solutions for customers in the financial industry.

The Innofactory is like a marketplace where projects get pitched, funded, and implemented. In the financial industry, all the banks can join and participate, for example by giving 20 percent of their money toward a project as well as providing 10 people to work on it. For each project, we try to find partners. If it is related to software development, we collaborate with software developers. If it is for the hardware industry, then we look for an industry designer, for example. If we reach the project goal, then every partner who participated in the project gets the whole solution and can start to work with it. They can even use it for Open Innovation. The partners can do what they want with the results.

Before my personal involvement with the Innofactory, I worked as a software developer, building up the IT architecture for the Berner Kantonalbank. The writing of my master's thesis on innovation management coincided with the start of the Innofactory.

The project: Integrating blockchain in the banking world

In 2019, after finishing a big project, we held a reception, during which a senior trader approached me to talk about the massive changes for trading coming in

the future. He said that integrating distributed ledger technology could help when trading. I also thought it was an interesting technology. I thought that we should start a new project in the innovation department so that we could have a research area to become more familiar with the idea of blockchain. Could we bring blockchain to the banking world? Which hurdles would we face?

One or two weeks later, the board members of the Berner Kantonalbank decided during a strategic meeting to start a research program on DLTs, or distributed ledger technologies. The strategic side and the execution side were created together. This was to find out whether it was a topic for the bank to pursue or not. We wanted to understand which systems already existed, how to adapt them, and even how to use them without any changes. How could we bring blockchain to normal trading?

The proof of concept

Our first goal was the proof of concept and to put 100 tokenized shares on a marketplace. My colleague from the reception could buy these 100 shares through the marketplace. Will we get the match? Will we get the orders? Can he execute the orders?

It took us four months to accomplish this proof of concept. In our test environment, defining the conditions was not a problem. At the beginning, to be honest, we thought we would go from failure to failure to find out which systems had to be manipulated and to adapt all the systems. However, at the beginning, we actually did not have any problems. The systems were very open, and we were able to configure parameters to pass all the systems. We understood how to get the Blockchain and the core banking system to interact. We wrote a simple application. It took four or five days to include all the tokens that we saw on the Ethereum Blockchain. We could rebuild a depot or portfolio with the normal shares in the core banking system and bring these two worlds together without any great obstacles.

We then returned to the board members and put two TVs in front of them. In the middle, we placed a projector. On the first TV, I spent my 100 shares. We said, «Now we are on the marketplace. You can see here my placement.» My colleague went to the marketplace, took these 100 shares and wanted to buy them. We showed them the matching place and the matching engine. On the execution engine Etherscan, we showed that the transfer was made. This was a key moment in this project because most of the board members did not realize what Blockchain technology was. For the first time, they saw it in action as well as its power. Since the share registry is updated in almost real time, one can see if somebody switches shares. The settlement is done instantly – we call it T+0. In the conventional world of banking, we have T plus two days or up to 40 days, depending on the share. This was really a huge moment. The board then responded, «Okay, cool stuff. But what can we offer to the customer?» Figuring that out was the next step in the project.

The technical side and customer integration

We started to build a product description with the Business Model Canvas and Value Propositions. We generated many ideas, even those that we knew would not work for the customers. After several iterations, we found a way for the customer to access digital assets. However, we decided not to include cryptocurrencies, because at this point in the project, cryptocurrencies were considered «bad things,» «dark things» in the banking world. We instead wanted to tokenize some shares.

Coming from the technical side, it was totally clear for us that every client would have a wallet. The bank would manage the wallet and customers would have access to their wallets via e-banking. They would not have to install another app or get a special ledger. Instead, everything would be fully managed by the bank. We developed a prototype and went to customers to validate our idea. Around 80 percent of the customers responded with, «What is a wallet? Why do I need a wallet? I don't want a wallet. I just want to get the digital assets.» We were stunned, asking ourselves, «What is the problem with this wallet?» First of all, most of the customers did not even know what a wallet is. We learned that we needed to make more of an effort in the knowledge transfer to the customers so that they understood the function of a wallet. We decided to change our strategy. We kept the same validation process, but we avoided showing a wallet to the customers. We instead just presented the depot as they were used to with their other shares, allowing them to simply make a transfer to that particular depot. This turned out to be no problem for our testers. At this point, we decided to switch direction and build a solution for our customers. They did not care whether they used a wallet or a depot, or anything else. They just wanted the shares from Nestlé, UBS, and the like. Maybe they also wanted to tokenize shares from a company, but all-in-one.

This was a strange period in the project. On the one hand, we worked on the specifications for how to implement all the high-security modules and bring the wallets together to the core banking system. However, on the customer side, we faced tremendous differences with the proof of concept that we had initially made. We had to change it. Fortunately, we did not lose a lot of time with that, but for us it was a bigger problem than the technical side.

Building the innovation ecosystem

After the validation, we moved ahead with finding some partners who would help us build an ecosystem. For the primary market, we needed a partner that was able to tokenize the whole capital structure of a company. We needed a partner that could also take care of the legal requirements. We needed the technical

part for the HSM, the high security module, and for the wallet infrastructure. Finally, we needed another partner for the trading system, the matching system, the execution system, and all of that.

We made an RFP, request for proposal, sent it out, and got some answers.

At the end of August in 2020, we found a partner for the primary market. For the infrastructure, we would team up with Hypothekarbank Lenzburg and Taurus. For the trading system, we partnered with a company that already had such a system in the Berner Kantonalbank.

At that point, the bank decided to start a normal waterfall project for building all the systems. The Innofactory was out of the project. But after three months, they realized that Innofactory would be better suited to complete the project in the required time to market – or even in a shorter time to market. They wanted to have a chance to be one of the first in Switzerland to offer this digital asset. We decided to return to this project but to change the whole project setup. We said, «Forget waterfall!» We started to apply Agile ways of working, with the goal of being technically ready within three months. At the end of November, we started with the first sprint. Already by the end of December, all of the technical functionalities and basic infrastructure were ready and installed, including all the network connections used to interact between the systems. In January, we had finished building up a new high-secure module. At the end of February, technically we were completely ready, and in March we planned to start tokenizing some shares.

We also had to get approval for our project from the financial authority, the *Finanzmarktaufsicht*. We explained the whole project step-by-step, and they raised questions such as: «Where are the tokens generated? On which chain is it? Is it public? Is it private?» This was the moment when we realized that we had to bring our know-how to these people as well and take them on our journey. For that, we needed some months.

In August 2021, we started with the operation of the system and were able to open wallets. We looked for companies that were interested in tokenizing their shares and found them. But your company is not ready to tokenize shares until a decision to change the charter is made by the general assemblies, or as it is called in Switzerland, Statuten. Once this is done, it has to be announced by the commercial register (*Handelsregister*) to let the public know that the company has changed to tokenized shares. This process took time.

The lessons: Communication and seamless customer integration

For me, one key moment during the project was during the meeting of the management board when the board members came to understand Blockchain technology. They could also play with it on their mobile phones and see it,

«Okay, it's that way. It's on Etherscan, I can see that.» From that point onward, they were very supportive, even if at the start of the project we had to invest a lot of money and earnings would only come much later.

A second big lesson was the effort we had to undertake on the legal side. At first, we thought that it was a technical project and that we were bringing a new technology to the bank. But we underestimated the legal requirements.

Yet another lesson learned was how to inform the employees of the bank. Around every month we taught new employees about Blockchain, what Ethereum is, why we use an ERT 20 token for that, and what we are generally doing. We also had to do that with the advisors so that they would be able to explain it to their customers. Coming from the technical side, we had to switch to the commercial perspective. Around the second sprint, we decided that we had to bring all the «product guys» into the project. They had to understand what we were doing in order for them to write a product description. By bringing in people and informing them early on in the project allows them to help you make a good product that will be accepted by the customers.

Where we are, and a glimpse into the future

We are now at a point where we can communicate the benefits of the technology. One of them is the time issue. Banks can get more capital, new capital, much faster than if they offer an IPO or something similar. Banks can also bring projects together. For example, all the small and medium-sized enterprises from a region can be enclosed in a single project that customers can invest their money into. This allows the bank to build new products, not only regionally but also within industries or branches in a so-called enclosure product asset allocation. Companies can adjust their processes for new shareholders, for example, by welcoming them. General assemblies can be organized on the Blockchain. It is so much faster from a governance perspective for shares, rights, and for combining products or developing products.

For the next step, we want to open the marketplace. At the moment, you have to be a customer of the Berner Kantonalbank if you want to trade something on the marketplace. We also plan to open it up to third banks to bring their orders to the marketplace. We also want to make advances with respect to cryptocurrencies. On the technology side, we are able to store cryptocurrencies in the wallet – this is not a problem. But from a legal perspective, the bank has to decide whether it wants to do that or to instead wait. In addition, we have some topics in the pipeline, such as NFTs, non-fungible tokens, and would they – from a marketing perspective – become part of a new brand that we want to establish, or would they be part of the same brand?

The interview was conducted in February 2022.

Mark Chardonnens
CEO, Innofactory AG

Mark became the CEO of Innofactory in early 2020. Beforehand, he worked for 15 years in various functions at Berner Kantonalbank AG, including the head of IT architecture.

He received his academic education at the Berner Fachhochschule BFH, including a Master of Advanced Studies in Information Technology.

PART 3

Lessons Learned

CHAPTER 6

Lessons Learned and Future Perspectives

The final chapter of this book contains three parts. The first part serves as an «executive summary», in which the authors outline key findings from the interviews. This part may be particularly useful for readers with a limited amount of time available, such as middle managers or top executives. The second part builds on the same framework but enriches and expands each finding and legitimizes it with excerpts from the interviews. The third part provides an outlook on digital technologies, and how organizations and society will cope with the challenge of digital transformation in the future.

As introduced at the end of Part 1, the book uses the meta-analysis of 18 digital transformation frameworks Bumann and Peter (2019) to identify six dimensions or «action fields» that are applied most frequently in the scholarly (and grey) literature. They encompass the areas of technology, culture, strategy, organization, customers, and people/employees.

Based on the qualitative findings and corporate narratives of the interviews, the authors have identified three clusters within this framework. The first cluster focuses on the category «technology», because the novelty of algorithms and software tools represents a challenge related to the fact that business units scarcely have obtained experience with this type of disruptive innovation and are confronted with a technology that may exceed their organizational capabilities.

The second cluster, comprising «strategy and organization,» refers to the upper levels of the Strategy Pyramid, by which companies define their approaches to digital innovations and restructure their organizations accordingly.

The third cluster identifies «culture, people and customers» as one of the most challenging hurdles, with deeply engrained routines and leadership styles from top management that may delay or prevent successfully leveraging digital innovations.

How to cite this book chapter:
Burger, C. and Weinmann, J. 2024. *Leveraging Digital Innovation: Lessons for Implementation.* Pp. 93–120. London: Ubiquity Press. DOI: https://doi.org/10.5334/bda.f.

Practitioners' summary: A digital innovation roadmap

The academic literature on digital transformation provides extensive analyses on the occurrence of certain topics and the «What?» (see e.g. Nadkarni & Prügl, 2021; Reis & Melão, 2023), but they often lack the practitioner's perspective tackling the question of «How?».

The intention of collecting the narratives of this book is exactly the «How?» – how can the process of implementing and leveraging digital innovations be successfully managed?

Based on the three clusters «Technology», «Strategy & Organization» and «Culture, People & Customers», the following graph sketches a roadmap and checklist for executives when they embark on the process of implementing a disruptive digital technology.

In the subsequent overview, the authors outline in sequential order the topics that the interviewees of this book portrayed as essential for their respective implementation:

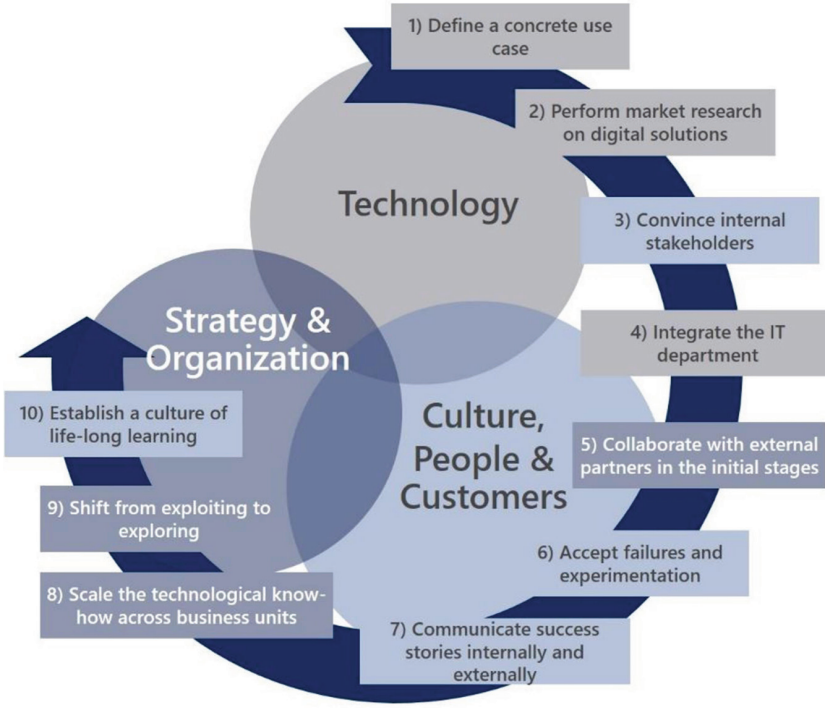

Figure 11: Digital innovation roadmap.
Source: Own illustration.

1) ***Define a concrete use case:*** Even more important is that the choice of technology is a compelling use case that justifies the effort. This can be either a concrete process optimization task, or a new business opportunity that requires an untested technological solution.
2) ***Perform market research on digital solutions:*** Instead of being fixated on specific digital technologies, the interviewees of this book appear to be agnostic towards the choice of the technology, as long as it serves the purpose as defined in the use case. In some of the best practice examples, conventional data analytics may suffice even if more sophisticated solutions, such as AI algorithms, sound more appealing and marketable.
3) ***Convince internal stakeholders:*** The buy-in within the organization requires communication skills, a solid, strategic network of like-minded peers, and patience. Various stakeholder groups must be managed effectively, especially top management, ensuring alignment with the strategic priorities of the organization. A further important stakeholder group are domain experts who are essential for the success in providing their specific knowledge to the project.
4) ***Integrate the IT department:*** Any disruptive digital technology is embedded in the larger operating system and has multiple interconnections with the legacy IT infrastructure. Representatives of the classical IT department remain essential in the facilitation and provision of resources, the implementation process, and the roll-out.
5) ***Collaborate with external partners:*** During the initial stages of the implementation, collaboration with academics, specialized consultancies or startups enables a head start with quick wins. In later stages, the organization can choose whether to build up internal expertise or remain in a mutually beneficial innovation ecosystem.
6) ***Accept failures and experimentation:*** Launching a disruptive digital technology always entails the risk of failure. A corporate culture that lacks psychological safety and the possibility of reporting errors is prone to stagnation or longer-term decline, also touching upon cultural topics, such as a «fail-forward» mentality and the promotion of a more entrepreneurial mindset.
7) ***Communicate success stories internally and externally:*** «Quick Wins» have an important psychological effect, both within the exploration team and the wider corporate audience, in particular the marketing and sales departments eager to position innovative content on social media platforms. In addition, a clear communication strategy may have a positive impact in terms of endowment and resources for the project, but may also serve as a role model for other departments within the corporation.
8) ***Scale the technological know-how across business units:*** Buying in know-how from outside providers may be a valid strategy in the initial stages of a project, but the longer-term objective of many interviewees

for these best practice cases seems to be an internal solution, building up proprietary algorithms and in-house expertise. This can materialize either via dedicated competence centers and technology ambassadors, the integration of externals within business units, or as a connected but legally separate organizational entity.

9) ***Shift from exploiting to exploring:*** Many projects described in this book started off as pragmatic tools for process optimization and enhanced operational efficiency, but they ended up as new business lines to be launched externally, thereby becoming new pillars of growth for the company.
10) ***Establish a culture of life-long learning:*** Transformations interfere with many established processes and may induce digital anxiety. Communication of adaptive changes is at the core of the cultural shift, inducing a sense of urgency and building on psychological phenomena such as loss aversion. Organizations must take all internal stakeholder groups into consideration, especially top management and domain experts, as well as their sales units, and important external customers.

This roadmap is not a guarantor for success. However, it builds on the cumulated experience of successful agents of change. As guiding principles derived from corporate experience, the next section of this book offers the possibility to delve directly into the testimonials of the interviewees, following the three clusters «Technology», «Strategy & Organization» and «Culture, People & Customers».

Technology

In the larger context of digital transformation, two contrasting approaches to technologies or, more precisely, information and data-processing technologies can be observed:

In the first approach, they are considered a necessary prerequisite but rather in a secondary, subsequent role – selected after a managerial, top-down decision process that defines the overarching strategic goals, such as outcome-based servitization, platform economy, or customer focus, as formulated in an exemplary way by German chemical company Henkel (2022).

The second approach towards technologies can be characterized imitation and strategic «Bandwagoning.» Bandwagoning is a typical phenomenon of corporations in situations of uncertainty, according to DiMaggio and Powell in their seminal paper on institutional isomorphism (1983). As digital transformation overthrows many established business practices and routines, it seems rational that organizations observe and imitate the activities of their competitors, they «follow the herd» with the intention to compensate their informational disadvantage vis-à-vis other companies they consider innovators and pioneers in their respective industry verticals. However, implementing a digital technology primarily because other organizations do it, or – even worse – just

for the sake of marketing purposes, as it happened for example during the Blockchain hype in some companies in the mid-2010s, typically does not lead to a competitive advantage or lasting economic success, especially when a technology is still in the stage of initial diversity with no dominant design having emerged yet.

Our interviews reveal, though, that a thorough understanding of digital technologies, their capabilities and limitations, can serve as a strategic trigger for internal process optimization or external business opportunities. Most importantly, discussing and defining a precise use case prior to the launch of any disruptive digital technology yields concrete, quantifiable results that can spearhead a larger, company-wide implementation, as the next section explains in greater detail.

Defining a concrete use case

Across all interviews, a recurring pattern suggests that a practical application of the digital technology is at the core of a successful implementation strategy. It can be observed that defining a plausible use case is the necessary precondition to get approval by key stakeholders in the organization. Given a larger portfolio of potential use cases, a focus on those that yield benefits quickly appears to be the most promising pathway. For example in the choice of RPA use cases, Stefan Weih from Allianz comments: «We started with projects that promised an early win.»

More concretely, the best practice cases of this book show that disruptive digital technologies are most likely to find corporate approval and get successfully implemented if the use case is clearly defined and corresponds to at least one of the following two objectives,

- either a concrete process optimization task,
- or a new business opportunity that requires an untested technological solution.

These two options correspond to our findings in the poll on the implementation of digital technologies, as presented in the introductory chapter.

In the first type of use case, a business unit faces a challenge that could be resolved with a hands-on, often quick-win implementation of, say, an algorithm. A typical example would be RWE's Forecast Combination Model (case 4). Increasing the precision of short-term weather predictions for renewable electricity generation assets has the advantage that – when operational – it immediately yields higher returns by reducing forecast errors. Thus, the use case becomes obvious to internal stakeholders. Given the frequency of the application, the model can be refined and improved, thereby contributing more generically to an effective risk mitigation strategy.

The second type of use cases concerns an extension of a company's portfolio of products or services, catering for adjacent or completely new

and disruptive markets with the support of digital technology. Uniper's move towards a Blockchain solution serves as an example for this motivation (case 8). Coming from conventional bulk natural gas trading, which involves big volumes in a low-margin commodity business and has been characterized by extensive manual and paper-based transactions in the past, the energy mid-stream company wanted to enter the market of small-scale liquefied natural gas (LNG): «There, decentralization, dis-intermediation, customer orientation, and flexible, small batches of molecules will be the future.» (Shevchenko, case 8) The complexity of transactions and coordination of actors involved in the value chain would not have been cost-effective with the conventional approach, so Uniper turned towards a Distributed Ledger Technology to reduce process costs via digitalization to tap into a new, more complex gas supply market segment.

The more a use case becomes ambitious by affecting or transforming the fundamental business model of the company, the more it may be perceived as a potential threat to some internal stakeholder groups. Christopher Kränzler, CEO of Berlin-based startup Lengoo, explains that a cautious approach may yield greater benefits than a far-reaching attempt to fundamentally overhaul the IT back-end: «I would advise everyone, who plans to get into machine learning, to never start implementing it in their core process, but in a peripheral process first. Winning acceptance for a technology is a fundamental success factor, and it is a lot easier to achieve this if you start with a process that is not essential to the user's everyday performance but ultimately has a positive impact on them.» (Kränzler, case 6)

The selection of the appropriate digital technology can be seen as a process of convergence between its evolving technical capabilities and the management know-how to connect them to relevant use cases. For example, the initial Blockchain and Distributed Ledger Technologies were fairly limited in terms of transactions per second and the respective complexity of the transactions, while being hampered by a relatively high energy consumption per transaction. Over the last years, new DLTs have been developed that tackle all three initial deficits, hence making DLTs more attractive for use cases. After four years of preparation, even the second-most highly valued DLT Ethereum succeeded in moving to the faster and more energy-saving proof-of-stake consensus mechanism (Chipolina, 2022).

Performing market research on digital solutions open to all technologies

In the best-practice cases of this book, corporate decision-makers appear to be agnostic towards the choice of the technology, if it serves the purpose as defined in the use case. The example of Chargeurs highlights this approach (case 9): «From a technical standpoint, the division's main objective was to find a technology that allowed its teams, partners, and customers to easily and securely share data. […] Of course, adapting a new technology can be

risky; it lacks maturity, and the success stories as to its implementation are still rare. However, since Blockchain was the only technology to satisfy the division's requirements, Chargeurs Luxury Materials went for it. If it worked, the strategic and organizational benefits would be high. […] With the help of Blockchain, Chargeurs Luxury Materials has been able to observe, for instance, if the weight of goods that have been received is the same as the weight of goods that have been shipped. If not, the system will automatically generate a notification and thus serve as a prevention of fraud as well.»

Another pragmatic approach is exemplified by Allianz (case 2). By implementing RPA, the company found a solution to how to deal with legacy IT: «RPA, by its nature, and being independent of the underlying systems, delivered what we were looking for. It was quite handy and fast to deploy. We also use it as a bridging technology to new systems. It bridges between the new target solution and the legacy systems; not only for pure data migration, but also to maintain the process in the time of transition.»

The agnostic approach to assessing all available options seems to be more promising than a predetermined focus on one technology – an observation that is equally true for the choice of potential partners for the implementation, as highlighted in the in the section on business strategies in this chapter.

Integrating the IT department

Another observation derived from the interviews relates to the integration of the new technologies into the IT legacy system. In particular, seamless access to existing data silos and warehouses is crucial for the success of a disruptive digital technology, as it is embedded in the larger operating system and has multiple interconnections and Application Programming Interfaces (APIs) with the front-end or back-end capabilities of the IT infrastructure.

A key role in this integration is played by the traditional IT department. Its changing role over the last decades may have been «a troubled one» in the overall context of organizations, as Ward and Peppard (1996) observe. It can be differentiated chronologically into three different phases. In the first phase, the perception of IT department could be coined «priesthood,» according to Peppard (2021), with all required knowledge to be located in the IT unit and the CIO as a functional manager. Following Peppard's characterization, the second phase in the perception of the IT department rather focused on its service functionalities and «partnership», with the objective of understanding business requirements as a vital ingredient of an organization's physical and informational infrastructure and the CIO as a «boundary spanner.»

Since awareness of the importance of digital transformation has steeply increased over the last five to ten years, the third phase of the IT department's changing role is characterized by a more pro-active integration into a company's strategy formulation and implementation, with the CIO as an «orchestrator» and the objective to «optimize opportunity from technology» (ibid.). The most visible

indicator for this increasing appreciation of data, analytics and communication issues is the emergence of a Chief Digital Officer (CDO) in the C-suite of especially larger corporations (Haffke, Kalgovas, & Benlian, 2016; Horlacher, 2016). Many of them have opted to allocate the task of accelerating digitalization and become «Digital Evanglist» or «Digital Advocate» – hence, one important future pillar of growth – to the CDO (Haffke et al., 2016), whereas traditional CIOs in this division of responsibilities rather have to deal with the complex objective to maintain legacy IT systems, ensure day-to-day operability and cybersecurity. Haffke et al. (2016) describe the separation of roles as an attempt to resolve the dilemma of ambidexterity that CIOs were previously facing. Some organizations, such as German chemical company Henkel, have returned to a unified solution by merging the two roles into a «CDIO» (König, 2021).

Throughout the cases in our book, though, the classical IT department remains essential in the facilitation and provision of resources and in the implementation process. This collaboration can materialize in facilitating access to existing data warehouses or the company's data lake, for example in the case of RWE's forecasting model for wind farms, as Dominik Felske (case 4) explains: «Since our model required the handling of huge amounts of real-time data, we collaborated with our IT department. They are responsible to maintain and organize our assets and have all the data available from the various wind farms, but the software, or the tool itself was developed by us.»

In the case of implementing AI at business school Saint Paul (case 5), the CIO personally joined the internal implementation team to ensure a seamless integration of the new functionality into the existing IT system using application programming interfaces (APIs).

Uniper's team to implement a Blockchain solution for LNG trading included not only Wipro as the external IT/Blockchain architect and consultant, but also the internal Uniper IT (case 8): «The in-house IT expertise at Uniper was an advantage so that all three partners were on the same page when working together,» Grigory Shevchenko from Uniper comments. «IT was excited to implement Blockchain. The major hurdle was that the legacy systems seemed just too stable to change. But once Blockchain was implemented, people were happy with it.»

The cases in this book are derived from anecdotal evidence, but they consistently highlight the role the IT department plays in the process of digital transformation. Its integration at an early stage of the implementation process is an important lever for the success of the overall project.

Strategy & Organization

The topics of strategy and organization are closely intertwined, as our interviews suggest, since all top-down strategic decisions must find their equivalent organizational reconfiguration to be successfully realized.

The academic and grey literature distinguishes between early adopters – or market leaders – and market followers (see e.g., Ismail, Khater, & Zaki, 2017). Our analysis reveals that also traditional companies, such as Berner Kantonalbank in Switzerland (case 10), manage to introduce lighthouses of radical digital innovation within selected business units acting as sandboxes and pockets of innovation within the organization. However, even if there is a decisive corporate vision from top management to become more digitally savvy, it still depends on individual agency and empowerment to establish the organizational prerequisites for an in-house digital venture.

Based on our interviews, a model of organizational ambidexterity (O Reilly & Tushman, 2004) has been observed to facilitate the implementation of disruptive digital technologies: Some teams act as «explorers» or corporate startups that are allowed to experiment, lose money (at least over a certain time span), fail and learn, whereas other units would simply «exploit» existing processes with only cautious and incremental steps of digital innovation (Osterwalder, Pigneur, Smith, & Etiemble, 2020). The best practice cases of this book span the entire spectrum of potential implementation strategies: First, developing an in-house solution, for example Turkcell in case 3 and RWE in cases 1 and 4 (albeit often with initial support of external consultants, academics, or IT specialists); second, establishing an ambidextrous organization, such as business school Saint Paul in Brazil (case 5); third, tapping into the wider innovation ecosystem via alliances and partnerships with long-standing external partners, like the Swiss Innofactory (case 10). All three approaches represented in the sample suggest that no «silver bullet» strategy exists, but each implementation challenge must be customized to the organizational context, the strategic intent, corporate culture, and digital expertise within the firm.

Notwithstanding, the interviews provide insights on three key questions during the different phases of the process of organizational implementation. Chronologically starting with the initiation, the first operational question relates to the options presented above, namely, whether new capabilities should be established in-house, or whether it yields faster results to team up with an external partner. Scaling the new technological capabilities across silos and business units is the next organizational question: How can a successful roll-out be secured? The third question relates to the move from internal process optimization to business model transformation and digital innovations that are exported beyond the organizational boundaries.

Collaborating with external partners

Should disruptive digital technology be established in-house, should a ready-made Software-as-a-Service solution be acquired externally, or should a long-term collaboration with an external partner be launched? Should the

organization strive for a unique solution customized to its needs, or should a larger yet less flexible consortium structure be joined?

The interviews with the practitioners reveal several trade-offs between the differing strategies. In case 4, the meteorological prognosis model, Dominik Felske of energy company RWE explains that off-the-shelf solutions are the conventional approach followed by many players in the industry: «When it comes to forecasting for utilities, you are always faced with the question whether you want to do it internally or externally. Most utilities come to the conclusion that in-house forecasting means high fixed costs. External forecasts are cheap. It makes more sense to buy them, find out how best to combine them and benchmark them against each other.» RWE decided to hire a Master's student from the University of Duisburg-Essen: «In his thesis, he developed a concept how to apply AI to choose the best forecasts by combining different forecasts – a concept we refined with him. After that he started to test his concept and implemented it in a monitoring tool.»

An approach often encountered in the cases of this book is the collaboration with academic institutions. In the other case of RWE (case 1), the company's representatives met several times with a professor, whose research area is the connection of the energy market and Artificial Intelligence, to receive state-of-the-art input. For their auction model, they launched an MBA project together with Berlin-based business school ESMT: «We used one of the student projects of ESMT to kick-start this initiative and build up our database. We had five MBA students working on the topic for six to eight weeks. We employed them for conceptualization, but also to build up a first, Excel-based model.» In a second step, RWE hired external experts and brought them together with their commercial domain experts and IT staff to develop and calibrate the tool and turn it into a format which allows people to comfortably use it.

At Turkcell, the implementation of RPA in business processes was steered and coordinated by an internal group specifically created for this purpose, yet accompanied by an outside consulting firm (case 3): «For the implementation process we used internal and external resources, including support from EY [an international consultancy]. At that time, we still needed to discover our roles and responsibilities. What should we do to construct the necessary infrastructure? How should we train our employees to expand RPA and how would we benefit from this technology? So we created a small organizational development team with people from different departments – from IT, Board of Directors' office, HR, Network Technologies – plus the external EY consultant. Our next step will be to hire a number of RPA developers.»

Buying in expertise from outside providers may be a valid short-term strategy, especially for sophisticated technologies, such as Blockchain. Energy midstream company Uniper, for example, used the expertise of a specialized consultancy for small-scale trading transactions based on a Distributed Ledger (case 8): «For the implementation process we used internal and external resources. That included us, Uniper IT, and Wipro as the external IT/Blockchain architect and consultant.»

São Paulo-based business school Saint Paul teamed up with IBM Watson to train it's AI-based student assistant «Paul,» using large parts of IBM's language recognition system – instead of developing its own customized language recognition algorithm (case 5): «We needed total confidentiality. We were developing an algorithm. Not developing from scratch, but customizing an algorithm with IBM. Bruna and I are professionals in business, education, and finance, therefore, we needed the help of IBM professionals.» However, they faced the challenge that Watson's mastery of the Portuguese language was less sophisticated than for English, so «Paul» cannot respond verbally and acoustically, but only as a chatbot.

Like Saint Paul, Stefan Sellschopp of Allianz envisaged a long-term partnership with a deep tech startup rather than a short-term consultancy service (case 7): «Autonomous driving is still new, and we are suffering from a lack of experience, which makes it hard to evaluate risk. Therefore, I contacted Peregrine Technologies. The idea was to understand traffic situations and the many ways they can change. […] We had to be able to automatically detect changes and judge the risks involved. […] With the help of Peregrine, we are able to solve these problems. […] Currently, we are in the process of turning our knowledge into a product, which we will offer to our customers from the autonomous vehicles side.»

The advantages of teaming up with an external partner range from speed of implementation or lack of internal expertise to becoming part of a mutually beneficial innovation ecosystem. Of course, they also bear the danger that solutions become too expensive or are cut out of a company's existing value creation. As data becomes the «New Oil» in tomorrow's economies, collaborations with outside partners especially in data analytics and AI may deprive companies of future sources of revenues and pillars of growth. In 2022, this phenomenon could be observed, for example, in the automotive industry, with some manufacturers like Volvo opting for Google's Android-powered infotainment system while others like the Volkswagen Group try to establish their own operating software called Cariad (Ruhkamp, 2022; Steinschaden, 2021).

Scaling the technological know-how across business units

Buying in know-how from outside providers may be a valid strategy in the initial stages of a project, but the longer-term objective of many representatives interviewed for these best practice cases seems to be an internal solution, building up proprietary algorithms and in-house expertise. The succeeding phase of the internal roll-out processes raises the question of how to scale the technology within the organization.

For example, Stefan Weih of Allianz explains his unit's strategy with respect to RPA (case 2): «While we relied on external consultants in the beginning to speed up our learning and to leverage experiences from other industries, we aimed for transferring knowledge and training people on automating

applications. Luckily, or you might say due to the character of this technology, within an intense one to two-week training, you achieve a lot if you have the right skilled people that you feed into such a training program.»

As highlighted in the section on technology, the IT department remains essential – also in the long-term implementation of many digital technologies, as in the case of better weather forecasting tools at RWE (case 4).

Innofactory made sure to have domain experts on board (case 10): «Around the second sprint, we decided that we had to bring all the 'product guys' into the project. They had to understand what we were doing in order for them to write a product description. By bringing in people and informing them early on in the project allows them to help you make a good product that will be accepted by the customers.»

From his experience as a provider of AI-based language translation technology for many corporate customers, Christopher Kränzler emphasizes the role of cross-silo communication (case 6): «We spoke to companies that develop machine learning applications and to companies that have successfully integrated machine learning into their business processes. That was the most important factor: Integrating machine learning into your entire business, not just within your IT team.»

Should a bottom-up approach be steered towards an own organizational unit? Our interviews suggest that there is no one-size-fits-all solution, but this decision rather depends on the context and the scope of the technology. In the case of RWE, the team opted for an integrated solution (case 4): «We never established a dedicated organizational unit. We brought our student in, who started in my team as an external analyst. By now he is fully integrated in our team. I think you should always incorporate the person who developed a model into your operational processes.»

By contrast, companies such as Allianz and Turkcell pursue the strategy to establish digital competence centers, which act as independent service units of experts who support different departments within the organization. They are complemented by selected domain experts that act as multiplier within individual business units.

In the case of RPA at Allianz, Stefan Weih describes the various stages of this process in the following way (case 2): «Concerning the organization, we relied for the pilots and the roll out on external resources to speed up the whole process. Right after the pilots, it became less and less. At the same time, we established a central competence center, which for some core application was in charge of the RPA bots used across a wider range of business units/countries, and which could help the more remote business units with expertise on certain use cases.» Their competence center did not have a physical location, but was set up online: «Building up this community of now more than 80 developers around the globe in that space was very interesting to see because we were actively managing the community. In the beginning, and now it's kind of running itself because they reach out to each other asking for help.»

After having bundled its RPA expertise in a Center of Excellence, Turkcell deploys the unit to educate technology ambassadors (case 3): «We [i.e., the Center of Excellence] determine ‹RPA champions› and train them so that they introduce RPA in their departments. Right now, we have more than 30 RPA champions in five departments, namely finance, supply chain management, HR, and network technology.»

Under certain conditions, though, the new technology faces cultural or administrative obstacles to be seamlessly integrated into the existing organization. For example, Brazilian business school Saint Paul chose a model of ambidexterity for the organizational implementation, setting up a new business called «LIT» that was completely detached from the business school itself (case 5): «At that time AI was available as a SaaS (Software-as-a-Service) model, thus we decided to found the digital platform LIT as a startup. […] LIT still provides its services to Saint Paul, and vice versa, but people now either work for LIT or Saint Paul. We needed to do that since the philosophy of LIT and Saint Paul differs. Saint Paul is a traditional business school, whereas a learning platform such as LIT is a disruptive element. It is based on AI, which needs a large number of interactions and A/B testing. In addition, it is a subscription service. These concepts cannot be applied to Saint Paul.» Even though there are many interlinkages between the two entities, Saint Paul's implementation strategy found approval among the workforce: «Most of our employees supported us when we trained and retrained Paul. They helped us to map different ways of asking the same question. They were our first users and our primary source of testing. And they saw and appreciated the results. Nevertheless, we decided to separate the operations. We could not have the same people working for both, the philosophy and the culture of the two are too different.»

Shifting from exploiting to exploring

Any implementation of a new digital technology entails an element of disruption. However, using digital technologies for process automation – in particular, cost-saving and efficiency gains – are a fundamental prerequisite to sustain a competitive advantage in the marketplace. Following a stepwise model of digital transformation (see Peppard, 2021), they are a means of process innovation, or «incremental innovation.» Already in 2012, US retail platform Amazon, for example, acquired a startup that provided the technology to incrementally replace humans by robots in its warehouses to collect the orders of their clients (Del Rey, 2019). Efficiency gains achieved by that type of automation are fundamental to maintaining a leading market position, but they do not alter or extend the business model of the company.

By contrast, when an assessment of internal know-how and technological capabilities leads to the conclusion that a fundamentally different business line could be built on top and be launched externally, it may become a new pillar of

growth for the company. Again, we revert to Amazon as a company that – over the process of revamping its digital infrastructure – realized that it had all foundations to establish an innovation platform on top of the existing cloud storage space it provided in data centers to its corporate clients. This became the starting point of Amazon Web Services (AWS), which turned out to be a significant and highly profitable line of business after the launch of AWS's predecessor in 2006 (Miller, 2016).

A similar pattern can be detected in our best practice case on Turkcell's implementation of RPA. After an assessment of the commercial RPA solutions that were available in the market, the Turkish telecommunications company decided to write the RPA code by themselves, calling it Ghost (case 3): «In the future Ghost may be one of the RPA tools globally available.»

French company Chargeurs confirms this observation, in which their business unit of Luxury Materials was able to attract new customers (case 9): «Luxury Materials decided to use Blockchain because this technology provided a value proposition for its customers. In the fashion industry it was thus the first company to offer end-to-end traceability. Due to this competitive advantage, the division gained new customers. In addition, it improved its standing in the fashion industry.»

Mark Chardonnens of Innofactory has similar plans (case 10): «For the next step, we want to open the marketplace. At the moment, you have to be a customer of the Berner Kantonalbank if you want to trade something on the marketplace. We also plan to open it up to third banks to bring their orders to the marketplace. We also want to make advances with respect to cryptocurrencies.» This announcement materialized, for example, when the bank joined other Swiss banks UBS, Credit Suisse, and Zürcher Kantonalbank to become a member of the Blockchain-based Central Securities Depository (CSD), operated by Swiss exchange SDX (Ledger Insights, 2022).

Culture, People & Customers

Out of the six major dimensions that characterize digital transformation frameworks, culture scores the highest (Bumann & Peter, 2019). This seems plausible, as «culture eats strategy for breakfast,» according to famous business science scholar Peter Drucker (Engel, 2018). The underlying prerequisite for digitally transforming an organization might be information technology, but the success of its implementation ultimately depends on the authenticity of top management to propagate new routines and practices among employees, and their respective willingness and curiosity to experiment with new apps, processes, and computing languages. Corporate culture has manifold manifestations, such as communication routines and terminology, behavioral standards and norms in human interaction, unspoken values and belief systems that create a sense of belonging and collective identity. People are the carriers, multipliers

and preservers of these corporate practices, and hence, they are the ones that can also change them.

However, no organization is a monolithic block with a uniform attitude towards digital technologies, nor homogeneous in the capabilities and ambitions of its workforce. The interviews reveal that often single business units – or even just individuals – get attracted to the opportunities disruptive digital technologies may offer, but they typically engage in smart stakeholder management to assemble a critical mass of supporters.

Convincing internal stakeholders is a necessary first step to implement disruptive digital technologies, irrespective of the hierarchical position and relative power of each corporate disruptor – even the CEO. Middle managers typically face a complex «sandwich» position, having to convince both their teams and their superiors of the commercial and technical validity of a proposed venture.

A key insight from the interviews relates to the ups and downs of the initial attempts to get acquainted with the technology and the definition of a relevant use case. From proof-of-concept to minimum viable product and to a prototype that can be tested, refined, and validated, teams may enter a psychologically stressful period of trial and error. Especially in companies with a strong engineering culture, in high-reliability organizations or in utilities ensuring critical infrastructure services, establishing a «fail-forward» mentality that encourages disclosing, discussing, and learning from errors may prove to be diametrically opposed to existing behavioral norms, attitudes and status systems. In any organization, though, internal marketing and the communication of early success stories across organizational boundaries increases acceptance within the workforce and approval from top management.

A further observation from the interviews is related to the challenge of how to maintain the momentum of change and establish a culture of life-long learning in the workforce. Particularly in information and communication technologies, innovation cycles have accelerated. Software expertise has an expiry date. New programming tools and computer languages appear in shorter intervals, but also strategic and managerial decisions must be taken, for example related to the cloud and external web services, cybersecurity, data protection regulation, or the combination of databases in warehouses and data lakes.

The interviews suggest that the implementation of disruptive digital technologies affects four major stakeholder groups in different ways. The first group consists of data scientists and data engineers. Typically, they are well-trained and specialized in their programming skillset, often with an IT background but without domain knowledge. The second group are domain experts, proven specialists in their field but without sophisticated programming skills. The third group are «knowledge managers» – executives who do not have to do the programming themselves, but who are either intrinsically or extrinsically motivated to gain a deeper understanding of the data technologies. They face the task of facilitating the communication between data scientists and domain experts, of strategically implementing and steering the process. For some of

them, the continuous adaptation to new data-related challenges may not be perceived as an opportunity but rather as source of acute stress, and be accompanied, more generically, by «digital anxiety» as a psychological overburdening that may negatively affect the knowledge manager's performance (Korotov & Sack, 2019). How to train and develop these groups to prepare for digital transformation has become a key question at business schools and in executive education trainings.

While internal users of the disruptive digital technologies often are domain experts, the fourth stakeholder group are external customers. They must be convinced of the benefits of getting acquainted with an unfamiliar functionality and trained in using it.

The following sub-sections highlight the interviews' insights on how managing different stakeholder groups is essential for the lasting success of a disruptive digital transformation project.

Convincing internal stakeholders

Each implementation of a new technology entails the provision of human and financial resources. A thorough analysis of different stakeholder groups or important individuals helps to identify in which direction internal promotion and marketing efforts should be steered to guarantee the necessary endowment of the project. As all organizations do not only consist of a formalized structure, in larger corporations often represented by a Matrix organization that sorts employees into a functional and a divisional unit, but also of informal networks among peers across departments and hierarchies, communication is the key to a successful implementation strategy (Carnabuci & Diószegi, 2015).

Obtaining support from top management is observed to be crucial for acceptance within the organization. Mark Chardonnens of Innofactory reports (case 10): «We then returned to the board members and put two TVs in front of them. […] We showed them the matching place and the matching engine. On the execution engine Etherscan, we showed that the transfer was made. This was a key moment in this project because most of the board members did not realize what Blockchain technology was. For the first time, they saw it in action as well as its power. […] This was really a huge moment.»

The buy-in within the organization requires communication skills, a solid network of like-minded peers, and patience, as Francesco Santoro's testimonial at Chargeurs shows (case 9): «While the project was met with considerable interest, people particularly wanted to know what was the business potential, the implementation challenges, and the customer feedback. Therefore, the division invested time to first present the Blockchain project to its own teams. For this purpose, it prepared presentations and demos with the help of its marketing experts.» Santoro explains the strategy he and his team pursued: «In the beginning, the priority of these presentations was to align the division's

operations and sales teams and instruct them as to the benefits and limitations of the new Blockchain platform. It was vital that they understood the system properly so that they could explain it to their customers. Then the division provided information about the project to all teams and employees of Chargeurs Group using the Group's newsletter, which is distributed on a quarterly basis. The information output regarding the Blockchain project and its main milestones continued during the whole process. This was extremely important as it was the first step to share the experience gained from this project with all other Chargeurs business divisions.»

An equally important stakeholder group are domain experts who are asked to provide their specific knowledge to the project. In the case of business school Saint Paul, the academic faculty had to be convinced to train the algorithm (case 5): «Many professors are conservative when it comes to new technologies, therefore we gave them time to understand Paul and answered the questions they had. […] After the initial barriers had been overcome, our faculty came on board.»

Even after the initial implementation, the communication with users and stakeholders remains an important strategic task, as Dominik Felske's testimonial in the case of RWE's auction model suggests (case 1): «Our tool is in place and established within our organization – the latter was maybe the biggest challenge. To achieve data quality and robust results was not easy, but it was nothing compared to getting stakeholder acceptance. It took us months, before stakeholders started to trust our model.» Explaining the functionality and providing transparency about the imperfections of the new application are essential for broader acceptance, as Dominik further explains (ibid.): «We went with our stakeholders through all details of the model and were absolutely transparent. We explained how the regression model worked and discussed the results it produced. We made it clear that we did not have an algorithm providing us with perfect results, but would rather offer the basis for a structured discussion and a sound comparison of auction results across global markets and technologies. We described how my team was going to interpret these results and deliver a value added.»

The perception of the success of a digitalization project hinges upon the expectations of various internal stakeholders. Setting the right Key Performance Indicators (KPIs) at Brazilian business school Saint Paul ensured a lasting support from the management board of the school (case 5): «This is the advantage that we discussed with our board members. If you start a project as we did, you traditionally think about budgeting, financial viability, ROI. If we had just focused on these aspects, we would have given up after two or three months. However, we agreed to shift our focus. In the long term, we would like to break even, but in the short and middle term, we are concentrating on the exponential curve regarding our users.» In an idealized setting, corporate disruptors can communicate a risk profile that entails a low risk with a high potential for efficiency gains or financial returns, often a quick win based on existing processes with little effort to acquire new data or merge isolated data silos.

The initiative to implement a disruptive digital technology can originate «bottom-up» from a middle management level or «top-down» from the CEO or the executive board of a company. In this selection of examples, we observe more frequently a bottom-up process, whereby individual units or managers within the organization identify an optimization or business opportunity within their sphere of responsibility and convince top management and major stakeholders to support the project. Ideally, their use cases match some element of the overarching Strategic Priorities or even the Strategic Intention within an organization's Strategy Pyramid and complement the existing toolkit of technological enablers. Some of our examples, such as the Innofactory (case 10), show that a simultaneous «bottom-up» and «top-down» momentum ensures long-term support, even if initial attempts do not yield immediate positive financial results.

Some companies in our book pursue a clear top-down strategy, with their top management being convinced of the value added of a certain technology. José Cláudio Securato, the founder and CEO of Brazilian business school Saint Paul, aims to democratize business education and to provide top-quality global learning for universal welfare empowerment by using digital technologies, as one of the objectives of his business school. The introduction of a machine learning algorithm to assist students hence is plainly in line with the school's Strategic Intention (case 5): «We hoped that AI would enable us to reinvent education in Brazil and make it affordable.»

Another top-down example is Robotic Process Automation at both Allianz and Turkcell (cases 2 and 3). In contrast to the intrinsic motivation of a business unit to implement a new technology because of a locally identified use case, top management appoints «technology ambassadors» who approach relevant teams, convince them and achieve a buy-in to make the implementation successful.

In the case of Turkcell, the trickle-down effect of a new technology was achieved with a multifaceted communication strategy: «To introduce RPA internally, we went to each department manager, explained RPA and described how their department would benefit from it, presented the advantages and disadvantages. We also use our internal communication channels to send infographics to all employees in order to familiarize them with RPA and increase their knowledge about this tool.»

Accepting failures and experimentation

In many established industries, the organizational culture has historically not been geared towards accepting errors and mistakes easily and in an institutionalized setting, as the startup scene has established, for example with so-called «Fuckup Nights,» which are used by entrepreneurs for sharing and discussing their failures with peers.

Launching disruptive digital technology always entails the risk of a failure. Brazilian business school Saint Paul embraced this uncertainty: «Our School was and is doing well, so we thought, let us be creative, and if we make mistakes, we'll learn from them, just as we'll learn from the mistakes other business schools made when they started their online courses.» Adriano Mussa comments: «Only Bruna and myself were aware of the fact that we would enter a trial and error period and had thus to accept that we would make mistakes. For months we worked very hard, had to throw away our results and start again. We knew that no member of our faculty would be willing to spend time on a project like that.»

Especially in the exploration phase of a new project, one way of establishing a more adaptive and flexible process culture is the use of Agile methods, as Dominik Felske of RWE explains: «We implemented our model with the help of Agile project management. We did several Sprints with other departments using internal resources only. We met every one to two weeks defining priorities and the next project elements to be implemented.»

Innofactory switched from the conventional waterfall methodology of project execution to Agile methods, as Mark Chardonnens explains, even in the context of a traditional Swiss bank: «We said, ‹Forget waterfall!› We started to apply Agile ways of working, with the goal of being technically ready within three months. At the end of November, we started with the first sprint. Already by the end of December, all of the technical functionalities and basic infrastructure were ready and installed, including all the network connections used to interact between the systems.»

Uniper used the user-centric ideation method Design Thinking in their IT innovation rounds: «This turned into a Design Thinking process and a number of workshops.»

Changing a corporate culture may prove hard in established, non-digital-native companies, but either the intrinsic motivation of individuals within the organization or competitive pressures, extrinsically, will enforce the change.

Communicating success stories internally and externally

An effective internal and external communication of early successes enables bottom-up initiators of digitalization projects to consolidate their status as «Early Adopters» in the organization. The positive repercussions of this perception are typically not only in line with a top management directive to «become more digital», but also have a positive impact in terms of endowment and resources for the teams that have implemented the technologies.

The case of Dominik Felske at RWE seems to confirm this observation (case 1): «By now our model is well-perceived within RWE. It is one of the examples to show that we are becoming more digital. People know that we have a ‹Forecast Combination Model›, but only a few understand what it does. Our internal

marketing helped to present our model to our board – as a positive example of digitization – which then helped us to increase our research budget.»

Successful projects can also serve as a role model for other departments within the corporation, as Francesco Santoro of Chargeurs reports (case 9): «The division Chargeurs Technical Substrates has by now decided to build a Blockchain platform for the traceability of technical textiles. This project started in June 2019. Their project team has been selected internally and they are working with the same startup for the technical developments Chargeurs Luxury Materials used. The division Chargeurs PCC Fashion Technologies is also looking into Blockchain to answer questions from their customers in the fashion industry. In short, the Blockchain project of Chargeurs Luxury Materials paved the way to adopt the technology on Group level for all cases where this technology will be advantageous.»

Establishing a culture of life-long learning – with employees and customers

Digital technologies require new skillsets. The interviews suggest that three stakeholder groups are affected in different ways.

The role of domain experts, for example, is to support the refinement process after implementation. Dominik Felske of RWE comments on the continuous improvements of their model (case 4): «It is a permanent updating and learning process, not only as far as the algorithm is concerned, but also how we interpret the results. In practice, we have learning sessions after every auction and check if we predicted the bid range within the probability curve we have. This is usually followed by a discussion. Do we have to calibrate? Should we take some data out?»

Domain experts are particularly valuable in the learning journey, combining their subject knowledge with the new digital application, as anecdotal evidence of the Allianz case on RPA suggest (case 2): «We built up the developer pool largely internally. We met very mixed experience around the globe. In the beginning, we started with high skill internal people. They were really a great advantage. In Brazil for example, a former teammate wanted to involve himself personally. He took the opportunity, became a developer, and accelerated the journey significantly, as he knew the business processes by heart from his own experience.»

Local units typically consist of knowledge managers and domain experts, but without the expertise provided by data scientists. Integrating the local units in the learning process is key to success, according to Stefan Weih from Allianz (case 2): «We started with a brainstorming and a small pilot, a very easy case, to obtain the buy-in of the local units. We achieved the proof of concept and with it the proof that it is working and delivers benefits to local business.» The RPA team would still provide guidance and support the selection of implementation

projects: «Then we had the two other components. We had the training so that right after the pilot the local team did not rely on some remote central team to help continue the journey, which often is a reason for failure of innovation projects. As a last piece during the implementation of that first use case, we already had created a prioritized pipeline of potential new applications with the local experts. Thus, the business, right after the pilot, was ready and knew exactly what to do next.»

The knowledge managers at Turkcell also foster a close partnership with local units (case 3): «Our organizational development team now works with each department in order to select process experts. These experts are familiar with RPA and know the needs of their department. Combining these two aspects, they decide which scenarios should be developed for RPA. Then we at the center of excellence of our AI team will start the development.» Similar to Allianz, their center of excellence also serves as gate keeper for new projects: «We have established control mechanisms in order to evaluate their plans by asking is it really worth to spend efforts on a scenario?» The decentralized decision making structure may also cause complications, though: «Sometimes it is difficult to manage people, in particular, when you cannot monitor them. That's the way it is when you have individual processes which have been initiated in a decentralized way.» The RPA experts at Turkcell provide training support via various media channels and also in direct interaction with their colleagues: «We have established a community platform where our RPA champions communicate with each other, ask questions and receive answers. In addition, we continue to encourage people to learn RPA and implement Ghost in their department. Furthermore, we work with our Turkcell Academy and design RPA training programs. So far we already have an online training program. The subjects include the basics of RPA, digital transformation, its advantages and disadvantages. There are also videos on how to use Ghost. And, of course, we support our RPA champions, because we know that they will drive RPA adoption within our organization.»

Adriano Mussa and Bruna Losada Pereira of business school Saint Paul sensed a certain degree of «digital anxiety» among their academic domain experts (case 5): «At the beginning, most of our faculty were afraid to transfer their knowledge to a robot, which we understood. However, by now – after two to three years – almost 70 percent of our faculty are working with Paul; but in the beginning, it was hard.» Active coaching may help, but also peer experience and initial success: «We didn't force anything. Most of our faculty said, ‹That's a beautiful project. I can create my content in LIT … but as to AI, I need to understand a bit more.› In the end they wanted to be part of the project. By now we have a number of professors waiting to participate and teach Paul new content.» Reducing Digital Anxiety is an on-going challenge at Saint Paul: «We still need to make more people use LIT. We have to make sure that neither faculty nor students are afraid to use AI. It's not easy to change habits.» But over time, the learning curve improved, and implementation

performance increased: «As with any AI project it was scary at the beginning. It was a shock when we analyzed the time sheet for the first course: We had invested 1,500 hours only on our side, IBM probably even more. But we were working on this project every month. Now we can teach a new course to Paul using only 16 hours of a faculty member.»

Beyond the internal constituency, a fourth stakeholder group that has to be trained is located outside the organization. For example, in the case of Chargeurs' Blockchain application the learning requirements stretch to the end users (case 9): «Organizationally the division is faced with the challenge to transfer full platform ownership and expertise from the project team to the end users, including those who have little IT expertise. This is difficult as the project manager was hired only temporarily from the Group and the platform's technical development was outsourced. The division's plan is now to train the end users and make sure that they acquire new competencies in IT without having either to ask for experts from the Group or hire someone from the outside.»

Christopher Kränzler from Lengoo confirms the importance of training, in their case related to the professional free-lance translators who get hired for cross-checking the machine translations (case 6): «Putting the end user first is paramount. When you start to develop machine learning applications, you must keep the people in mind that will be using the technology. When you move your idea from research into the real world and put your technology into production, you have to make sure that you include your user in every step of the way.» Lengoo actively integrated the relevant domain experts in the development of their tools: «In our case, we assembled a product team with people from our IT team, research team, and a translator. […] We are working very closely with our translators and continuously collect feedback in order to make sure that the software really makes their work easier, not harder or more complicated.» Relieving the concerns of their translators vis-à-vis machine translations is a major part of the learning process: «We have a community management team that makes sure that everybody understands that we apply our technology not to replace humans but to make them more efficient and increase their income.»

Digital transformation interferes with many established processes and may induce anxiety, as Grigory Shevchenko at Uniper reports (case 8): «The […] platform has been concepted and launched in a niche environment, nevertheless, it stood for disruption, which some people always consider to be threatening.» He describes the move to more fundamental changes in the following quote: «The rationale was better to deal with disruption before disruption deals with you.»

Technological progress will not come to a standstill – on the contrary, the pace of innovation will increase. The last section of this book provides some of the authors' observations and reflections on future developments in the digital realm.

Outlook: Pushing boundaries of the technically feasible

Bill Gates, the co-founder of Microsoft and philanthropist, is known for his insights and predictions about the future of technology. One of his most famous quotes is, «We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten.» This quote highlights the importance of considering the long-term impact of technology and societal change, rather than focusing solely on short-term advancements.

The idea that we overestimate short-term change and underestimate long-term change is supported by numerous studies and historical examples. For instance, a study conducted by the Gartner Hype Cycle, which tracks the maturity of various technology trends, found that new technologies often experience a «peak of inflated expectations» in the short-term, followed by a «trough of disillusionment» before eventually reaching a «plateau of productivity» in the long-term.

Additionally, throughout history, there have been instances where we have underestimated the long-term impact of certain innovations. For example, the Internet, which was first proposed in the 1960s, was initially seen as a tool for academic research and the military, but it has since transformed virtually every aspect of society. Similarly, the personal computer, which was invented in the 1970s, was initially seen as a niche product for enthusiasts and businesses, but it has since become a ubiquitous household item.

The text in italics was generated by a machine learning program called ChatGPT, based on GPT3.5 and released by OpenAI, a research and deployment venture sponsored – among others – by Elon Musk and US-based tech company Microsoft, using the following command: «Write a short essay in academic style on the quote by Bill Gates: ‹We always overestimate the change that will occur in the next two years and underestimate the change that will occur in the next ten.›» For an academic audience, ChatGPT's output may not reveal surprising insights, rather comparable to the intellectual depth and stylistic maturity of an informed pupil preparing for his or her A-level exam. In addition, the algorithm did not detect that Bill Gates just paraphrased a statement of US American futurologist Roy Charles Amara (1925–2007). Nonetheless, future releases of Large Language Models and other GenAI tools will become more sophisticated and move beyond their capabilities as «stochastic parrots,» with an increase of available and up-to-date data inputs, quantity and speed of calculation, and ever-better algorithms, according to Floridi (2023).

The global media attention that ChatGPT received after its launch and its record-setting user base (Hu, 2023), is a brief demonstration of a the enormous potential that digital technologies may unleash to disrupt the world as we know it. School teachers and university professors might revert to hand-written homework and exams, because all previously used software tools to detect plagiarism and copy-and-paste attempts to cheat will no longer be useful, because texts are instantaneously generated by a machine. One day not so far in the

future, students may even let a machine learning algorithm write their entire bachelor thesis.

In the world of businesses and corporations, the jobs of literally millions of software programmers might transform from developers of software code to «prompt engineers» who are specialized in finding the right commands for chatbots writing the actual software (Glen, 2022), because algorithms will provide equivalent results at a substantially lower rate of programming mistakes and in a much faster pace than their human counterparts could ever do. Even in highly sophisticated and well-paid professions, the rise of machines seems inevitable. In his seminal article «The Robots Are Coming for Wall Street,« published in the New York Times, Popper (2016) predicted that human judgment is soon to be replaced by robo-advisors. Many algorithms, for example for granting loans to individuals, are already established, and used in daily business practice, and many highly compensated functions in, say, stock trading might become fully automatized (ibid.).

Similarly, visual depictions and interpretations of verbal inputs made by humans will alter job configurations of artists, designers, and IT developers. Based on algorithms, computers will provide tailored and even animated solutions to practical applications, while only high-end content may be delivered by humans (Gupta, 2023).

Not astonishingly, this evokes important regulatory and ethical questions. Language-based software tools with similar capabilities like ChatGPT may be exploited for generating hateful, racist, or in other ways harmful or discriminatory texts (Beuth, 2023). Given their capabilities of producing computer code, which is just another language they can learn, they may be enhanced to automatically publish text for echo chambers in social media, and spam news platforms. DeepFakes in facial videos may become so realistic that it is no longer clear whether a person actually expressed specific sentences (Scientific Foresight Unit, 2021).

While Artificial Intelligence will radically alter our verbal and visual communication and human interaction, Blockchain and DLTs may cater for attractive use cases because of their fundamental axiom of decentralized decision mechanisms, with a multitude of atomized agents ensuring that no central control could manipulate or jeopardize the stability of established conventions. In particular, the emergence of an increasing number of Decentralized Autonomous Organizations may lead to a new perception of the boundaries of a firm, based not only on transaction costs, but also on the empowerment of the owners.

In many key industry sectors, such as the energy supply industry with an increasing amount of residential, decentralized producers of energy and a high potential of peer-to-peer energy trading, DLT applications may suffer from inter-platform competition with conventional digital solutions, slow technological progress in terms of low-frequency interactions, and contradictory and incompatible layers of regulatory complexity (Burger & Weinmann, 2022).

By contrast, DLT applications may emerge as technological winners whenever multiple agents along a value chain require access to specific pieces of information (Giegling, 2022). So-called Certificates of Origin may serve, for example, as a proof that a company reduces its carbon footprint by switching to renewable energies like wind or solar power (Amirifard & Taherdoost, 2023; Cali et al., 2022; Delardas & Giannos, 2023). Blockchain technologies prosper in applications such as the tokenization of real-world assets (Drogovoz, Kashevarova, & Starikova, 2024) or gaming (Teoh, 2023). They secure virtual territory in metaverses such as Decentraland or The Sandbox. Consumers and organizations may want to use these technologies to transfer their assets – be it a pair of virtual, customized sneakers or a non-fungible token (NFT) of a piece of art – from one metaverse to the next (see also Hutson, Banerjee, Kshetri, Odenwald, & Ratican, 2023; Huynh-The et al., 2023). Large corporations, such as Meta, invest vast amounts of their revenues in advancing haptic devices to enable a full immersion into virtual worlds (Böhm, 2022), or develop glasses that allow for real-time enhancement of visual information via Augmented or Mixed Reality, such as Google Glass (Nijholt, 2022) and Apple's Vision Pro (Stern, 2024).

Future applications of Blockchain and other Distributed Ledger Technologies may become the computer cloud of the future, a guarantor for secure and transparent transactions in a digital world where complexity is driven by customization and regulations. They may ensure digital security against hacking when the privacy of digital identity becomes increasingly important (Careja & Tapus, 2023).

With a perspective of scientific progress until the early 2030s, there are two applications of digital technologies that are breaching the boundaries of the expectable and will most likely impact our future way of living:

- First, Quantum Computing may lead to a «5th Industrial Revolution» in the future (Rietsche et al., 2022). The technology fundamentally differs from conventional, binary computer processes because of its capability to harness phenomena of quantum mechanics, such as superposition and entanglement, to speed up optimization and the simulation of complex systems, such as weather forecasts or traffic congestion. Once commercially available, it may be capable to overhaul cybersecurity and jeopardize existing solutions in, for example, encryption, fraud detection, or digital identities (Faruk, Tahora, Tasnim, Shahriar, & Sakib, 2022; Raheman, 2022). Beyond cybersecurity, the technology may serve to optimize the development of chemical-electrical battery technology, or speed up the development of medicinal drugs via protein folding of large biological molecules (Hao, 2022). Despite fast technological progress and some first applications (Arute et al., 2019), current commercial applications are still in an experimentation phase (Au-Yeung, Chancellor, & Halffmann, 2022).

For example, DHL, a global logistics company, used the quantum expertise of Honeywell, a technology-solutions provider, to run first trials optimizing the placement of parcels in containers (Hughes, 2021).

- Second, a neurological-electrical connection between a human organism and a computer may not only provide an opportunity for paralyzed patients to communicate with their environment, but also use their thoughts to direct and steer motoric movements, carried out with mechanic tools (Portillo-Lara, Tahirbegi, Chapman, Goding, & Green, 2021). In the further future, so-called Brain-Computer Interfaces (BCIs) may serve for cognitive or affective state estimation, detection of attention or mental fatigue, and adaptive human-robot interaction (Alimardani & Hiraki, 2020). Several companies are working on invasive and non-invasive BCI technologies, including Blackrock, BrainGate and Elon Musk's Neuralink (Hurley, 2023), or Synchron. While current non-invasive BCIs are not as accurate in the detection of neurological activities, invasive methods face challenges in terms of biocompatibility (Pisarchik, Maksimenko, & Hramov, 2019). The authors would of course raise important ethical questions related to technology, for example the possibility of manipulating or controlling a human being's thoughts and behavior «by directly sending commands to the brain» (ibid.).

The socio-economic evolution of human civilizations is closely linked to technological progress. With the steam engine, water turbines and combustion technology, the first Industrial Revolution sequentially developed more sophisticated methods for the transformation of energy, whereas – starting in the midst of the second half of the 20th century – the «current metaparadigm focuses on the transformation of information,» according to Hilbert (2020).

Some scholars emphasize the accelerated pace of the transformation (Su, Yuan, Umar, & Lobonț, 2022). For instance, compared to Moore's Law of a doubling of the number of transistors on a microchip about every two years with the cost of computers being halved (Moore, 1964), the rate of machine learning algorithms increasing their speed and accuracy is estimated to have doubled every 3.4 months (Saran, 2019). In the societal discourse, these rapid changes lead to differing assessments:

- The pessimistic perception of digital transformation and automation is based on the historical observation that technological progress has often led to a redefinition of tasks that humans perform (Deschacht, 2021). Functions that have previously been assigned to humans because of their capability to filter and synthesize available information may be taken over by machines. For example, Tschang and Almirall (2021) predict a «hollowing-out of middle-skill jobs.» Fears emerge that automation may eliminate entire professions, such as translators, lawyers or accountants (Céspedes, 2019; Crossley, 2018).

- By contrast, the optimistic perspective on the progress of digital technologies in economy and society typically follows the argument that technological innovations provide a stimulus to the labor market (Su et al., 2022). Human workers will be able to move from routine to non-routine jobs and concentrate on functions that lead to a higher degree of job satisfaction (Parker & Grote, 2022). This may include the interaction with clients and users for more sophisticated requests, but also an advanced deployment of device-driven technologies. The global «War for Talents» that emerged after the end of the COVID-19 pandemic (Botting, 2022) may not only accelerate the digital transformation of many industries, especially in countries with a general shortage of labor, but also ensure that they can sustain their levels of wealth by replacing scarce human resources with AI-enhanced robots, for example on shop floors or in mobile care for elderly people (Asgharian, Panchea, & Ferland, 2022).

When we started working on this book in 2019, many digital technologies were still viewed as experimental gadgets. Only a few companies tried to leverage the potential with regards to cost-cutting, revenue generation or simply trying to get up-to-speed by setting up the infrastructure to harness the new technologies.

Now, three years later, the momentum has increased significantly: OpenAI, the metaverse, digitization of assets have become part of the core strategy. Geopolitical turbulences, IT security issues and a fast-changing financial system accelerate the momentum even further.

The transformation of information will not stop at the doorsteps of any residential home or office. Leaders now have the task of incorporating disruptive digital technologies in operations and develop new revenue models by transforming legacy data silos into strategic assets of a company or organization and embarking on pilot use cases to implement disruptive digital technologies to gain a competitive advantage vis-à-vis competitors. New technologies will change the way decisions will be taken. However, any existential fear of a dystopian future in which a novel reign of machines will emerge and enslave or extinguish the human species, based on the empirical observation that our natural habitat is severely endangered by our lifestyle, seems too far-fetched (Floridi, 2022; Tariq, Iftikhar, Chaudhary, & Khurshid, 2023). Also, we may have time left to prepare ourselves for the day when «Singularity» will be reached, that is, when machine intelligence will surpass human intelligence, not only in highly selective fields of data analytics and specialization, but as a generic capability to digest knowledge and experience (Hoffmann, 2022).

For the time being, the authors of this book remain confident that we will be able to create a habitat populated by both humans and machines with a harmonious collective future of collective human intellect and digital technologies as their constructive complementarity (Tariq et al., 2023). As Rob Thomas, an IBM executive, comments on the effect of machine learning on the business

world, «AI is not going to replace managers, but managers that use AI will replace those that do not.» (Handley, 2020)

We hope that the case studies on implementing digital technologies and the respective lessons learned will help you to benefit from some of these pioneering experiences, gain valuable insights, and allow you to apply these technologies in the best way for yourself and your organization.

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Digital technologies offer unprecedented opportunities for organizations to realize efficiency gains and explore new lines of business.

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Based on their experience, this book provides a roadmap for executives how to become agents of change and implement digital transformation in their organizations.

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ISBN 978-1-914481-52-9
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